ANAIS / *PROCEEDINGS*

XXI SIMPÓSIO DE MIRMECOLOGIA

01-05 de dezembro de 2013
Fortaleza, Ceará, Brasil

ORGANIZAÇÃO / *ORGANIZATION*

Laboratório de Entomologia da UECE

Programa de Pós-Graduação em Ecologia e Recursos Naturais
Universidade Federal do Ceará

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APRESENTAÇÃO

O Simpósio de Mirmecologia é um evento bienal que tem como meta fundamental incentivar e divulgar a pesquisa sobre a fauna tropical, em particular neotropical, de formigas. Ele reúne os especialistas do Brasil e do exterior, e de um modo geral, profissionais e alunos, que usam as formigas como modelos de investigação em importantes áreas da biologia, tais como a taxonomia, a sistemática e a biogeografia, o comportamento animal e a ecologia comportamental, as interações plantas/animais, a ecologia de populações e de comunidades, a bioindicação, a bioinvasão e a biologia evolutiva.

Ao longo dos seus mais de 30 anos de existência, o Simpósio de Mirmecologia, incialmente denominado Encontro de Mirmecologia, evoluiu de um evento a caráter regional (Estado de São Paulo) a um evento do qual participam pesquisadores e alunos de todos os estados do Brasil. Nas suas últimas edições, o evento adquiriu um caráter resolutamente internacional, com uma importante participação de pesquisadores, e até alunos, de outros países e continentes. A 21ª edição do Simpósio de Mirmecologia pretende manter e consolidar essas características.

O programa do evento será composto por oito conferências plenárias e 16 mesas-redondas, além de sessões de apresentação de trabalhos sob a forma de comunicações orais ou de painéis. As conferências e mesas-redondas contemplarão todas as principais áreas da mirmecologia, com ênfase na diversidade da mirmecofauna neotropical, e contarão com a participação de 61 palestrantes do Brasil e outros países, todos especialistas de destaque das diversas temáticas que serão abordadas.

PRESENTATION

The "Simpósio de Mirmecologia" is a biennial event that aims to encourage and disseminate research on tropical ants, especially neotropical species. It brings together experts from Brazil and abroad, and, more generally, professionals and students that use ants as research model in important areas of biology such as taxonomy, systematics and biogeography, animal behavior and behavioral ecology, plant-animal interactions, population and community ecology, bioindication, bioinvasion and evolutionary biology.

Throughout its thirty-plus years of existence, the "Simpósio de Mirmecologia", initially named "Encontro de Mirmecologia", evolved from being a regional (São Paulo state) to a national event involving professionals and students from all over Brazil. In its latest editions, the event took on an international character, with an important participation of foreign ant experts, and students. The 21st edition of the "Simpósio de Mirmecologia" intends to maintain and strengthen these characteristics.

The event program will consist of eight plenary lectures and 16 round-tables, as well as talk and poster presentations. Conferences and round-tables will address all major areas of myrmecology, with an emphasis on the diversity of neotropical ant fauna and will be attended by 61 prominent experts from Brazil and other countries.

OBJETIVOS

O XXI Simpósio de Mirmecologia tem por objetivo reunir estudantes e profissionais da área de mirmecologia do Brasil e de outros países, estimular as interações, e oferecer aos alunos dos diversos programas de graduação e pós-graduação do país a oportunidade de expor e discutir seus trabalhos e projetos com a comunidade de mirmecólogos.

Mais especificamente, o evento visa:

- Integrar as várias áreas do conhecimento científico que contribuem para o avanço da mirmecologia;
- Possibilitar o intercâmbio de conhecimentos entre pesquisadores de diferentes estados da Federação e também de outros países;
- Estimular o estabelecimento de parcerias técnico-científicas e de arranjos multi-institucionais de pesquisa, pelo contato direto dos pesquisadores;
- Contribuir à formação de estudantes de graduação e pós-graduação;
- Consolidar o Brasil como pólo de pesquisa e desenvolvimento na área de mirmecologia, e de maneira mais geral, da área de ecologia e conservação;
- Analisar os avanços, identificar os desafios e discutir o desenvolvimento futuro da área no Brasil.

OBJECTIVES

The "XXI Simpósio de Mirmecologia" aims to bring together students and professionals in myrmecology from Brazil and other countries, to stimulate interactions, and to offer undergraduate and postgraduate students the opportunity to present and discuss their works and projects with the myrmecological community.

More specifically, the event aims to:

- Integrate the various scientific fields that contribute to the advancement of myrmecology;
- Facilitate the exchange of knowledge between scientists from the different states of Brazil and also from other countries;
- Encourage the development of partnerships and technical-scientific arrangements for multi-institutional research, by direct contact between the scientists;
- Contribute to the training of undergraduate and postgraduate students;
- To consolidate Brazil as a center of research and development in the area of myrmecology, and more generally, in the area of ecology and conservation;
- Review progress, identify challenges and discuss the future development of the area in Brazil.

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RESUMOS / *ABSTRACTS*

CONFERÊNCIAS PLENÁRIAS / *PLENARY TALKS*

COLONY FOUNDATION STRATEGIES IN ANTS: ALONE OR IN A GROUP ?

C. PEETERS

Laboratoire Ecologie & Evolution, CNRS & Université Pierre et Marie Curie, Paris 75005, France, e-mail: cpeeters@snv.jussieu.fr

The ability to disperse and establish new colonies is crucial to the ecological success of ants. However, founding queens are often alone, which means that they face the same dangers as solitary insects. Colony-founding behaviours have diversified tremendously across the ants, and underlie their capacity to colonize almost all terrestrial habitats. Unlike social wasps and bees, many ant species evolved queens that can store large amounts of metabolic reserves, making it possible to raise the first workers without outside food. This novel adaptation is arguably central to the success of ants in subfamilies Dolichoderinae, Formicinae and Myrmicinae.

TWO CONTRASTING FOUNDATION STRATEGIES

During independent colony founding (ICF), lone queens need to raise the first generation of offspring without the help of nestmates. Following aerial dispersal and mating with a foreign male, they locate a suitable nesting site and break off their wings. They excavate or take over an existing shelter, and lay a first batch of eggs. During the next few weeks (sometimes months), they must guard and feed their offspring. ICF is a risky strategy, necessitating the annual production of a large number of sexuals. In many phylogenetically independent lineages, ICF has been replaced by a strikingly different founding mode, whereby queens are not alone. In such dependent colony founding (DCF) species, existing colonies divide into two or more daughter groups which soon become autonomous. Thus the queens disperse on foot to a new nesting site together with nestmate workers, and the latter feed and protect the brood.

INDEPENDENT COLONY FOUNDATION (ICF) BEHAVIOURS ARE HIGHLY DIVERSE

1) A minority of species have queens that cannot raise their first daughters without bringing food from outside. This 'non-claustral' ICF predominates in the phylogenetically basal poneroid subfamilies (Amblyoponinae and Ponerinae) (Peeters 1997), as well as in four formicoid subfamilies (Ectatomminae, Heteroponerinae, Myrmeciinae and Pseudomyrmecinae) (Table 1). Non-claustral ICF is likely to be linked with high mortality of foundresses, due to predation while active outside, together with parasitism of the unguarded brood. Ants evolved from solitary ground-hunting wasps where mothers provision their individual offspring with insect food. Accordingly, non-claustral ICF is the ancestral strategy in ants, as young queens must behave like solitary insects while they establish a new colony.

2) A majority of ICF species evolved the ability to found colonies 'claustrally', i.e. without needing food from outside. This is possible because young queens feed their first offspring using substantial metabolic reserves that are accumulated before leaving the natal nest. In addition to fat stores and storage proteins in the abdomen, the wing muscles are disproportionally huge compared to flying wasps: this is an adaptation for claustral ICF, not better flying (Peeters 2012).

Claustral ICF is not found in any social bees or wasps, and it is a true novelty of the ants. The importance of metabolic reserves is amplified by the large size dimorphism between queen and worker castes in numerous formicoid ants: this makes it possible for a founding queen to produce many first offspring. Moreover, these first workers are often smaller than average (‘nanitics’), which is another adaptation for claustral ICF.

3) In a small number of genera, claustral ICF is possible due to a mutualism or other behavioural adaptations. In *Acropyga* and *Tetraponera,* foundresses carry a pseudococcid to a stem cavity which they never leave - because they are clonal, the sap-suckers multiply and supply sufficient honeydew to produce the first worker brood. Similarly in *Atta,* claustral foundresses start a fungus garden with which they feed their offspring. In *Discothyrea oculata,* which is a specialized predator on spider eggs, founding queens locate the silk egg sacs of spiders to begin their family, so the first larvae can feed on eggs and queens do not need to forage outside (Dejean & Dejean 1998). Thus claustrality is possible in various species with queens that do not have large metabolic reserves, provided that food is available inside the nest. This is analogous to claustral ICF in many termites that feed on the rotten wood in which they nest.

4) In several lineages, unrelated foundresses cooperate (‘pleometrosis’) to increase success at producing the first workers (Bernasconi & Strassmann 1999). Generally, once the first workers emerge, only one queen survives while the others are executed. In various species, pleometrosis is an optional strategy that is influenced by the density of dispersing queens (see Peeters & Molet (2010) for more details).

DEPENDENT COLONY FOUNDATION (DCF): QUEENS RELY ON NESTMATE WORKERS

The evolution of DCF is another major evolutionary breakthrough, whereby the benefits of social life are retained at all stages of the life history (Cronin et al. 2003). Indeed, the queen(s) is continuously protected and her offspring cared for. Most ant species can emigrate to another nest as soon as conditions become unsuitable, and the same behaviours are used when colonies divide during DCF. Older workers can locate a suitable site before emigration is started, so the dispersal phase can be quick and efficient. DCF also evolved in other social Hymenopterans, but it is particularly suited to the biology of ants in which eggs, larvae and pupae are moveable items that are easily carried. This contrasts with social bees and wasps where brood develops in cells, hence emigrating to a new nest means that all existing brood must be abandoned.

DCF occurs widely in all ant lineages, both poneroid and formicoid (Table 1), and it involves both monogynous and polygynous species. Different terms (‘fission’ and ‘budding’) exist in the literature to refer to DCF, but they are used inconsistently and this distinction appears not be heuristic (Peeters & Ito 2001). DCF is the only mode of colonial reproduction in many species, while it exists as an alternative to ICF in a minority of species.

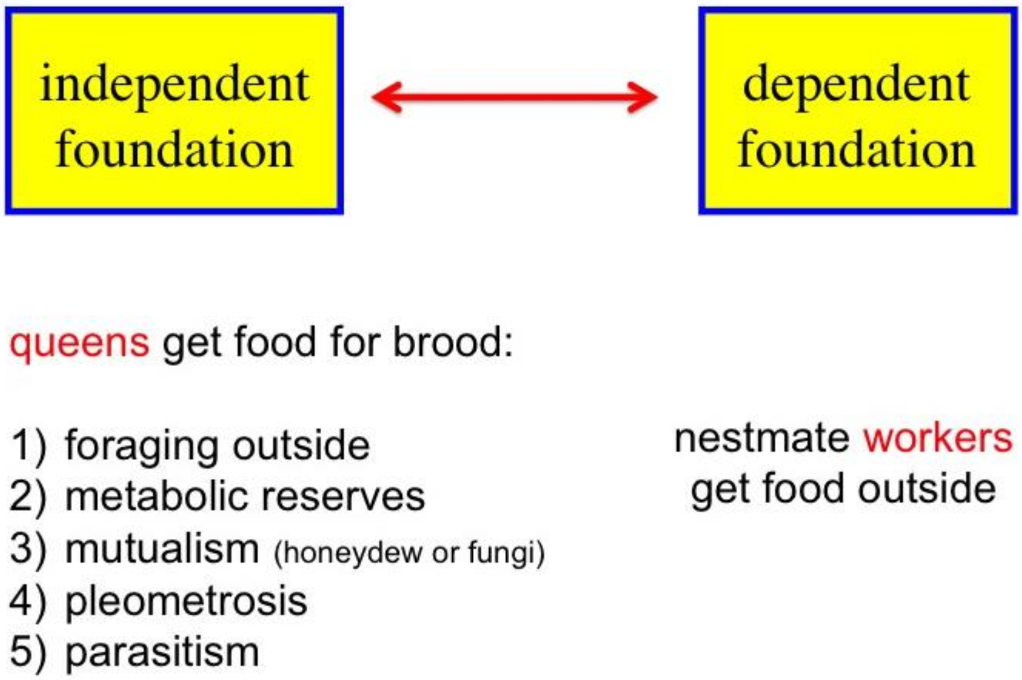
Table 1. Phylogenetic distribution of colony-founding strategies across the ants. Evidence for DCF is either direct (e.g. field observations), or indirect (e.g. absence of winged queens). First five subfamilies are poneroids, the others are formicoids.

subfamily	ICF					DCF
	non-claustral	claustral (metabolic reserves)	claustral (mutualism, food inside)	pleome trosis	social parasite	
Amblyoponinae	✔					✔
Ponerinae	✔			✔		✔
Paraponerinae	✔					
Proceratiinae	✔	?	✔			✔
Leptanillinae						✔
Cerapachyinae	✔					✔
dorylomorphs						✔
Pseudomyrmecinae	✔		✔	✔	✔	
Myrmeciinae	✔				✔	?
Dolichoderinae		✔		✔	✔	✔
Ectatomminae	✔					✔
Heteroponerinae	✔					✔
Formicinae	✔	✔	✔	✔	✔	✔
Myrmicinae	✔	✔	✔	✔	✔	✔

PARASITISM IS AN INDEPENDENT FOUNDING STRATEGY

In several lineages, newly mated queens attempt to enter existing colonies of their own or different species, following which they exploit local resources to raise their offspring. As discussed by Peeters & Molet (2010), social parasitism is a form of ICF because queens are not helped by nestmate workers. They disperse alone and take considerable risks when trying to enter the host colony. Host colonies are nothing more than a resource of the environment to be exploited, similar to insect prey. Many authors have considered parasitism to be DCF because queens 'depend' on their host colonies, however claustral queens also depend on their metabolic reserves, and non-claustral queens depend on the food they gather outside. What is crucial in DCF species is that queens 'depend' on nestmate workers, and there is convergence of genetic interests among relatives.

Fig. 1. Major differences in food acquisition between independent (ICF) and dependent (DCF) founding species. Many DCF queens have lost much of their autonomy.



MATING STRATEGIES ARE DISTINCT FROM FOUNDING STRATEGIES

Colony founding usually follows mating, but these are two very different events affected by distinct selective pressures (Peeters & Molet 2010). ICF queens in some species mate close to their natal colony ("female-calling") before dispersing, while in other species they mate far away ("male-aggregation"). DCF queens mate near their natal colony, or even inside it. This seems true even in DCF species with queens that are capable of flying: since newly mated queens stay in their natal nest, they cannot fly to male-aggregations that are far away. Female-calling is associated with lower mortality since flight means increased risks of predation or getting lost.

COLONY-LEVEL ADAPTATIONS: REPRODUCTIVE INVESTMENT

The establishment of a new social unit is entirely distinct from the birth of individual queens and workers, and it requires the coordinated action of all components of the parent colony. ICF species must produce a large number of sexuals every year, to compensate for heavy mortality. Furthermore, female sexuals are expensive per capita in many species: (i) production costs are high because of an often large size dimorphism relative to workers; (ii) they accumulate large metabolic reserves before leaving their natal colony. In some species they emerge as adults several months before dispersal and mating (Peeters et al. 2013), and their fresh weights increase significantly during this residency (up to triple in *Solenopsis invicta)*.

In sharp contrast are the majority of DCF species where very few female sexuals are reared. This is partly because the mortality of DCF queens is considerably reduced. Furthermore, existing colonies can divide in only two or a few daughter groups, thus producing excess queens is selected against (exceptions exist: see Molet et al. 2009). However lower investment in queens is compensated by producing more workers, because they determine the success of daughter colonies. A sufficient number of workers is necessary for new colonies to be fully autonomous.

INDIVIDUAL-LEVEL ADAPTATIONS: QUEEN MORPHOLOGY

As explained above, ICF queens are able to behave claustrally because they evolved a large size dimorphism relative to the worker caste. A significant component of this dimorphism involves hyperdeveloped wing muscles. Such a size dimorphism does not exist in ICF wasps and bees. Another unique feature of ants is the evolution of permanently wingless queens in many species exhibiting DCF. Many social wasps and bees start new colonies with DCF, but winglessness never exists. This is due to the universal retention of flying workers. This constraint is absent in ants: wingless workers are the major players during the division of existing colonies, and since winged queens disperse on foot, their production is selected against. Accordingly, ergatoid (no wings) and brachypterous (short-winged) queens evolved convergently in species belonging to over 50 genera (Peeters 2012).

In a very small number of species (<200) belonging to three subfamilies, workers have retained a functional spermatheca and can reproduce sexually. Such ‘gamergates’ have completely replaced winged queens in a proportion of species, and DCF is the obligate strategy. Other species have winged queens together with gamergates, and the latter function as secondary reproductives (Monnin & Peeters 2008).

FUTURE STUDIES

The founding strategies of a majority of ant species remain unstudied. Indeed, there are no published data about colony foundation for many large genera. This scarcity of information is linked to the necessity of studying colony foundation in the field. DCF is especially difficult because it can occur unpredictably over the year, and it needs to be distinguished from simple nest emigrations (Cronin et al. 2012).

The thorax architecture of queens reflects their musculature. Among species with flying queens, some have strong neck muscles (similar to workers') because they need to forage just like the workers (non-claustral ICF), and their prothorax is larger than in claustral species. In non-flying queens, the absence of wing muscles is associated with a simplified thorax (i.e. fusion of sclerites), and such queens generally perform DCF. Hence data on queen morphology can generate testable hypotheses about colony founding strategies.

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THE PHYLOGENY AND EVOLUTION OF ANTS

P.S. WARD[1]

[1]Department of Entomology and Nematology, University of California, Davis, CA 95616, U.S.A., email: psward@ucdavis.edu

Ants (Hymenoptera: Formicidae) are the world's premier social insects, surpassing other eusocial taxa in species richness, morphological variety, and diversity of social organization. Ants have collectively occupied almost all major terrestrial ecosystems, where they assume important roles as predators, scavengers, herbivores, and granivores. They have also developed complex symbioses with a wide range of other organisms, from bacteria to butterflies. Facilitated by advances in molecular phylogenetics our knowledge of the ant Tree of Life is in a rapid phase of growth, with important revelations emerging in the last decade, but also several challenging issues remaining to be resolved. Ants belong to the Aculeata, a distinctive subgroup of Hymenoptera characterized by the modification of the ovipositor as a stinging device. There has been considerable uncertainty about the placement of ants in the Aculeata tree, but a recent phylogenomic study indicates that their sister group is the Apoidea (spheciform wasps and bees), contradicting earlier views that ants are more closely related to ectoparasitoid wasps. There is very strong support for monophyly of the ants and most of the 21 extant subfamilies, but the relationships among these major lineages are still in the process of being clarified. The phylogeny of the poneroids (subfamily Ponerinae and allied groups), Leptanillinae, and Martialinae is somewhat problematic. Although in most analyses the last two taxa emerge at the base of the ant tree, this result may influenced by long-branch attraction and base frequency heterogeneity, factors that are known to confound phylogenetic inference. One group that has very strong support in all molecular phylogenetic analyses is the formicoid clade. This contains the bulk of ant diversity, including the species-rich subfamilies Dolichoderinae, Formicinae and Myrmicinae, as well as dorylomorphs (army ants and their relatives), pseudomyrmecines, myrmeciines, and ectaheteromorph ants (Ectatomminae and Heteroponerinae). The phylogeny of the major branches of the formicoid tree is reasonably well resolved: dorylomorphs are sister to all other formicoids; pseudomyrmecines and myrmeciines are sister taxa (and in turn sister to dolichoderines plus aneuretines); and the remaining three lineages resolve as (Formicinae + (ectaheteromorphs + Myrmicinae)). A series of studies is beginning to clarify the details of evolutionary history within each of the major subfamilies of formicoids. Although crown-group ants appear to have arisen in the early Cretaceous much of the diversification of modern subfamilies and tribes occurred in the late Cretaceous and early Tertiary, contemporaneous with radiations of other insect groups and angiosperms. Several large and well known groups of ants have been revealed to be non-monophyletic, including the subfamily Cerapachyinae, the tribes Dacetini, Lasiini, Pheidolini and Solenopsidini, and the genera *Aphaenogaster*, *Cerapachys*, *Camponotus*, *Messor*, *Monomorium*, *Pheidole*, *Tetramorium* and *Tetraponera*. This situation has arisen because taxonomists were misled by two evolutionary processes that are widespread in ants: (1) trenchant convergence in morphology, ecology and behavior; and (2) heterogeneity in rates of phenotypic evolution, with highly divergent taxa nested within groups whose other species show much greater evolutionary stasis.

COLLECTIVE DECISION-MAKING IN SOCIAL INSECTS

J.L. DENEUBOURG

Unité d'Ecologie Sociale (UES), Campus de la Plaine, Université Libre de Bruxelles, Bd du Triomphe, 1050 Bruxelles, Belgium, e-mail: Jean-Louis.Deneubourg@ulb.ace.be

Group-living animals are often faced with choosing between one or more alternative resource sites. A central question is how a collective decision is taken. This experimental and theoretical review demonstrates that choices can emerge through nonlinear interaction dynamics between equal individuals without perfect knowledge or leadership. We explore a number of situations differing in the number and quality of the options, in the type of interactions, and in the number of individuals concerned. The interplay between individual responses to site characteristics and to group-members can give rise to a diversity of patterns of decision-making. We will focus on how the environmental characteristics influence the collective responses and their diversity in two situations. The first one is the case where the environmental parameters do not affect the behaviour or the interactions between individuals. In second case, we will discuss the case where the environmental parameters affect the individual responses, but not the interactions between individuals. Using choice experiments and a theoretical approach, we will show how individuals in a group dramatically outperform the problem-solving ability of a single individual. Finally, we briefly discuss cases where the social composition influences the collective response. Our research points towards a generic self-organized collective decision-making process shared by many group living-species.

HISTORICAL BIOGEOGRAPHY SHAPES COMMUNITY ECOLOGY: SAVANNA ANTS IN NORTHERN AUSTRALIA

A.N. ANDERSEN

CSIRO Ecosystem Sciences, Tropical Ecosystems Research Centre, PMB 44 Winnellie, NT 0822. Alan.Andersen@csiro.au

The savanna ant fauna of northern Australia has its biogeographical origins and therefore evolutionary history in the arid zone, and in this presentation I will discuss how this shapes its contemporary community ecology. The functional composition of Australia's savanna ant communities is essentially that of its deserts. These communities are exceptionally rich, are dominated numerically and functionally by species of *Iridomyrmex*, and support an extremely high diversity of other arid-adapted taxa within *Monomorium*, *Melophorus*, *Meranoplus* and *Tetramorium*. One important consequence of its evolutionary origins is that savanna ant diversity is maintained along the extreme rainfall gradient from 2,000 mm on the northern coast of the Northern Territory, to 500 mm at the fringe of the northern arid zone, 800 km inland. This diversity pattern contrasts strongly with that of plants and other key faunal groups such as birds, which all decline markedly in species richness with decreasing rainfall. The evolutionary history of the Australian savanna ant fauna also confers remarkable resilience to fire. Australian savannas are among the world's most fire-prone landscapes, with more than 40 million hectares burnt each year, and in many regions most sites are burnt at least every two or three years. These fires cause inconsequential mortality for most ant species because of their soil-nesting habits. Rather, frequent fire maintains the open habitats that make the savanna ant fauna feel right at their evolutionary home. Long-term fire exclusion sees a progressive decline in abundance and diversity of arid-adapted taxa, an increase in abundance of highly generalised, more shade-tolerant taxa (such as species of *Nylanderia*, *Tetramorium*, *Pheidole* and *Odontomachus*), and an overall reduction in diversity. The savanna ant fauna of the neotropics has a totally contrasting evolutionary origin, with its biogeographical history immersed in tropical forest. Many of the key taxa have been derived from forest, as illustrated by the remarkable diversity of specialist arboreal species (especially from *Cephalotes*, *Pseudomyrmex* and *Camponotus*). The dominant terrestrial species often belong to taxa that historically prefer shady rather than open habitats, and there are few specialist thermophiles. It is therefore likely that ant diversity in neotropical savaanas is far more sensitive to declining rainfall and to fire than in Australia.

A LONG-TERM CAREER IN MYRMECOLOGY – MAXIMIZING BENEFITS AND HARNESSING OPPORTUNITIES

J.D. MAJER[1,2]

[1]Department of Environment and Agriculture, Curtin University, PO Box U1987, Perth, WA 6847, Australia. Email: J,Majer@curtin.edu.au
[2]Biomonitoring International, 45, Ranford Way, Hillarys, WA 6025, Australia. Email: Biomonitoring-international@bigpond.com

Abstract

Many of the conference delegates are commencing their careers in science, most likely in the area of myrmecology. They may be students, young university lecturers or they may work in research institutions. Either way, if their careers develop as planned, they may continue this line of research for many years. This plenary contribution will outline the benefits of long-term research and will highlight certain precautions that need to be taken to ensure that maximum benefits are gained from the data that accumulates. Aspects that will be considered include storage of raw data, standardisation of sampling protocols, maintenance of ant reference collections, correct recording of study plot locations, and more. The talk will be furnished with real-life examples that have accumulated from 40 years of research involving ants.

INTRODUCTION

The majority of you here are either planning a career in myrmecology or are at the early stages of employment. By contrast, I have recently retired from university teaching and administration, although I am continuing with my research. Having worked on ants, and other insects for over 40 years, I here provide some tips and ideas for ensuring a successful and continuing pursuit of your common interests: ants. Some of these tips originate from my own experiences, but some come from observations on colleagues. As I run through these, I will illustrate each with examples on how one's approach can contribute to, or hinder the development of your career.

JOB MOBILITY

So, you've finally gained employment. You are a tutor, an assistant professor, or a junior researcher. You may feel that working your way through a series of institutions is the way to work yourself up the stages the career ladder. This certainly works for many people, but it isn't always necessary. Staying in one place provides the stability of opportunity to develop a good laboratory structure, study an ecosystem in great depth and really come to understand it. By the time I had been at my institution for 20 or so years, people would say 'are you still here', as if one was becoming some kind of a living fossil! Far from it, it has provided the stability to establish long-term research (see below), a network of contacts and, importantly, a backdrop of data on which to observe change. For this reason, stability of employment should be seen as a privilege, not an impediment.

PRIVATE VERSUS GOVERNMENT EMPLOYMENT

Unfortunately, tenure-tracked academic or government research positions are becoming increasingly hard to find, not so much in Brazil where state and federal universities are expanding, but nevertheless an issue. University courses are being rationalised and government departments are continually down-sizing. The result of the latter is that much research is being outsourced to private organizations. There is also a proliferation of private universities in Brazil and these teaching focussed, with little opportunity for research. In addition to this, there has been a proliferation of environmental consulting companies who service the mining and energy industries. Until recently, this resulted in almost 100% employment of our biology graduates in Australia, although the situation has changed now as a result of the Chinese economy coming off the boil. Nevertheless, the point still holds, which is that employment of biologists is likely to become more certain in the private than in the public sector. I am aware of many entomologists who are able to continue their research activities while employed in the private sector, even in private universities, so aspiring biologists might do well to accept that this might be the course to their future employment, and devise ways in which they can still fulfil their research aspirations.

DEALING WITH INCREASING BUREAUCRACY

Whether it be universities, government departments or private industry, researchers are being confronted with increasing regulation. They have to prepare a risk analysis for each field trip or laboratory experiment, they must acquire the appropriate collecting licence, permits to collect on certain lands, export permits and permits to transport dangerous goods. Vertebrate biologists must seek animal ethics approval for their projects. Entomologists have generally not been affected by the latter until now, although they sometimes become snared due to the vertebrate by-catch in pitfall traps. Also, amongst the invertebrates, Australian animal ethics approval has long covered cephalopod molluscs and recently has been changed to include decapod crustaceans. How much longer will insects escape the reach of this approval system?

All of this bureaucratic regulation absorbs immense amounts of time - time that could be spent on active research. On no account should a researcher seek to avoid these requirements; this could lead to serious problems at a later date. Also, apply for all permits well in advance; all of the above can take considerable time for approval to be granted and could result in delays in your research. My advice is for the researcher to become familiar with all regulations, come to terms with them, and become as efficient as possible at completing the necessary paper work.

OFFICE VERSUS FIELD WORK

Having decided on the area of research that you wish to pursue, you probably want to make progress as quickly as possible, a pressure that is now exacerbated by the pressure to publish (see below). I have noted a tendency for many researchers to undertake minimal sampling in the field, return to the office and analyse the data using a whole suite of complex multivariate data analysis packages to unearth the trends. The results are often so abstract that the journal referees and the reader can’t tell whether they are meaningful or not. I would not be surprised if some of the results that get published are an artefact of the data set that was used and, if someone else was to repeat the sampling, a totally different result might be obtained. This is exemplified by a simple pitfall trapping exercise. The same 20 pitfall traps placed in an array might yield a different set of ant species if run in a slightly different position, or in consecutive seasons, or even weeks. This can only be resolved by spending more time in the field using a suite of complementary sampling methods or by sampling more often. A by-product of this approach would be more opportunity for direct observation, leading to a greater ecological understanding of your data.

Another drawback of resorting to complex analytical tools is that they may mask true ecological interactions. I can think of examples where seemingly anomalous findings have been derived from the statistics, which cannot possibly be correct from the ecological point of view. So, the lesson is: spend more time in the field or laboratory in order to adequately understand the organism(s) that you are researching.

LONG-TERM STUDIES

Ecosystems are dynamic, succession can occur over considerable periods, and most habitats are being subjected to human-induced influences, not the least being climate change. Detection of these changes may require considerably more time to monitor than the duration of a typical research grant (usually 3 years). There is a similar problem with grants for graduate studies, which only run for up to 2 years for MSc students and 4 years for PhD ones. Researchers have attempted to circumvent this problem by setting up controlled experiments or field trials to assess the impacts of disturbance or whatever, and measure the outcome. Others attempt to simulate the likely outcome using mathematical models. In the former approach, a conclusive result may not be achieved due to lack of replication, unexpected events during the duration of the experiment, or because funding bodies and/or managers do not wish to wait long enough for the results to manifest themselves. Modelling too has its weaknesses, often due to problems with parameterising the inputs. Ultimately, there is no better way to understand a series of events than to undertake long-term monitoring. This is well illustrated by a recent article in *The Economist* (May 11th, 2013), which I paraphrase below.

'In 1956 Charles D. Keeling started to build instruments that could measure the proportion of carbon dioxide in the atmosphere, a relatively new scientific topic at the time. He installed some instruments high up on Mauna Loa, a Hawaiian volcano and found that the annual average was 315 ppm. Once he had shown that carbon-dioxide levels were rising, he came under pressure from funding agencies to go and find something else to do but Keeling stuck to his guns. To him, understanding the Earth meant looking at it unblinkingly with careful and consistent scientific eyes. His patient work proved him right. This year, eight years after Keeling's death there will be a day when that curve breaks the 400 ppm barrier for the first time'.

Unlike techniques such as measuring trapped air bubbles in polar ice, there is absolutely no way that climate-change sceptics can deny this information. Parallel situations exist in biology, with studying ants for example, and I encourage researchers to establish long-term studies and sites, at least as a part of their research portfolio. Of course, GPS data should be recorded for all sites, transects, etc. and metal (not wood – termites!) marker posts should be inserted so that sites can be revisited at some future time.

STANDARDISATION OF SAMPLING PROTOCOLS

The ant literature is full of examples of 'rediscovering the wheel' when it comes to sampling procedures. Some studies use baiting, some use pitfall traps, Winkler sacks, or combinations of various techniques. Even in the case of pitfall traps, different diameters, preservatives and sampling times exist. This leads to a lost opportunity; the ability to compare data between studies, either your own studies of those of other people. The data-yield from two separate studies can be more than doubled if valid comparisons can be made, as I have found when looked at ant recolonisation of minesites in Brazil, South Africa and Australia (Majer 1996). The Ants of Leaf Litter (ALL) protocol provides a good model for standardising of sampling (Agosti et al. 2000).

PROTECTING YOUR DATA

Even if you have not planned this at the outset, it is highly likely that you will need to revisit your data and/or sites in order to make comparisons with subsequent studies. For this reason, it is critical that you retain all notes, data sheets, maps and anything else that is relevant to your study. I discarded most of the data from my PhD due to a transcontinental migration, and have regretted it ever since. Now, I never throw anything away, a policy that has assisted me and several other researchers who wished to revisit some of my studies. Much of my material is stored as hard copies in a secure place, my loft now that I have retired, but much is also stored digitally. The latter can be problematic, as technology changes, resulting in some files being unreadable; an issue which should be thought about well in advance of any technological changes.

FUNDING

There is always the important issue of funding your research. Funding bodies such as CNPq generally only fund projects for 3 years, the expectation being that answers should have been obtained by that time and that the researcher should move on to other challenges. Another problem that researchers face is the low success rate of grant applications. These can be as low as 20% with Australian ARC grants, and the application forms are so complicated that they can take a month to prepare. This is not very encouraging. My experience is that chances of success are much higher, and the amount of funding provided can be greater, if industry is approached for support. An application is even more likely to be successful if the study is mission-orientated towards the activities of the industry concerned.

A further benefit of this is the opportunity to forge a lasting relationship with an industry group. I have done this with several mining companies, who have not only provided funds, but also maintenance of study sites, on-site transport, airfares and so on. It is through such an association that I have been able to follow the succession of ants in rehabilitated mines over 37 years (Majer et al. 2013), a task that would be most unlikely to be funded by government grants.

REFERENCE COLLECTIONS

A sizeable proportion of Neotropical ant species have yet to be described, and researchers in these groups tend to assign ants to morphospecies; they may even use morphospecies codes for described species if they do not have ready access to the main museums where reference collections are held. This unsatisfactory situation is confounded by the fact that each research group tends to adopt its own morphospecies coding system, or even a separate coding system for each individual study! Thus we have endless papers featuring *Pheidole* sp. 1, *Pheidole* sp. 2, *Pheidole* sp. 3, but have no idea whether they are the same species or not.

This imposes serious limitations for the making of comparisons between studies - a lost opportunity indeed. It is a relatively simple matter to determine an ant to genus level and assign codes to perceptibly different morphospecies, but obtaining determinations requires access to keys, museums or specialists, and producing a uniform morphospecies coding system requires a system of voucher specimens, deposited in secure and accessible locations, which is a mention to be inserted in “material and methods” that is currently required by most of the entomological journals. All of this takes time and money.

What can we do to overcome this impediment? Delabie et al. (2012) have suggested that each of the major countries have at least one, and preferably more, central reference collections, comprising formally determined material plus vouchers of coded morphospecies, all compiled using a standardised numbering and data-based system. Attempts should be made to 'clone' these collections, or at least regional subsets of the material, and placing the sub-collections in strategic regions of the country where they are accessible to local research groups. As an adjunct to this, keys to the material should be produced, illustrated with line drawings or photographs, and rapidly made available on the internet. The existence of undescribed 'morphospecies' need be no bar to the production of keys. Admittedly co-ordination of collections from the various research groups would be an enormous task and consequently expensive, especially if cross-national co-ordination was involved. At the very least, integrated collections for each country could be assembled, with each having a pre-fix letter before the code number (e.g., *Pheidole* sp. B1, *Pheidole* sp. B2 and *Pheidole sp.* B, etc for Brazil, for example). Subsequent integration of the national collections, at least for individual genera, could then be undertaken as specialist projects or could be co-ordinated through organized groups, possibly under the direction of the International Union for the Study of Social Insects (IUSSI).

To assemble these "national" collections and keys would require dedicated staff, a committed and guaranteed amount of resources, with security of tenure. However, considering the importance of ants in our natural and cultural landscapes, and their increasing importance in the disciplines linked to Neotropical entomology as a whole, this might well be a good investment. Major research organisations, governments and national or international philanthropic funding bodies should seriously consider this option. An embryo of this effort is the site http://www.antweb.org maintained by the Californian Sciences Academy, which has the explicit project of documenting through high quality imagery, the whole ant diversity of the Planet, beginning with the types. Other examples can be found by visiting http://gap.entclub.org/resources.html. Besides offering the option of "digital curation" for countries or areas, initiatives like this can encourage taxonomists to have consensus on the delimitation of morphospecies of large or problematic genera, together with the well-known genera with broad morphological variation. It is critical that the few researchers with access to types can offer high quality photos of them, in order to assist those who have to rely less on loans and risky mail.

OUTREACH

If working with industry, agricultural or forestry organizations, try to speak at their dedicated conferences, thus presenting your results in a timely manner to the people who need to know about them. I used to speak at all the Australian mine restoration conferences and regularly secured funding from industry partners as a result of the exposure of my work. A conference presentation can also provide an incentive and initial preparation of data and ideas for writing a scientific article. Sometimes the conference will require a written contribution for the proceedings and this can be developed further at a later date for a full journal article.

One problem is that the Excellence for Research in Australia (ERA) exercise, and equivalents in other countries, places indirect pressure on authors to publish in an A-grade journal. The result of that is that people are sending their manuscripts to the peak journals, with an unrealistic prospect of them being published in those journals, so they are rejected. They next send them to the next one down in status, which may still be a very high ranking journal, and it is rejected again. And they send it to another one. They may go down a ladder of three of four journals before it is accepted by the journal at the right level or specialisation for that particular paper. This is wasting a massive amount of people's (and referees!) time, because something has to be recast perhaps three times as often as it would have done if they had sent it to the most appropriate journal in the first place. It can also be demoralizing for the young scientist. So from that point of view, I believe that the ERA process is extremely counter-productive. The two weeks to recast a rejected paper could be better spent on research. Although your employer may not be pleased to hear this, my advice is for authors to be more realistic and modest about the level of journal they submit to in the first instance.

INTER-PERSONAL RELATIONSHIPS

Dealing with people can be as important as dealing with data! You are more likely to succeed as a long-term researcher if you establish good collegial relationships with other researchers, especially with more experienced ones when you are beginning your researcher life; a little good-will goes a long way. If you assist other researchers with data-sharing, or collaborating in programs, they are likely to reciprocate. You are more likely to succeed in the long term by this approach than taking a parochial or empire-building approach. It should also result in better understanding of the topic than if you were to work in isolation.

If your work is funded by industry or government departments, as a courtesy always request that they have a look at your writings before publication. Such organisations are sensitive to bad press, and appreciate the opportunity to make input in what information is released. This runs the risk that you could be 'muzzled' and lose your independence to speak out, but in my experience this has not happened; companies have simply worked with me to ensure that any sensitive information is released in a diplomatic way, one which could not readily be misconstrued by opponents of a particular development or action. By taking this approach, one maintains the good-will and the likelihood of future funding.

CONCLUDING REMARKS

The ideas presented here apply to most areas of research, not just ants. You may end up working in a different area to the theme of this symposium. Whichever is the case, adhering to some of these ideas should assist you to develop a successful career, for which I wish you all the success you deserve.

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MAMMAL PREDATION ON ANTS IN AFRICA VS AUSTRALIA AND ITS CONSEQUENCES FOR ANT COMMUNITES

W.J. BOND

Department of Biological Sciences, University of Cape Town, Rondebosch 7701, South Africa, e-mail: William.bond@uct.ac.za

The organization of ant communities has been a topic of considerable research interest. Here I consider the potential importance of mammal predation in structuring ant communities using the drier regions of Australia versus Africa as examples. Behaviourally dominant ants, as defined by Andersen (1995; J. Biogeogr 22, 15-29), are diverse and abundant in Australia but sparsely represented in Africa. Their prominence in Australia has been attributed to physical features of the continent and especially nutrient-poor soils and erratic rainfall. However the large nests of behaviourally dominant ants are also concentrations of a food resource targeted by mammalian myrmecophages. Africa has a diverse assemblage of specialist and generalist ant-eating mammals, including the 60 kg aardvark (*Orycteropus afer*), contrasting with the 4kg echidna (*Tachyglossus aculeatus*) and 0.5 kg numbat (*Myrmecobius fasciatus*) in Australia. Several of these species, including the aardvark, have powerful limbs capable of rapidly excavating nests. All the ant-eating mammals of Africa also target termites. Predation rates on ants (and termites) are estimated to be at least an order of magnitude greater in Africa than in Australia based on energy requirements related to body size, density, and foraging hours of common ant-eating mammals. Ants exposed to heavy predation pressure might diverge from those where predation is light in having patchier distributions (because of nest destruction), different nest structures (deeper for protection) and, possibly, shifts in diurnal activity to reduce detection when mammal predators are most active. Because many African ant-eating mammals also forage on termites, the formidable digging activity of some of these species may also have selected for inter-continental divergence in the structure of termitaria. There is limited data to test these predicted effects of mammal predators. However the high estimates of predation rates on ants in Africa suggest that mammal predation cannot be ignored as a factor in ant community organization.

GENES AND SOCIAL ENVIRONMENT JOINTLY AFFECT ANT BEHAVIOR

L. KELLER

Department of Ecology and Evolution, University of Lausanne, CH-1015 Lausanne, Switzerland, e-mail: Laurent.Keller@unil.ch.

In this talk, I will discuss how interactions between genes and social environment influence behavior and social organization. In particular, I will show that, in ants, worker behavior and gene expression profiles are more strongly influenced by indirect effects associated with the genotypic composition of workers within their colony than by the direct effect of their own genotype. This constitutes an unusual example of an "extended phenotype," and suggests a complex genetic architecture directly and indirectly influencing the individual behaviors that, in aggregate, produce an emergent colony-level phenotype. I will finally discuss of these gene by environment interactions underlie the presence of two distinct modes of social organization.

A SOCIAL CHROMOSOME CAUSES ALTERNATIVA SOCIAL ORGANIZATION IN FIRE ANTS

J. WANG[1,2], Y. WURM[1,3,4], M. NIPITWATTANAPHON[1], O. RIBA-GROGNUZ[1,4], Y. HUANG[2], W. SHOEMAKER[5], L. KELLER[1]

[1]Department of Ecology and Evolution, University of Lausanne, CH-1015 Lausanne, Switzerland, e-mail: Laurent.Keller@unil.ch; [2]Biodiversity Research Center, Academia Sinica, Taipei 115, Taiwan; [3]School of Biological and Chemical Sciences, Queen Mary University London, London E1 4NS, UK; [4]Swiss Institute of Bioinformatics, CH-1015 Lausanne, Switzerland; [5]USDA-ARS Center for Medical, Agricultural, and Veterinary Entomology, 1600/1700 Southwest 23rd Drive, Gainesville, FL, USA.

Intraspecific variability in social organization is common, yet the underlying causes are rarely known. We previously showed that the existence of two divergent forms of social organization in the fire ant *Solenopsis Invicta* is under the control of a single Mendelian genomic element marked by two variants of an odorant binding protein gene. In this talk I will show that it is part of a pair of heteromorphic chromosomes having many of the key properties of sex chromosomes. The two variants, hereafter referred to as the social B and social b (SB and Sb) chromosomes, are characterized by a large region (55% of the chromosome) where recombination is completely suppressed between SB and Sb. Genomic comparisons revealed limited differentiation between SB and Sb, with the vast majority of the 616 genes identified in the non-recombining region present in the two variants. The lack of recombination over more than half of the two heteromorphic social chromosomes can be explained by at least one large inversion of ca. 9 Mb, and this absence of recombination has led to the accumulation of deleterious mutations including repetitive elements in the non-recombining region of Sb. Importantly, most of the genes with demonstrated expression differences between individuals of the two social forms reside in the non-recombining region. I will argue that similar genomic rearrangements are likely to me important in many known cases of social polymorphisms in other ant species.

ANTWEB AND THE CHANGING DEMOGRAPHY OF ANT RESEARCH

B.L. FISHER

Department of Entomology, California Academy of Sciences, 55 Music Concourse Drive, 94118, San Francisco, California, U.S.A., email: bfisher@calacademy.org

What would it be like to live in a world where you could know the name of any ant? And learn not just its name, but what it looks like, its habits, its distribution, whether it is endangered, whether it has been introduced? What if you could do this without visiting a European museum or library? What if you could do this based in the tropics where ants are most diverse? And what if we could use this knowledge to help protect ant habitats, monitor ecosystems, and link ants to human health and well-being?

In other words, what if we could attain the same level of understanding for ants and their role in conservation as we have for birds? To achieve this, we will need a new generation of globally connected ant researchers with access to a comprehensive digital ant collection and library.

Building the online Global Ant Museum

AntWeb was formed to help move taxonomic knowledge out of the hands of select Northern Hemisphere institutions and into the hands of a new generation of global ant taxonomists. This community-driven virtual museum enables anyone, anywhere to access the diversity of ants previously was locked away in museum drawers. Created in 2002, AntWeb is the world's largest online database of images, specimen records, and natural history information on ants. AntWeb's mission is to provide high-quality images of all the world's ant species, maps of their distribution, field guides for their identification, and access to each species' original description, along with links to images of type material. AntWeb focuses on specimen level data and images linked to specimens. In addition, contributors can submit natural history information and field images that are linked directly to taxonomic names. Distribution maps and field guides are generated automatically. All of the data in AntWeb can be downloaded by users. AntWeb also provides specimen-level data, images, and natural history content to the Global Biodiversity Information Facility (GBIF), the Encyclopedia of Life (EOL.org), Wikipedia, and AntWiki.

Changing Demography of Ant Research

The natural world continues to be destroyed at an ever increasing pace and now faces growing pressure from climate change. The risk of species extinction is only increasing. With an estimated half of the world's ant species still undescribed, we need to move now to document the diversity of ants before forever losing this chance. The Neotropics, home to the greatest ant diversity, is on its way to leading the world in ant research. My hope is that AntWeb will enable South American myrmecologists to both accelerate their efforts in ant research at home and become global leaders in the field. By participating in the virtual museum of AntWeb, and adding images and data to its collections, I am confident they can dramatically speed up the advancement of traditional taxonomy. I hold out hope that they can bring humans closer to an appreciation of the world's biodiversity, perhaps, giving society at large a reason to support our scientific adventure.

RESUMOS / *ABSTRACTS*

MESAS-REDONDAS / *ROUND TABLES*

RT 1
EXPLORING THE FRONTIERS OF KNOWLEDGE IN ANT EVOLUTION

CHALLENGES AND OPPORTUNITIES OF "BIG DATA" IN ANT ECOLOGY AND BIOGEOGRAPHY

M.R. PIE[1]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Departamento de Zoologia, Universidade Federal do Paraná, 81531-980, Curitiba, PR, Brazil, e-mail: pie@ufpr.br

A combination of increased computational power, improved data-collection methods, and easily accessible databases have spurred a revolution in recent decades often dubbed “big data”. The advances stemming from big data have brought valuable insight into a variety of scientific disciplines, from astrophysics to molecular biology. In my presentation, I will discuss several exciting opportunities for taking advantage of the big data approach to further our understanding of ant behavior, ecology, and evolution. First, improved movement-tracking software allow for obtaining individual time-series of ant movement and activity at a level of resolution orders of magnitude higher than what could be done even a few decades ago. I explore some of the results of investigating these time series, including striking differences that had not been recognized previously regarding ant workers of different castes and from colonies with varying degrees of social complexity. Second, the availability of comprehensive phylogenetic information on the relationships between ant lineages, in combination with long-term studies of ant population dynamics and spatial organization, can provide an unprecedented opportunity to investigate ant community ecology, including detailed patterns of phylogenetic and functional diversity and their underlying mechanisms. Moreover, I illustrate how integrating phylogenetic information, occurrence records, and georeferenced bioclimatic data can be used to understand the evolution of climatic niches among ant lineages, as well as how it can drive large-scale biogeographical patterns. Finally, I discuss how the integration of research efforts - particularly in Brazil - through “crowd-sourcing” can rapidly improve our knowledge on the diversity and geographical distribution of ant species. (CNPq)

THE EVOLUTION OF THE ANTS: FROM PHYLOGENIES TO THE MICROBIOME

C.S. MOREAU

Field Museum of Natural History, 1400 South Lake Shore Drive, Chicago, Illinois, 60605, USA, E-mails: cmoreau@fieldmuseum.org; www.moreaulab.org

To fully understand the macroevolutionary factors that have promoted the persistence and diversification of the ants diverse tools and disciplines must be integrated. By combining data from several fields including molecular phylogenetics, biogeographic range reconstruction, stable isotope analyses, and microbial community sequencing, we are beginning to understand the drivers of speciation and the interconnectedness of biodiversity. Molecular phylogenetic analyses are providing a stable framework for the ant tree of life and divergence dating suggests that the ants originated ~140 million years ago and diversified after the rise of the angiosperms (Moreau et al. 2006; Moreau 2009; Moreau & Bell 2011; Moreau & Bell 2013). Biogeographic range reconstruction suggests that the Neotropics were historically (museum) and continue (cradle) to be an important geographic region for the evolution of the ants (Moreau & Bell 2013). While studies combining stable isotope analysis to infer the trophic ecology of the ants and microbiome sequencing of gut-associated bacteria of ants highlight the importance of this association in the evolution of herbivory (Russell et al. 2009; Kautz et al. 2013). These multiple lines of evidence are illuminating a more complete picture of ant evolution and providing novel insights into the factors that promote biological diversity.

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NEXT GENERATION TOOLS AND METHODS IN ANT PHYLOGENETICS

S.G. BRADY

Smithsonian Institution, Washington, USA, e-mail: bradys@si.edu

Molecular data have transformed phylogenetic studies of ants and have bolstered our understanding of their evolution, diversification, and historical biogeography. Cutting-edge next generation sequencing technologies are capable of greatly increasing available molecular data, providing phylogenetic information several orders of magnitude more than previously available. I will discuss one such method, the use of ultraconverved elements (UCEs) to extract phylogenomic data from hundreds or thousands of loci. UCE data can be generated much cheaper and more efficiently compared to traditional methods. After reviewing the benefits and potential issues of applying the UCE approach to phylogenomics, I will present preliminary data illustrating the effectiveness of this method in resolving phylogenetic relationships among ants, bees, and other aculeate wasps

COMBINING MORPHOLOGY, MOLECULAR BIOLOGY AND GENOMICS TO STUDY THE SPECIATION PROCESS IN *Atta laevigata*

M. BACCI, M. FERRO, C. RODOVALHO, S. KAKAZU & C. BEZERRA

Centro de Estudos de Insetos Sociais, Instituto de Biociências, Universidade Estadual Paulista (UNESP). Av. 24A, 1515, CEP 13506-900, Rio Claro, SP, Brasil, e-mail: mbacci@rc.unesp.br

The leafcutter ant *Atta laevigata* had traditionally been classified into two distinct species: *Atta laevigata* and *Atta silvai*. However, recent studies have suggested that *A. laevigata* is a single species with significant morphologic variations. Based on mitochondial DNA sequence, we show that *A. laevigata* is represented by two lineages (I and II), which are largely distributed in Brazil. The type locality of *A. silvai* (Maraú, Bahia) harbors a single lineage as Southeast Brazil harbors both lineages in sympatry. Both lineages were confirmed by microsatellite genotyping in most of the individuals analyzed. However, three individuals showed a mixed genome originated from both lineages, in proportions consistent with a first hybridization followed by secondary back crosses leading to mitochondial introgression. In the sympatric region in Southeast Brazil, the males from lineage I were heavier and larger than the males from lineage II. Distinct metasoma and genitalia morphologies and significantly different body weights of males from both lineages provided sufficient discrimination between the two lineages on morphological grounds. Genotyping of the spermathecae content, using both mitochondrial and microsatellite markers, indicated dominant and likely exclusive insemination within lineages and very unusual insemination between lineages. Data is consistent with a very recent speciation process occurring to split *A. laevigata* from *A. silvai*. To investigate the genetic changes underlying the speciation process, we carried out next generation transcriptomics sequencing 114 million paired-end reads from lineage I and 120 million paired-end reads from lineage II individuals. After clustering reads, we found 2,397 nuclear genes representing the genetic differences between lineages. Further analysis of these genes will reveal phenotypic differences involved in the speciation process.
(CNPq, CAPES, FAPESP)

RT 2
MECHANISMS OF COMMUNITY ASSEMBLY IN ANTS: CONTRASTING EVIDENCE FROM DIFFERENT ECOLOGICAL CONTEXTS

THE ROLE OF BEETLES-PRODUCED CAVITIES AS A FILTER ON THE ASSEMBLY OF ARBOREAL ANT COMMUNITIES

S. POWELL

The George Washington University, Department of Biological Sciences, 2023 G St. NW, Washington, D.C., 20052, USA, e-mail: scottpowell@gwu.edu

Understanding the extent to which species interactions mechanistically shape ecological communities remains a central challenge to the field of community ecology. Moreover, the extent to which species traits mediate these interactions and their outcomes is still being actively debated. One challenge for studies of trait-mediated community assembly is choosing which traits to focus on. The field of community ecology has often suffered with choosing blindly, or choosing the traits that "seem" important to investigators. When focal traits are found to have no importance for community assembly, it is increasingly resulting in split interpretations. Some investigators remain convinced of trait-mediated assembly processes, and conclude that the wrong focal traits were selected. Others reject the importance of trait-mediated processes and conclude that neutral processes predominantly determine community assembly. Neither conclusion is very useful if the root of the problem is inadequate approaches for selecting focal traits. So how do we know we are focusing on the "right" traits in studies of ant community assembly?

Understanding the ecology of trait diversification on deep evolutionary time scales can greatly inform trait-selection decisions in community assembly studies. Ecological interactions, and especially competitive interactions, are thought to drive major axes of trait diversification within diversifying lineages. When such evidence is found, the implication is that these key traits continue to play a central role in the ecological interactions and patterns of resource use in contemporary species and communities. Consequently, these traits are critical to include in studies of trait-mediated processes of community assembly.

Studies of community assembly in tropical arboreal ant communities have historically focused on trait-mediated competitive interactions over food. From a behavioral perspective, ants fight a great deal over food, so these interactions seem like they should be important in community assembly. Nevertheless, we have increasingly learned that the outcomes of interspecific interactions over food have a weak to non-existent impact on community structure in natural systems. Concordantly, we have also learned that most arboreal ants are functional herbivores, highlighting a disconnect between diets that are poorly differentiated in communities of ants with an astonishing array of traits. The common lack of a signal of trait-meditated interactions over food in arboreal ant communities is therefore increasingly not surprising.

Here I report on ongoing work on the role of trait-mediated interactions over cavity nesting-resources in arboreal ants. Preformed cavities, initially produced by wood-boring beetles, are used as the sole nesting resource of most tropical arboreal ants. Critically, the focus and design of these studies were informed by strong evidence that competitive interactions over cavities has played a central role in shaping the astonishing trait diversity of the arboreal ant genus *Cephalotes*, which typically makes up around 20% of the species richness of any arboreal ant community in the Neotropics. The strong evolutionary relationship between nesting cavities and trait diversification in a diverse component of modern arboreal ant communities predicts that cavity-ant interactions should have important implications for assembly of contemporary arboreal ant communities.

All fieldwork has been conducted in the low and accessible canopy of the Brazilian savanna, or cerrado. Ant diversity surveys across a total of 240 trees spanning 6 common tree species, a range of sizes within each species, and a gradient of canopy connectivity revealed a diverse community of over 80 arboreal ant species. Tree size and canopy connectivity both had significant positive effects on ant species richness, but tree species did not. Surveys of over 600 meters of stems sampled from eight trees of each of the six focal tree species revealed a total of 1390 beetle cavities. There were significant differences among individual trees and tree species in the abundance of beetle cavities, as well as the mean and variance of cavity size and entrance size. Cavity abundance and variation in cavity properties had positive effects on species richness. Preliminary analyses suggest a stronger effect of cavity variation on size-based species composition. Experimental manipulation of canopy connectivity and cavity diversity have shown that cavity connectivity increases overall richness on individual trees, while cavity diversity dramatically increases the richness of species colonizing new cavities. Recent experimental work is testing how different axes of cavity variation shape community assembly, especially with respect to species body size and other morphological traits functionally related to cavity occupation. Broadly, this work suggests that trait-mediated interactions over cavity resources have a significant impact on community assembly in arboreal ant communities. The implications of these finding, and the general approach employed in the study of trait-mediated community assembly, are discussed.

COMPETITION FOR FOOD RESOURCES IS NOT A STRUCTURING FORCE ON CERRADO ARBOREAL ANT COMMUNITIES

F.C. CAMAROTA[1], H.L. VASCONCELOS[1], S. POWELL[2], G. PRIEST[3] & R. MARQUIS[3]

[1]Instituto de biologia, Universidade Federal de Uberlândia, Uberlândia, Brasil, e-mail: **camarotaflavio@hotmail.com**. [2]Department of Biological Sciences, The George Washington University, Washington, DC, USA. [3]Department of Biology, University of Missouri, Saint Louis, Missouri, USA.

Competition has long been seen as the hallmark of ant ecology (Holldobler & Wilson 1990), but recent works are challenging this traditional view by suggesting that if competition is still a leading force shaping ant community structure, it is in more subtle ways (Cerdá et al. 2013 and references therein).

To understand how resources can shape the community structure of ants we chose to study the arboreal ants of an extremely diverse neotropical savanna, also known as cerrado. The cerrado canopy is remarkable for the study of arboreal ants because of its high accessibility, with trees of about five meters tall. The most important resources for arboreal ants are usually food and shelter (Bluthgen & Feldhaar 2010), and to understand how food resources shape the ant community structure we focused on an abundant resource on the cerrado vegetation and other tropical habitats; extrafloral nectaries (EFN´s therein).

EFNs are nectar producing organs that are not directly involved in plant reproduction. They are especially abundant on tropical plants (Koptur 1992) and are very important in ant-plant interactions (Rico-Gray & Oliveira 2007). EFNs are an extremely important food resource for tropical arboreal ants, which can act mainly as herbivores, foraging extensively for nutrient rich plant secretions and insect exudates (Tobin 1995; Davidson 1997; Davidson et al. 2003; Blüthgen et al. 2003).

If there is competition for food, the arboreal ants may organize themselves in competitive dominance hierarchies, where dominant species generally outcompete subordinates, especially in simpler habitats (Fellers 1987; Savolainen & Vespsäläinen 1988; Andersen 1992). The hierarchical distribution of arboreal species in plantations led to the development of the ‘ant mosaic’ concept, where a few aggressive dominant species hold territories and coexist with non-random subsets of subdominant and subordinate, less aggressive, ant species (Leston 1973).

For our purpose of understanding how food resources influence the ant community structure, we used two complementary approaches of a natural experiment and experimental manipulations in the field.

The natural experiment aimed to evaluate how seasonality in EFN production influences arboreal ant communities. We used three tree species with EFN´s *(Caryocar brasiliense* Cambess. **(**Caryocaraceae); *Qualea grandiflora* Mart. (Vochysiaceae); and *Stryphnodendron polyphyllum* Mart. **(**Fabaceae**))** and three species without EFNs, (*Sclerolobium aureum* (Tul.) Benth. (Caesalpinaceae); *Machaerium opacum* Vogel (Fabaceae); and *Kielmeyeria coriacea* Mart. & Zucc. (Clusiaceae)). We surveyed ant diversity on trees during two different periods of the year, one when the EFNs were mostly inactive (between June and July of 2010) and one in the peak of extrafloral nectar production for the tree species with EFNs (between October and November of the same year). The tree species without EFNs served as a control for seasonal fluctuations unrelated to EFN activity.

We also did two experimental manipulations with the addition of artificial nectaries in two tree species; one that has EFNs (*Caryocar brasiliense*) and one that does not (*Sclerolobium. aureum*). We measured the rates of occupation of artificial wood nests (20 nests per tree). In the first manipulation, we aimed to mimic the natural scattered distribution and low-volume delivery of extrafloral nectar. In the second manipulation, we mimicked homopteran aggregations, which offer a much more localized and larger volume of liquid resources for the ants.

In the natural experiment, we found a greater number of ant species foraging on trees with EFNs, but did not see any compositional changes between the ant species that forage on both kinds of tree (with or without EFNs). We also saw a marginally significant increase in the ant species turnover on trees with nectaries, showing a slight influence of the seasonality of these resources. Our first experimental manipulation showed no differences in the rate of arboreal nest colonization on trees with or without the artificial increase of resources. Despite this, our second manipulation, which mimicked homopteran aggregations led to a higher rate of nest site colonization on trees with this massive increase of resources.

If there was strong competition between ant species for these food resources, we would expect either a less diverse community because of competitive exclusion, or a bigger set of resource specialization on ants found on trees with EFNs. We showed that competition does not strongly structure these ant communities, since there is no competitive exclusion and no resources specialization between the ants. Our experimental manipulations showed that the presence of food resources can increase the rate of arboreal nests colonization, but this is dependent of the way these resources are offered to the ants.

Another one really important way to keep so many species living on single trees is the resource use specialization, which can lead to a diversification of morphological and behavioral traits amongst the ants. For example, we would expect ants to diversify not just on their diets, but on the way they acquire their food and shelter resources, leading to important interespecific trade-offs, like the discovery-dominance for food resources and discovery-colonization for shelter resources. These aspects of the ant community do not necessarily imply on differences on the ant species composition on a given tree, but the way these ants acquire and keep these resources, either food or shelter.

Overall, our results support the view that EFNs offer important food resources for canopy dwelling ants, increasing not just the number of ants but the number of ant species foraging on a tree. But this greater number of ant species found on trees with EFNs rejects the idea that competition over food represents a strong structuring force in arboreal ant communities. It also suggests that there is no significant specialization within these communities over EFN and non-EFN food resources, since community composition was the same across EFN and non-EFN tree species. The results of the experimental manipulations tell us that the importance of food resources can vary according to the kind of resources being offered and the amount of resources available.

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ASSEMBLING (AND DISASSEMBLING) ANT COMMUNITIES IN A CHANGING WORLD

N.J. SANDERS

Department of ecology and evolutionary biology, University of Tennessee, 569 Dabney Hal, Knoxville, Tennessee, 37996, USA, e-mail: nsanders@utk.edu

Myrmecologists have long known that ants respond to temperature; on cold days, very few ants forage and on hot, dry days, very few ants forage. Similarly, at global scales there tend to be more ants in warmer places than in colder places. These observations suggest that temperature matters to ants. Thus, changes in temperature should then lead to changes in ant activity, community structure, and biogeographic patterns.

For the past 10 years, we have been exploring these issues - how changing temperatures influence the activity of particular ant species, the structure and dynamics of communities, and the distribution of ant species at regional and global scales. We have taken advantage of two experiments that naturally manipulate temperature and we have been experimentally manipulating temperatures at two sites in the eastern US for since 2010.

The natural experiments have revealed that both the abundance and diversity of ants at regional and global scales increases with temperature. When we extend these observations and model the projected effects of changing global temperatures on ant diversity, we find that many areas will see dramatic reductions in diversity and changes in composition.

Changes in abundance and activity come about because of functional traits associated with particular ant species. In this case, thermal tolerance can account for >75% of the variation in activity and >60% of the variation in community structure.

Together, these observational and experimental results demonstrate that novel ant communities are likely to emerge, and contemporary ant communities are likely to fall apart. Understanding the consequences of those changes today, and predicting them in the future, are the next key steps in this research program.

PLANT-ANT COMMUNITIES AND GEOGRAPHIC VARIATION IN A NEOTROPICAL ANT-PLANT MUTUALISM

E.G. PRINGLE[1]

[1]Michigan Society of Fellows, Department of Ecology & Evolutionary Biology, School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI, USA, email: epringle@umich.edu

Species with broad geographic distributions interact with different species in different communities. This geographic variation in the identity and diversity of interacting species is particularly interesting in the case of mutualisms, which are maintained in evolutionary time when species on both sides of the interaction incur net fitness benefits. The myrmecophytic tree *Cordia alliodora* hosts stem-dwelling ants throughout its range from Mexico to Argentina. At least three of the ant species that regularly nest in *C. alliodora* are specialists, but the tree also hosts several species of live-stem-nesting generalists. All of these ant species regularly tend phloem-feeding scale insects inside tree-stem cavities and thus presumably subsist on similar honeydew-based diets. In addition, ants must chew their way into the *C. alliodora* stem cavities, which are formed without an entrance hole. I examined variation in host-tree ecology and in the presence and abundance of *C. alliodora* ant symbionts from Mexico to Costa Rica. Tree growth and demography changes dramatically throughout this range, with trees growing larger and exhibiting higher recruitment limitation and mortality in low-latitude sites. Ant communities nesting in *C. alliodora* were more diverse at lower latitudes. The most abundant ant symbiont at all latitudes was the specialist *Azteca pittieri*; *A. pittieri* also provided the best protection for trees against leaf-eating insects. The other two *C. alliodora* specialists, *Azteca oecocordia* and *Cephalotes setulifer*, had more restricted geographic distributions and were found only at low-latitude sites. Trees were often cohabited by *A. pittieri* and *C. setulifer* within the *C. setulifer* range. Cohabitation by ants is unusual in myrmecophytic trees and appears to be faciliated in this system by the relatively small colonies of the more-aggressive *A. pittieri* species in this part of the range, and by the particular nesting behaviors of these two species. I suggest that biogeographical and ecological factors both contribute to latitudinal changes in ant diversity at the community level in this system. There are clearly interesting and unexplored biogeographical factors that contribute to higher intraspecific genetic diversity and species diversity in low-latitude sites, particularly in the Monteverde region of Costa Rica. In addition, higher abundance but less-stable demography of tree hosts in low-latitude sites could facilitate the persistence of non-mutualistic ant symbionts in these sites. Finally, these patterns may be strongly affected by interactions between the tree and its most common ant symbiont, *A. pittieri*. Strongly mutualistic interactions between *C. alliodora* trees and their *A. pittieri* ants in high-latitude sites could contribute to the persistence of the tree's myrmecophytic traits, while changes in *A. pittieri* life-history strategies, including colony size, could contribute to the higher abundance of less mutualistic ant species in low-latitude sites.

RT 3
PHYSIOLOGY OF ANTS: MORPHOLOGY AND GENOMICS

VITELLOGENIN AND ANT BEHAVIOR

D.O. AZEVEDO[1] & J.E. SERRÃO[2]

Laboratório de Ultraestrutura Celular. Departamento de Biologia Geral. Universidade Federal de Viçosa. Av PH Rolfs, s/n, Campus UFV, Viçosa MG. CEP 36570-000. Tel (31) 38991301
[1]E-mail: dihego.azevedo@ufv.br, [2]E-mail: jeserrao@ufv.br.

Vitellogenin is the precursor of vitellin, the major yolk protein stored in the insect eggs, which play a role in embryo nutrition (Tufail & Takeda 2008). The insect vitellogenin is mainly synthesized in the fat body as a single or multiple polypeptides that undergo modifications such as glycosylation, lipidification, phosphorylation, sulfation, and proteolytic cleavage before release into the haemolymph as oligomeric proteins with molecular weights ranging from 300 to 600 kDa (Tufail & Takeda 2008; Wheeler *et al*. 1999). The vitellogenin is transferred from haemolymph to oocytes via receptor-mediated endocytosis and stored as protein granules termed vitellins (Tufail & Takeda 2009). The vitellogenin provide amino acids, phosphates, carbohydrates, lipids, sulfates, fatty acids, vitamins, hormones and metals for the developing embryo (Raikhel & Dhadialla 1992).

In the honeybee *Apis mellifera*, vitellogenin is related with age polyethism in workers and bee longevity (Amdam *et al.* 2004; Corona *et al.* 2007; Marco Antônio *et al.* 2008). In ants, vitellogenin is involved in caste determination (Libbrecht *et al.* 2013), and also in the production of non-reproductive trophic eggs by workers used to feed other colony individuals (Camargo-Mathias & Caetano 1995).

Workers of the ant *Ectatomma tuberculatum* (Ectatomminae) have active ovaries and produce trophic eggs to feed the queen and brood (Hora *et al.* 2007). The vitellogenin present in the haemolymph and eggs of *E. tuberculatum* queens and workers is a single oligomeric protein with 400 - 500 kDa. In the haemolymph and eggs of workers, this protein consists of two polypeptides of approximately 31 and 156 kDa, while in the eggs of queens, some of the 156 kDa polypeptide is cleaved into two subunits of 31 and 123 kDa, allowing the identification of four proteins (Azevedo *et al.* 2011; Wheeler *et al.* 1999).

Using antibodies raised against the 156 kDa vitellogenin, we identified the period of protein release in the haemolymph of *E. tuberculatum* workers (Azevedo *et al.* 2011). The vitellogenin appears in the haemolymph of workers 5 days old and its level increase, with a peak in workers 20 days old. The vitellogenin is still present in high level in the haemolymph of workers 30 days old, showing a slight decrease until the 60th day. The vitellogenin is not present in the haemolymph of workers around 100 days old.

This variation in vitellogenin synthesis may be linked to the different activities performed by workers in the colony, suggesting that vitellogenin play a role in maintaining the age polyethism. Workers of *E. tuberculatum* showed a gradual progression of inside colony tasks to outside colony tasks with aging: in the first week of adult life, the workers are involved in activities recognition, not performing any specific function inside the colony; from the second week, the workers begin nursing activities with eggs, larvae, and pupae; the workers around 90 days of age are mainly involved in cleaning, guarding, and foraging tasks (Champalbert & Lachaud 1990; Fénéron *et al.* 1996).

The absence of vitellogenin in older workers may be a trigger for the beginning of outside colony activities, based on the theory that the onset of foraging activities of worker ants is linked to a decline of their physiological functions and to an increased chance of extrinsic mortality (Chapuisat & Keller 2002), related to the fact that the interruption of vitellogenin synthesis can compromise the immunity and resistance to oxidative stress of workers (Amdam *et al.* 2004; Corona *et al.* 2007).

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THE MORPHOLOGY AS A TOOL TO UNDERSTAND THE PHYSIOLOGY AND BEHAVIOR OF ANTS

M.I. CAMARGO-MATHIAS

UNESP- Depto. Biologia, Avenida 24A, n. 1515, Bela Vista, IB, Rio Claro, SP, Brasil, e-mail: micm@rc.unesp.br

The new era of the studies of insect in general makes use of tools that allow to perform the morphological analysis telling a story which contained many facts to be reported through new information obtained mainly by the application of histological and histochemical techniques and by the improvement of the researchers' knowledge

Exemplifying the importance of the use of the morphohistological tools in studies on insects, we mention those which addressed the internal organs like: exocrine and endocrine glands, male and female reproductive, nervous and digestive systems. Notwithstanding what many researchers think about the morphological studies, it is important to emphasize that they are of fundamental importance to the understanding of the basic functioning of the organs and systems of several biological models.

When dealing specifically with ants, many knowledge acquired were obtained from the application of the morphohistological techniques, which provided data those when associated with another ones like: taxonomic, behavioral and molecular allowed to draw a more accurate profile of the biology of these, as well as other animals.

In the last decade, such studies have been carried out by several brazilian and foreign researchers among them may be mentioned: Ortiz et al, 2012; Vieira et al, 2012; Roma et al, 2008, 2010, and others, which showed different aspects of the morphology and physiology of internal and external organs.

Specific researchs with different species of ants and using morphology techniques, performed by various researchers have shown for example that the fat body, the main organ of the intermediate metabolism of insects are responsible for the synthesis and storage of proteins, lipids and carbohydrates. This tissue is also responsible for the synthesis of vitellogenins, proteins with an important role in the reproduction, being incorporated into the oocytes during vitellogenesis. In this way Roma et al (2009) performed a study of the fat body cells and showed important results that helped in better understanding the phylogenetic relations between basal and derived species of the Attini tribe ants (Figures 1-2).

Earlier these same authors have previously performed a study showing by morphological analysis (ultrastructural cytochemistry) the detection of the proteins and lipids in the fat body cells from workers of Attini ants, showing in the fat body cellos of workers of the basal Attini *Cyphomyrmex rimosus* and *Mycetarotes parallelus* and the derived *Acromyrmex disciger* and *Atta laevigata* the presence of very electrondense protein granules of varied sizes and shapes distributed throughout the cytoplasm of parietal and perivisceral trophocytes and oenocytes. Lipids were present in the cytoplasm of trophocytes as very electrondense granules. In *M. parallelus, A. disciger*, and *A. laevigata,* lipids were present as droplets. In parietal as well as perivisceral oenocytes, lipid granules were very electrondense. In *A. laevigata,* lipids were present as droplets (Figures 3-4).

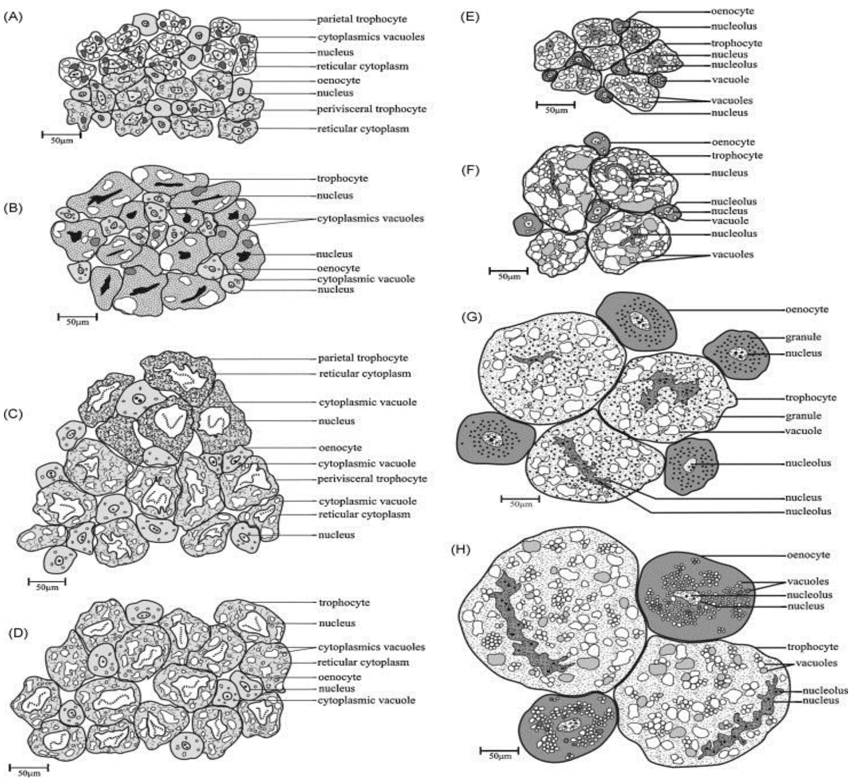

Fig. 1. Schematic drawing of the fat body cells from ants of the Attini tribe. (A) Workers of *Cyphomyrmex rimosus* and (B) *Mycetarotes parallelus* (basal species), (C) media workers of *Acromyrmex disciger* and (D) *Atta laevigata* (derived species), (E) gynes of *C. rimosus* and (F) *M. parallelus* and (G) queens of *A. disciger* and (H) *A. laevigata*. Observe that reproductive castes (gynes and queens) have larger vacuolation in the trophocyte cytoplasm in comparison with worker castes; consequently their nuclei become more irregular. In the gynes and queens are also observed greater amount of inclusions in oenocyte cytoplasm such as

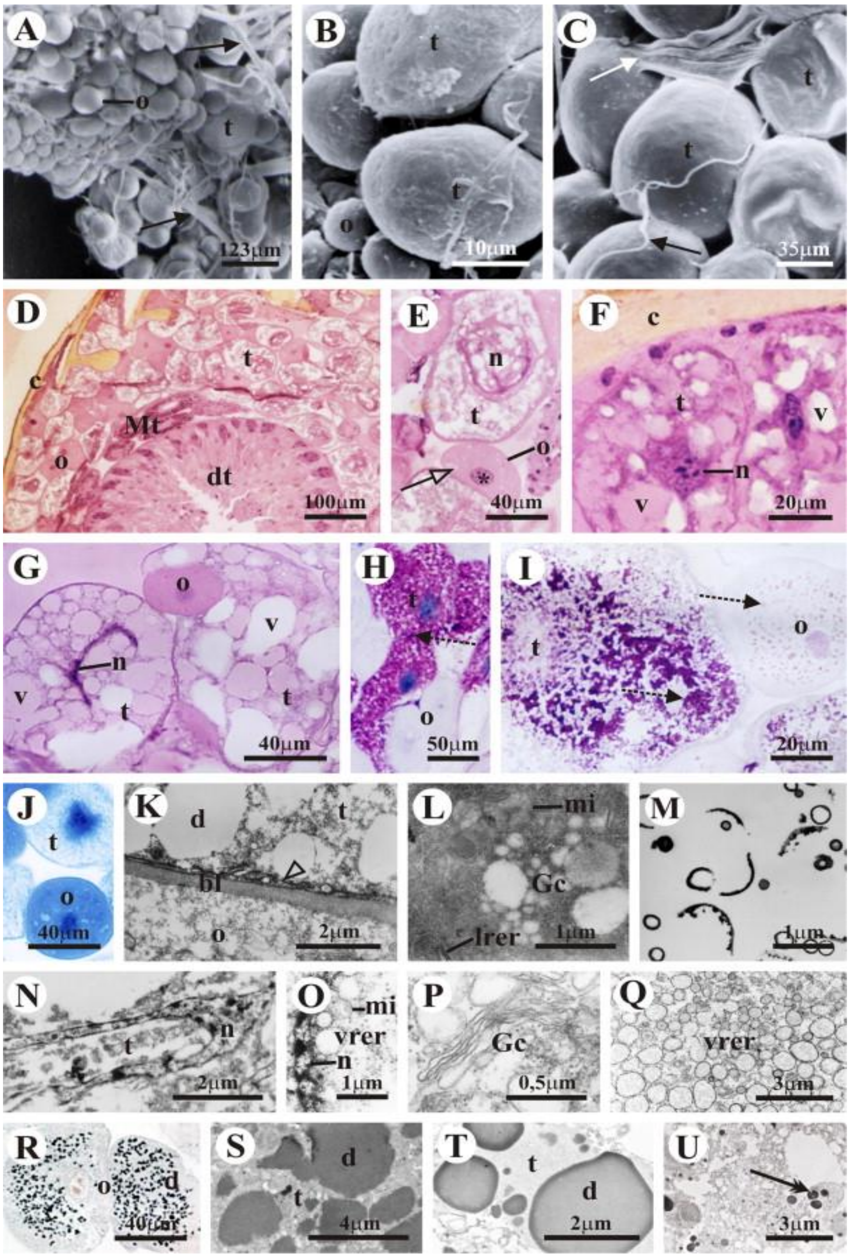

Fig. 2. (A) Scanning electron microscopy of the fat body cells from queens and (B) workers of *A. laevigata* and (C) *M. parallelus* gynes. (D and E) Histological sections of the fat body from *A. disciger* workers, (F) *C. rimosus* workers and (G) *M. parallelus* gynes stained by hematoxylin and eosin. (H) Detail of the histological sections of the fat body of *M. parallelus* workers and (I) *A. disciger* queens stained by PAS. (J) Histological sections of the fat body of *A. laevigata* workers stained by Bromophenol Blue. (K) Electron micrograph of the oenocytes (o) and trophocytes (t) of *A. laevigata* workers, (L) *C. rimosus* workers showing lamellar rough endoplasmic reticulum (lrer), Golgi region (Gc) and mitochondria (mi). (M) Protein granules of trophocytes of *A. disciger* workers showed through ultrastructural cytochemistry for basic protein. (N) Electron micrograph of the trophocytes of workers and (O) queens of *A. disciger* exhibiting vesicular rough endoplasmic reticulum (vrer). (P) Trophocytes of *M. parallelus* gynes and (Q) oenocytes of *A. laevigata* queens. (R) Histological sections of *A. disciger* workers stained by Sudan Black B showing the large amount of lipidic inclusion in the oenocyte cytoplasm. (S) Ultrastructural cytochemistry for lipids detection in the trophocytes of *A. disciger* workers and (T) *C. rimosus* gynes. Observe in figure U the lipids droplets inside the mitochondria (⟶) of the oenocytes from *A. disciger* queens. (t) Trophocytes, (o) oenocytes, (n) trophocyte nucleus, (*) oenocyte nucleus, ( ) tracheoles, (white arrow) membranous expansion, (dt) digestive tract, (Mt) Malpighian tubules, (c) cuticle, (v) vacuoles, ( ) vacuoles in the oenocyte cytoplasm, ( ) granules PAS positive, (bl)

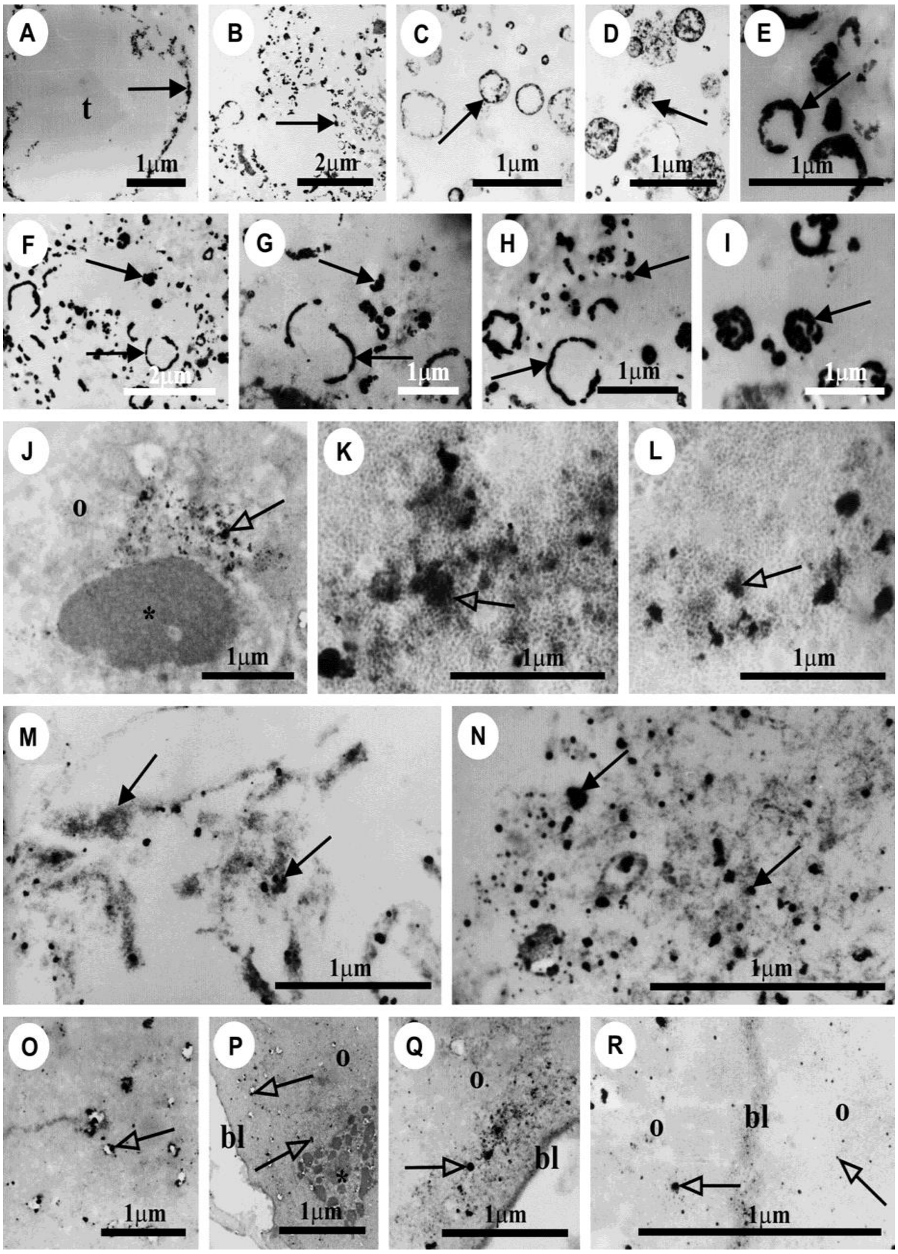

Fig. 3. Electron micrograph of the fat body cells from workers of the basal species of *Cyphomyrmex rimosus* and *Mycetarotes parallelus* submitted to the cytochemical test for basic proteins detection. (AeE) Detail of *C. rimosus* parietal trophocytes (t) and (FeI) perivisceral ones showing the protein granules ( ). (J, K) *C. rimosus* parietal oenocytes (o) and (L) perivisceral ones. Observe the nucleus (*) and the strongly electrondense protein granules ( ). (M) Detail of *M. parallelus* parietal trophocytes and (N) perivisceral ones, showing the protein granules ( ). (O, P) *M. parallelus* parietal oenocytes (o) and (Q, R) perivisceral ones. Observe the negativity to the test of basal lamina (bl) and strongly electrondense protein granules ( ).

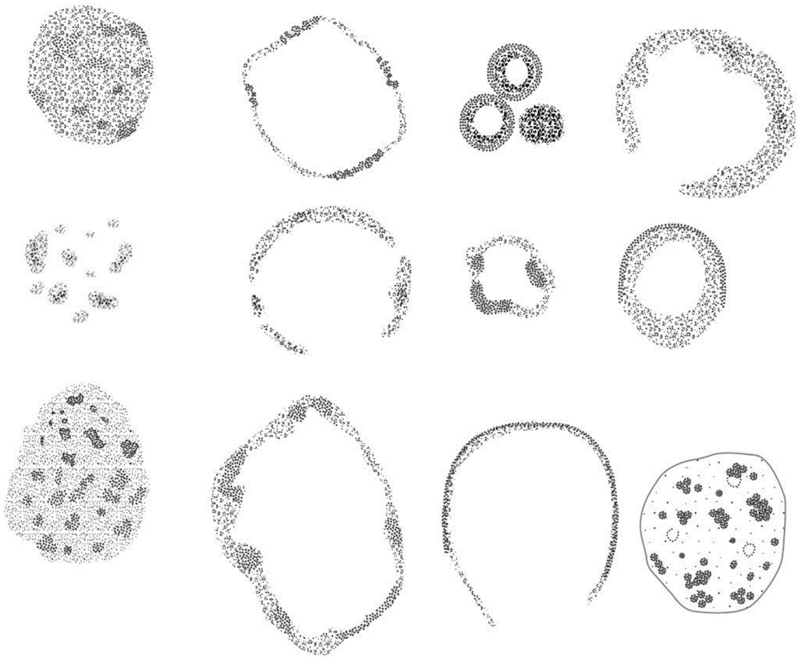

Fig. 4. Schematic representation of the main types of protein granules of the fat body cells from workers of the basal species *Cyphomyrmex rimosus* and *Mycetarotes parallelus* and derived species *Acromyrmex disciger* and *Atta laevigata.*

Other studies by making use of morphological techniques allowed the authors as Ortiz and colleagues (2006) make the characterization of the venom gland of *Pachycondyla striata* worker ants, belonging to the Ponerinae subfamily, and they observed ultrastructurally that this gland consists of three distinct regions: an external secretory portion, composed by a secretory filament that bifurcates in order to give rise to other two filaments; an internal secretory portion, represented by the convoluted gland; and a storage portion, represented by a sac-shaped reservoir. The external secretory portion is composed by cells forming a simple cubic epithelium, in which the apical portion presents numerous microvilli while the basal portion of the cells shows infoldings of the plasma membrane containing numerous mitochondria. The convoluted gland possesses cells of irregular morphology with nuclei containing condensed chromatin, suggesting inactivity. However, these cells are in fact undergoing secretory activity, which is probably added to the final secretion produced by the gland. The cytoplasm of these cells contains protein inclusions in the form of crystals, thus suggestive of protein storage, which would be used by the insect when metabolically required (Figures 5-6).

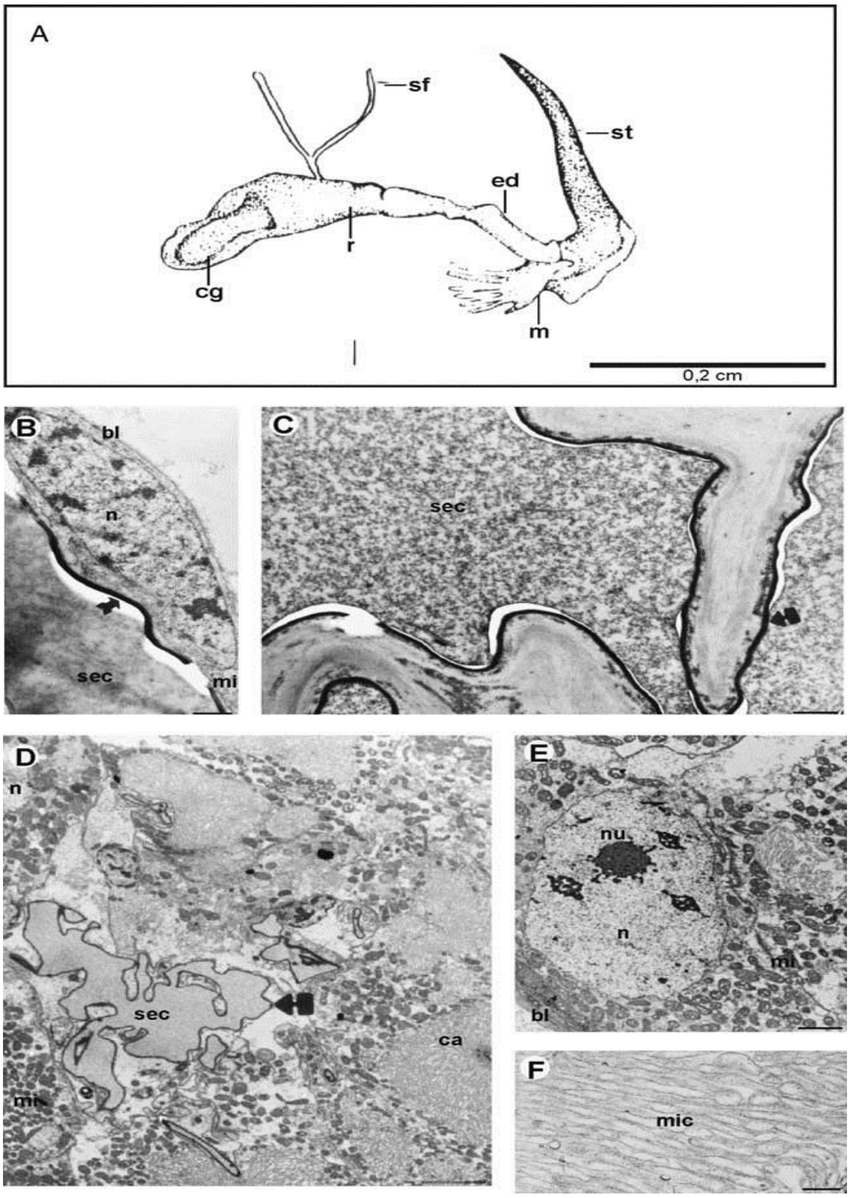

Fig. 5. (A) Schematic representation of *Pachycondyla striata* venom gland, sf, secretory filament; r, reservoir; cg, convoluted gland; ed, excretory duct; m, muscle layer; st, sting. (B–F) Ultrastructural aspects of the reservoir and secretory filaments of the *P. striata* workers venom gland. (B) Detail of the epithelial cell of the reservoir, bl, basal lamina; n, nucleus; sec, secretion; mi, mitochondria; arrow, cuticle coating the lumen of the reservoir; Scale bar, 1 mm. (C) Detail of the cuticle (arrow) that covers the lumen of the reservoir containing secretion (sec), Scale bars 2 mm. (D) Electron micrograph showing the insertion of the secretory filament into the reservoir, n, nucleus of the secretory cell; sec, secretion; mi, mitochondria; ca, intracellular canaliculi; arrow, cuticle; Scale bar, 10 mm. (E) Ultrastructural aspects of the basal portion of the cells of the secretory filament of the venom gland of workers of P. *striata*, n, nucleus; nu, nucleolus; bl, basal lamina; mi, mitochondria; Scale bar, 1 mm. (F) Ultrastructural aspects of the apical portion of the cells of the

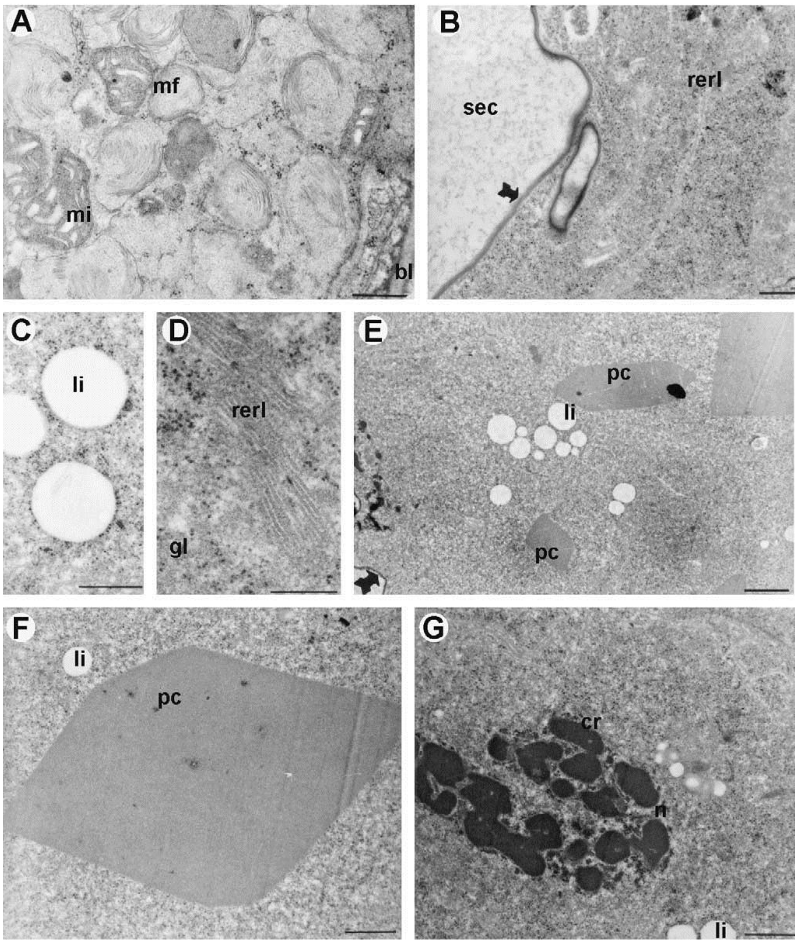

Fig. 6. (A) Ultrastructural aspects of the basal portion of cells of the secretory filaments showing myelinic figures (mf), basal lamina (bl) and distorted mitochondria (mi), Scale bars 1 mm. (B and C) Ultrastructural aspects of the cytoplasm of the convoluted gland of workers of the ant *P. striata*, li, lipid droplets, rerl, lamellar rough endoplasmic reticulum, arrow, cuticle recovering the lumen of the gland, and separating the gland from the secretion stored in the reservoir, sec, secretion, Scale bars 1 mm. (D) Detail of lamellar rough endoplasmic reticulum (rerl), gl, glycogen, Scale bars 1 mm. (E and F) Detail of the convoluted cell cytoplasm showing crystalling inclusions, protein crystals (pc), li, lipid droplets. (E) Scale bars 3 mm and (F) Scale bars 2 mm. (G) Ultrastructural aspects of the nuclei (n) of the cells of the convoluted gland, li,

Still other studies with exocrine glands of ants now performed by Pavon (2005) in ants *Atta sexdens rubropilosa* showed that mandibular glands of this species contains two portions: a secretory and a storage portion (or reservoir) both connected by canaliculi. The ultratructure of the mandibular glands of minima, media and soldier ants of *A. sexdens. rubropilosa* under TEM observation present in the three castes a reservoir, constituted by a simple pavementous epithelium surrounded by the cuticular intima and the secretory portion constituted by cells of rounded shape. The secretory cells, mainly of minima and soldier, were rich in smooth endoplasmic reticulum. The media worker and soldier presented a large number of mitochondria, of varying shape. Well-developed Golgi regions were also present in the soldiers. The secretory cells in minima, media and soldier were provided with collecting intracellular canaliculi, linked to the reservoir through the extracellular portion. The cytoplasm of the canaliculi-forming cell was poor in organelles. In the individuals of the three castes of *A. s. rubropilosa,* the presence of lipid secretion granules suggested, beyond the other functions, also a possible pheromonal action (Figures 7-8).

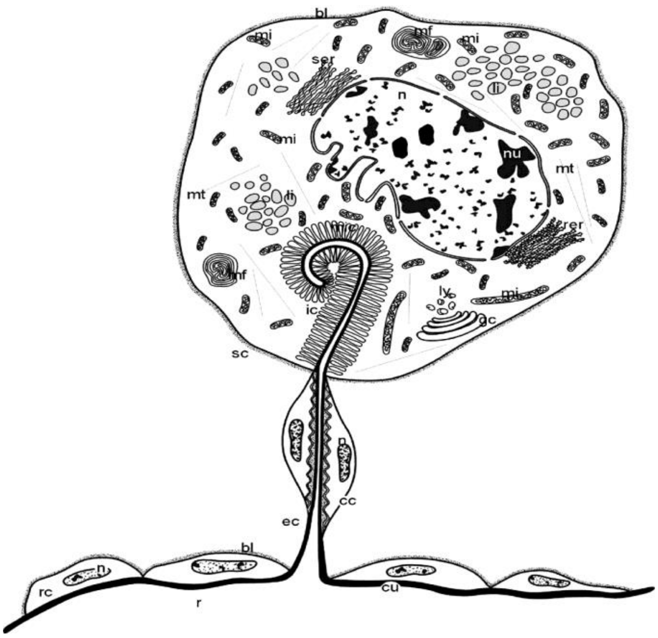

Fig. 7. Schematic representation of the mandibular glands of *Atta sexdens rubropilosa*. sc, secretory cell; r, reservoir; n, nucleus; nu, nucleolus; ic, intra- cytoplasmic canaliculi; ec, extra-cytoplasmic canaliculi; mf, myelin body; mi, mitochondria; gc, Golgi; ly, lysosomes; mt, microtubules; ser, smooth endoplasmic reticulum; rer, rough endoplasmic reticulum; mic, microvilli; li, lipids; cc, canaliculi-forming cell; rc, reservoir cell; cu, cuticle; bl, basal lamima

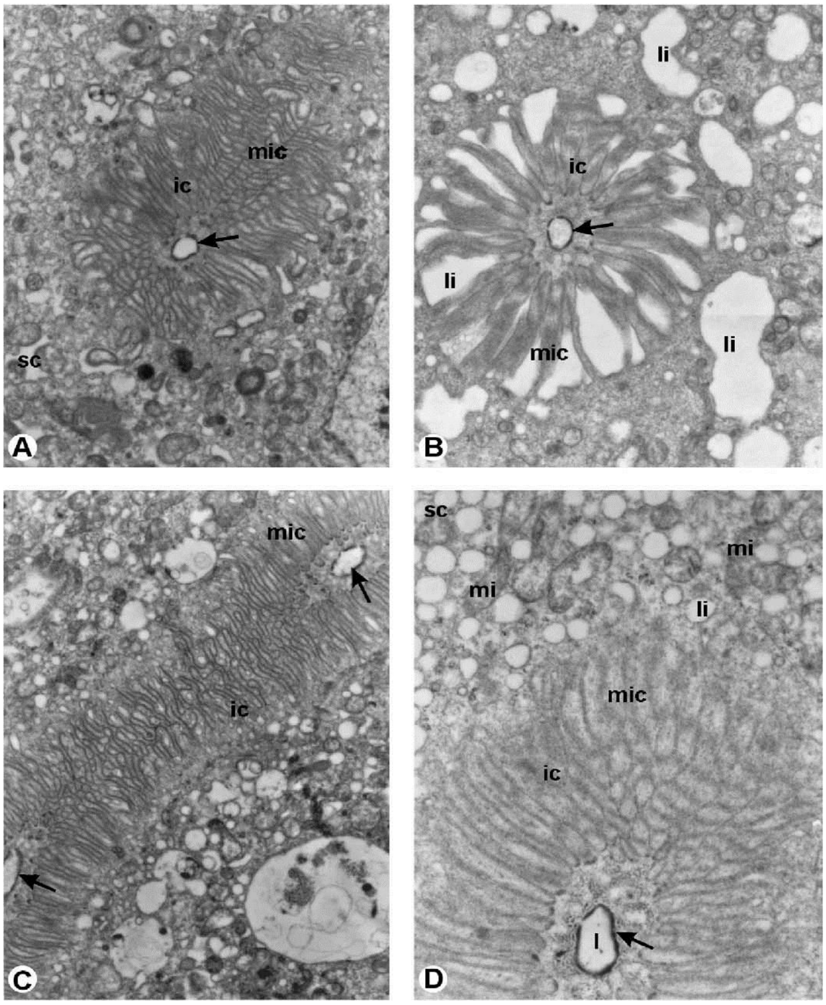

Fig. 8. Mandibular glands of *Atta sexdens rubropilosa*. (A) Media worker. Secretory cell (sc) with intra-cytoplasmic canaliculi (ic). Arrow, cuticle; mic, microvilli. Magnification: 2050x. (B,C) Minima worker. (B) Intra-cytoplasmic canaliculi (ic) with their microvilli (mic) pushed apart due to accumulation of a lipidic secretion (li). Arrow, cuticle. Magnification: 2900x. (C) Longitudinal section of intra-cytoplasmic canaliculi (ic). Arrow, cuticle; mic, microvilli. Magnification: 2050x. (D) Secretory cell (sc) with intra-cytoplasmic canaliculi (ic). Arrow, cuticle; mic, microvilli; l, lumen of the canaliculi; li, lipids; mi,

Vieira et al in 2012 working with metapleural glands of fungus growing and non fungus growing ants observed the morphology and the pgysiology of this organ, in various species representing the derived attines *Trachymyrmex fuscus*, *Atta laevigata*, and *Acromyrmex coronatus*, the basal attines *Apterostigma pilosum* and *Mycetarotes parallelus*, and non-fungus-growing ants of the tribes Ectatommini (*Ectatomma brunneum*) and Myrmicini (*Pogonomyrmex naegeli*) showed the secretions of leaf-cutting ants (*A. laevigata* and *A. coronatus*) and the derived attine, *T. fuscus*, containing a greater variety and larger quantities of volatile compounds than those of myrmicine and ectatommine ants. Compared with basal attines and non-fungus-growing ants, the metapleural glands of leaf-cutting ants produce more acidic compounds that may have an antibiotic or antifungal function. Morphologically they observed that in the metapleural gland of the non–fungus-growing ants and the basal attine ants has fewer secretory cells than that of the derived attine ants (leaf-cutting ants). In addition, the metapleural gland of the latter had more clusters of secretory cells and sieve plates, indicating a greater storage capacity and demand for secretion in these more advanced farming ants. The glands of the derived attine ants also produced higher levels of polysaccharides and acidic lipids than those of Myrmicini, Blepharidattini, and basal attines. These results confirmed the occurrence of morphophysiological differences between the metapleural glands of the derived attines and those of the basal attines and non–fungus-growing ants, suggesting that the metapleural glands of the derived attines (leaf-cutting ants) are more developed in morphology and physiology, with enhanced secretion production (acidic lipids and protein) to protect against the proliferation of unwanted fungi and bacteria in the fungal garden, it is possible that leaf-cutting ants may have evolved more developed metapleural glands in response to stronger pressure from parasites (Figures 9-10).

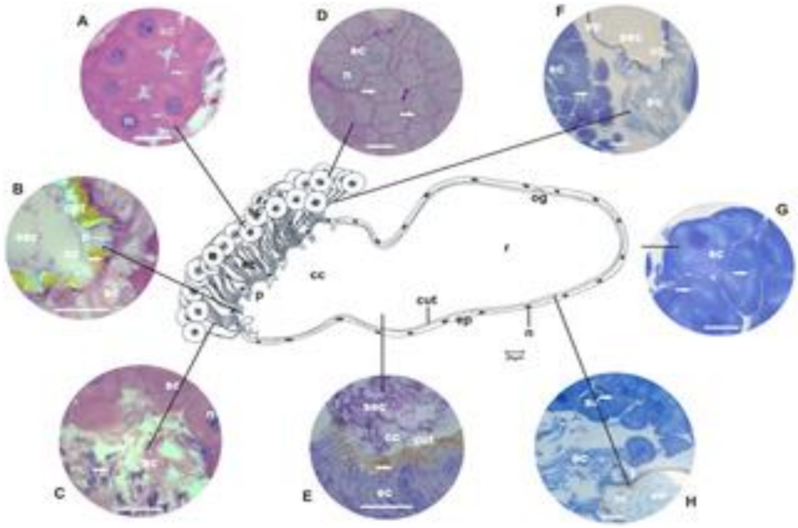

Fig. 9. Schematic representation, histology, and histochemistry of the metapleural gland of the basal ant *Ectatomma brunneum*. Secretory cells (**sc**) and their nuclei (**n**), extracytoplasmic portions of canaliculi (**ec**) and their nuclei (**n**), collecting chamber (**cc**), sieve plate (**p**) and reservoir (**r**) with opening (**og**), lined by epithelium (**ep**) and cuticular intima (**cut**) are shown. **A–C:** Histological sections of the metapleural gland stained with hematoxylin and eosin (staining in nucleus and cytoplasm). Details of secretory cells (**sc**) and their nuclei (**n**), intracytoplasmic (**arrow**) and extracytoplasmic portions of canaliculi (**ec**) with nuclei (**n**). Note canaliculi surrounding the nucleus of the secretory cell and arising individually from each cell and opening in the sieve plate (**p**) of the collecting chamber (**cc**) lined by the cuticular intima (**cut**), and the reservoir storing secretion (**sec**). Scale bar = 25 µm. **D–E:** Histological sections of the metapleural gland stained with PAS/methyl green (for detecting polysaccharides and RNA). Details of the secretory cells (**sc**) showing the cytoplasm, nucleus (**n**), intracytoplasmic (**arrow**) and extracytoplasmic (**ec**) canaliculi, collecting chamber (**cc**), and the lining epithelium (**arrow**) and nuclei of cells (**arrow**). Note the presence of secretion (**sec**) containing polysaccharides in the collecting chamber and reservoir. Scale bar = 25 µm. **F:** Histological sections of the metapleural gland stained with bromophenol blue (for detecting total proteins). Details of the secretory cells (**sc**), intracytoplasmic (**arrow**) and extracytoplasmic (**ec**) portions of canaliculi, and collecting chamber (**cc**) lined by epithelium (**ep**). Note the presence of secretion (**sec**) in the collecting chamber. Scale bar = 25 µm. **G–H:** Histological sections of the metapleural gland stained with Nile blue (for detecting acidic lipids). Details of the secretory cells (**sc**), intracytoplasmic (**arrow**)

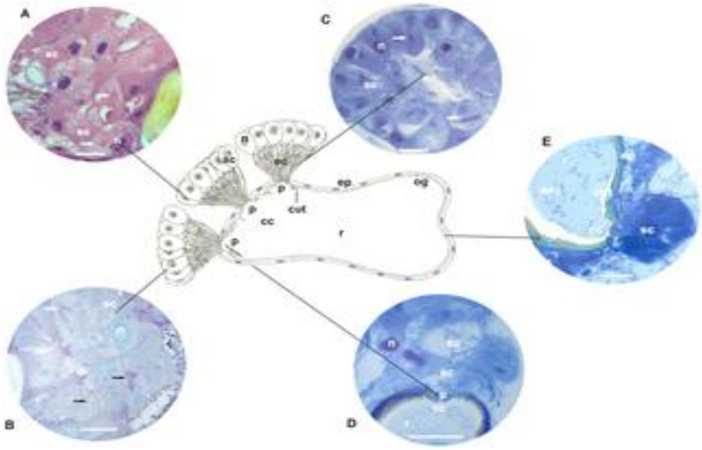

Fig. 10. Schematic representation, histology, and histochemistry of the metapleural gland of *Trachymyrmex fuscus* (Attini). Secretory cells (**sc**) and nuclei (**n**), extracytoplasmic portion of canaliculi (**ec**), collecting chamber (**cc**) and the sieve plate (**p**), and reservoir (**r**) with opening (**og**), both lined by epithelium (**ep**) and cuticular intima (**cut**) are shown. **A:** Histological sections of the metapleural gland stained with hematoxylin and eosin (staining in nucleus and cytoplasm) Details of secretory cells (**sc**) and nuclei (**n**), intracytoplasmic portion of canaliculi (**arrow**). Scale bar = 25 µm. **B:** Histological sections of the metapleural gland stained with PAS/methyl green (for detecting polysaccharides and RNA). Details of secretory cells (**sc**) and nuclei (**n**), intracytoplasmic portion of canaliculi (**arrow**). Note the presence of granules containing polysaccharides in the periphery of the secretory cells (**dark arrow**). Scale bar = 25 µm. **C:** Histological sections of the metapleural gland stained with bromophenol blue (for detecting total proteins). Details of secretory cells (**sc**) and nuclei (**n**) and the intracytoplasmic portion of canaliculi (**arrow**). Scale bar = 25 µm. **D:** Histological section of the metapleural gland stained with Nile blue (for detecting acidic lipids). Details of the secretory cells (**sc**) and nuclei (**n**), extracytoplasmic portion of canaliculi (**ec**), collecting chamber (**cc**) and the sieve plate (**p**), and reservoir (**r**) lined by epithelium (**ep**) and cuticular

All the results presented here can confirm the importance of the morphology as a tool to study and elucidate aspects of the physiology and the behavior of ants, as well as of the other animals.

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CELLULAR BIOMARKERS OF TOXICITY IN ORGANS OF *Atta sexdens rubropilosa* WORKERS TREATED WITH BORIC ACID AND HYDRAMETHYLNON.

E.C.M. SILVA-ZACARIN[1], O.C. BUENO[2], P. DECIO[2], S.S. SUMIDA[2], F.C. BUENO[2] & O. MALASPINA[2]

[1]Departamento de Biologia, Laboratório de Biologia Estrutural e Funcional (LABEF), Universidade Federal de São Carlos (UFSCar), Campus Sorocaba, Rodovia João Leme dos Santos (SP-264), Km 110, Bairro do Itinga, Sorocaba, São Paulo, Brasil, CEP: 18052-780. [1]E-mail: elaine@ufscar.br; [2] Departamento de Biologia, Centro de Estudos de Insetos Sociais (CEIS), Universidade Estadual Paulista (UNESP), Campus de Rio Claro, Avenida 24-A, n.1515, Bela Vista, Rio Claro, SP, Brasil, CEP: 13506-900. [2]E-mails: odaircb@rc.unesp.br; pameladecio@yahoo.com.br; sasumi_si@hotmail.com; fabianacbueno@yahoo.com.br; malaspin@rc.unesp.br.

INTRODUCTION

Leaf-cutting ants are considered important pests in agriculture and silviculture in Brazil, because they cause intense defoliation of plants. Although basic studies have aimed at developing safer alternative control methods for the environment and the general population (Bueno *et al.* 2004 a,b; Batista-Pereira *et al.* 2006), a replacement for chemical control, which is the most effective in on a large scale, has not yet been developed.

Although there are several works for the control of these insects by examining the toxicity of chemical compounds on various species of ants, few are focused on analyzes of morphological changes caused in the ant organs. Histopathological and ultrastructural analysis combined with toxicological bioassays have already been conducted in bees exposed to insecticides (Silva-Zacarin *et al*. 2006; Malaspina & Silva-Zacarin 2006; Cruz *et al*. 2010; Silva-Zacarin *et al*. 2011; Cousin *et al*. 2013; Ferreira *et al*. 2013), whereas in ants, currently only some morphological studies were published (Sumida *et al*. 2010, Decio *et al*. 2013).

The evaluation of the cell biomarkers in the organs would provide the following diagnostics of the side-effects induced by chemical compounds in organs of insets: I- some damages can be repaired and cellular homeostasis is restorable (compensatory response); II- cells that remain viable after intermediate level of damage (compensatory response); III- cells undergo cell death by apoptosis, macroautophagy or necrosis after a high level of damage (non-compensatory responses).

Midgut and Malpighian tubules are organs associated with absorption and excretion, respectively, of chemical compounds and an examination of their morphology can reveal ultrastructural changes induced by chemical compounds (Malaspina & Silva-Zacarin 2006; Silva-Zacarin *et al*. 2011; Gregorc *et al*. 2012). Additionally, the chemical compound absorbed by the gut and not excreted adequately by the Malpighian tubules may remain in the hemolymph and indirectly affect glands that absorb precursors from the haemolymph, such as the postpharyngeal glands of Formicidae.

The current study aimed to analyze histopathological and ultrastructural alterations in the midgut, Malpighian tubules and postpharyngeal glands of adult workers of the leaf-cutting ants, which are exposed to boric acid and hydramethylnon in order to determine the cell biomarkers of toxicity in these organs

MATERIAL AND METHODS

To conduct the toxicological bioassays with the chemical compounds (boric acid and hydramethylnon), adult workers of *Atta sexdens. rubropilosa* were collected from nests maintained in the laboratory, at the Center for Studies of Social Insects (Centro de Estudos de Insetos Sociais-CEIS) of the Institute of Biosciences of UNESP Rio Claro, São Paulo State, Brazil.

Bioassays

To conduct bioassays, worker ants were distributed in autoclaved 10cm Petri dishes (10 ants per dish) covered with filter paper. Each group, essayed in duplicate, was kept on an artificial solid diet throughout the bioassays, as described by Bueno *et al*. (1997). Petri dishes were identified, and maintained in a Biochemical Oxygen Demand incubator at 25°C ± 1°C and with relative humidity above 70%.

Boric acid bioassays: 70 adult workers were distributed in Petri dishes and they were exposed to two sublethal doses of boric acid at the concentrations 0.2 and 0.5% (Klotz *et al*. 2000), added to an artificial diet. In the control group, ants were fed only an artificial diet. Ants used for the morphological analyses were collected randomly from Petri dishes of each group. In total, 18 ants were sampled from each test group (0.2 and 0.5% boric acid), with six ants (n= 6) collected for each exposure time (48, 96, and 168 h). From each group of six ants, three (n= 3) were used for histological examination with a light microscope and the remaining three (n= 3) were processed for ultrastructural analysis by transmission electron microscopy. The control group consisted of ants fed an artificial diet without boric acid, and six ants also were collected, three (n= 3) for the histological analysis and three (n= 3) for the ultrastructural analysis (sampling time, 0 h).

Hydramethylnon bioassays: 50 adult workers were distributed in Petri dishes and they were exposed to sublethal doses of hydramethylnon. Diets with hydramethylnon (treated groups) were offered daily to the insects (0.5 g per dish). Hydramethylnon dissolved either in acetone (HA) or in acetone and soy oil (9 mL of acetone per 1 mL of oil) (HAO) was added to the artificial diet at a concentration of 200 μg/mL (sub-lethal dose for workers, according to Bueno (2005a). Three controls were established: one group received only the artificial diet (diet control), another group received the artificial diet with acetone (acetone control), and a third group received the artificial diet with acetone and soy oil (acetone + oil control). Acetone or acetone and soy oil were added in the same proportions as those used for the hydramethylnon-treated groups. Workers were fed for 4 days and collected and dissected on the 5th day, when symptoms of hydramethylnon toxicity appeared in the treated groups. Ants used for the morphological analyses were collected randomly from Petri dishes of each group (n=6). From each group of six ants, three (n= 3) were used for histological examination with a light microscope and the remaining three (n= 3) were processed for ultrastructural analysis by transmission electron microscopy.

Light and Transmission Electron Microscopy

A. s. rubropilosa workers from the control and experimental groups were immediately dissected after collection at room temperature in 0.6% saline solution under a stereomicroscope with cold light source. The organs (midgut, Malpighian tubules, and postpharyngeal glands) were immediately fixed with 4% paraformaldehyde in 0.1 M sodium phosphate buffer, pH 7.4, for analysis by light microscopy, or they were fixed with 2.5%

glutaraldehyde in 0.2 M sodium cacodylate buffer, pH 7.2 (for 24 h at 4°C) for examination under a Transmission Electron Microscope - TEM.

For the morphological analysis by light microscopy, dissected organs were immersed in fixative solution composed of sodium cacodylate buffer, pH 7.2, and paraformaldehyde 2% for2hat room temperature, washed in 0.1 M sodium phosphate buffer, pH 7.4, dehydrated in a graded ethanol series (70-95%) and later embedded in resin overnight and included in historesin. After microtomy, 5µm-thick histological sections were stained with Hematoxylin and Eosin, mounted in balsam, and later examined and documented with photomicroscope.

For the ultrastructural analysis by transmission electron microscopy, the dissected organs were immersed in fixative solution for 2h at room temperature, washed in sodium cacodylate buffer (0.1 M; pH 7.2), and postfixed in 1% osmium tetroxide, in the same buffer used for the fixative solution, for 2h at room temperature. The material was then washed with buffer (twice for 5 min each), immersed in 10% alcohol (for 15 min), contrasted with 0.5% uranyl acetate before dehydration (for 2h at room temperature), dehydrated in a graded acetone series, and embedded and included in resin Epon-Araldite. Ultrathin sections from the blocks were placed on a copper mesh and contrasted with saturated solution of 2% uranyl acetate in alcohol and 0.4% lead citrate. Observations were carried out with a Transmission Electron Microscope at the Center of Electron Microscopy of UNESP, Rio Claro, SP.

RESULTS AND DISCUSSION

The histological and ultrastructural analysis of the midgut, Malpighi tubules and postpharyngeal glands from worker ants showed morphological alterations induced by boric acid and hydramethylnon, which were classified in compensatory and non-compensatory responses, according to Gregorc *et al*. (2012), which represent cell biomarkers of exposure and toxicity in the analyzed organs (Table 1).

Table 1- Morphological biomarkers that indicate compensatory and non-compensatory responses in cells according Gregorc *et al*. (2012).

Cell Structure	Compensatory Response	Non-Compensatory Response
Microvilli	Shortening, irregular morphology and numeric reduction	Absence or destruction by lyses
Mitochondria	Alteration of the typical electron density of the matrix (increase or decrease), moderated swelling and increasing in the amount of cristae	Membrane disruption, disorganization of cristae, myelin figures in the matrix, exacerbated swelling combined with decreasing in the amount of cristae
Rough endoplasmic reticulum	Vesiculate cisternae or with dilatation, degranulation, alterations in the amount of cisternae (increase or decrease)	Membrane disruption and mylin figures formation
Nucleus	Morphological alteration in nucleus and/or nucleolus, electron density changes (chromatin compaction), dilatation of perinuclear space	Blebbing of condensed nucleus or swelled nucleus with karyolysis

Regarding the ultrastructural characteristics of the midgut and postpharyngeal glands of ants treated with the chemical compounds used in the current study, the data revealed the following features that indicates toxicity: nuclear pyknosis and nuclei with marginalized chromatin, which is indicative of programmed cell death (Bowen, 1990; Bowen *et al*., 1998); and regions of cytoplasmic vacuolization, as well as the presence of autophagic vacuoles, which are indicative of macroautophagy (Silva-Zacarin, 2007; Malagoli et al., 2010).

In the high concentration of both chemical compounds, some digestive cells of *A. s. rubropilosa* exhibited rupture of the apical plasma membrane and the microvilli swelled. Additionally, nuclei with compacted chromatin were observed with an electron-lucent perichromatin halo, resulted from a centripetal retraction of the chromatin (Silva-Zacarin et al. 2007), in addition to nuclear blebs.

Regarding Malpighian tubules, in the experimental groups treated with boric acid and hydramethylnon, it is important to point out to the decrease in mineralized granules in the excretory cells and/or the reduction of concentric rings inside the granules. According to Caetano and Cruz-Landim (1983), these granules are composed of metabolic residues from hemolymph filtrates, which indicate that cells in high metabolic activity store large quantities of granules (Arab and Caetano, 1999). In the current study, concretions (or mineralized granules) of the Malpighian tubules may be in different stages of organization, which could represent a pathway to a complete degeneration (loss of concentric rings) or an indication of early states of cell death, forming myelin figures that could be a progression of morphological changes of concretions, as observed in the gut and Malpighian tubules of *A. s. rubropilosa* of experimental groups. Based on the assumption that cells in high metabolic activity store large amounts of granules, if cells of the midgut and Malpighian tubules lose their activity in response to the exposure to boric acid, the concentration of metabolic residues tend to decrease in the granules, which would explain the loss of electron-dense concentric rings.

The results of the current study support the importance of using toxicological bioassays combined with morphological analysis of organs from ants chronically exposed to insecticides of commercial ant baits. The midgut is the first organ to be affected, followed by the postpharyngeal gland, and the Malpighian tubules. This sequence is in agreement with the absorption pathway of this chemical compound in the midgut, its transference to the hemolymph, possibly reaching the postpharyngeal glands, and its excretion by the Malpighian tubules.

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INTRAMANDIBULAR GLANDS OF FORMICIDAE: PHYLOGENY, POST-EMBRYONIC DEVELOPMENT, CASTE DIFFERENCES AND CHEMICAL COMPOUNDS

L.C.B. MARTINS[1] & J.E. SERRÃO[2]

[1]Laboratório de Ultraestrutura de Insetos/Departamento de Biologia Geral/Universidade Federal de Viçosa, Avenida P.H.Rolfs, s/nº, CEP 36.570-000, Viçosa, MG, Brasil, Email: luiza.martins@ufv.br. [2]Departamento de Biologia Geral. Universidade Federal de Viçosa. Viçosa-MG, Brazil. E-Mail: jeserrao@ufv.br

Ants are especially rich in exocrine glands: 75 exocrine glands varying in their structural, chemical, and functional complexity (Billen & Delsinne, 2013; Billen & Morgan, 1998; Caetano *et al*., 2002) are currently known among the Formicidae (Billen, 2009a).

Insect exocrine glands are traditionally classified in three main classes, class-1, class-2 and class-3 glands (Noirot & Quennedey, 1974). Besides these three classes of glands, in Attini a different epitelial gland with reservoir occurs (Amaral & Caetano, 2006; Billen, 2009; Martins & Serrão, 2011).

Unlike the mandibular glands that are the most studied, the current knowledge regarding intramandibular glands is restricted to occurrence and descriptive morphology in adult ants (Billen & Espadaler, 2002; Billen & Delsinne, 2013; Grasso *et al*., 2004; Martins & Serrão, 2011; Martins *et al*., 2013; Ribeiro & Caetano, 2000; Roux *et al*., 2010; Schoeters & Billen, 1994), so further studies of these glands should be conducted to determine the functions that remain unknown.

Comprehension of phylogenetic, ontogenetic, morphological and chemical features of intramandibula glands in ants may contribute to the elucidation of the mechanisms involving the exocrine system and their relationships with functional and behavioral aspects in different Formicidae. Considering the above, this study focused intramandibular gland of Attini and Ponerini.

PHYLOGENETIC ANALYSIS

Mandible of 17 species of Attini and Ponerini were dissected and subjected to histology and histochemistry (Bancroft & Gamble, 2007; Pearse, 1985).The comparison of the intramandibular glands between these species resulted in a seven character matrix, which was evaluated for phylogenetic comparison. The characters were polarized, based on a comparison, using *Camponotus rufipes* (Fabricius, 1775) (Formicinae) as the out-group (Maddison *et al*, 1984; Nixon & Carpenter, 1993; Watrous & Wheeler, 1981).

The study of intramandibular glands in Attini and Ponerini show that there are three class of intramandibulares glands in ants (Fig. 3 A, B and C), that the occurrence of such glands vary according to tribe, and can be used as phylogenetic characters. Although class-1 gland cells are lacking in Attini, these ants have epitelial glands with reservoir. This difference can be used as a phylogenetic character that differentiates Ponerini of Attini (Fig. 1 and 2).

POST-EMBRYONIC DEVELOPMENT

In this study, mandibles of prepupae, white-eyed, pink-eyed and black-eyed pupae, pupae of pigmented body, and adults of *Pachycondyla verenae,* were dissected and subjected to histological and histochemical tests.
The intramandibular glands differ during pupation, together with the tegument differentiation of the mandible (Cruz-Landim & Abdalla, 2002; Martins *et al.*, 2013). The results of this study indicates that the class-1 and class-3 glands differentiate during pupation, beginning their development in pink eyed pupae and are fully developed in black eyed pupae (Fig. 4 A-F).

DIFFERENTIATION BETWEEN CASTE

This study investigated the occurrence of intramandibular glands in castes and subcastes of the ant *Atta laevigata*. Mandibles of queen, soldier and major and minor workers were submitted to histological, histochemical and morphometric analyses.

Different of intramandibular glands found in species of *Pachycondyla*, *A. laevigata* has not class-1 glands, but showed class-3 glands and epitelial glands with reservoir. The class-3 glands in queens show cell area of 241.04 μm^2, while the soldier, major and minor workers have cellular areas of 272.76, 138.64 e 108.56 μm^2, respectively.

The size of the cell area of the class-3 glands show significant differences in caste (($F = 34.60$; $p < 0.0001$) (Figure 5).

In *A. laevigata*, the intramandibular glands, in different castes, may indicate individualized and specific functions of each caste. According Cruz-Landim (2009), Hernández *et al.* (1999), Hughes *et al.* (2001), and Nascimento *et al.* (1993), the composition of the pheromones or chemical substances, may vary between castes of ants. Our findings suggested that in the different castes of *A. laevigata* intramandibular glands may be release pheromones attractive in queens and alarm pheromones in soldier, and in major and minor workers a different function to be determined.

CHEMICAL COMPOUNDS

For the study of the chemical compounds, chemical profiles of the body and mandibular of queens and workers were obtained by a non-destructive technique using solid phase microextraction (SPME). The fibers were immediately injected in GC-MS - gas chromatography and mass spectrometry analyses.

In order to study the effects of exocrine gland secretions on the behavior of the ant, *Pachycondyla villosa*, identification of body surface and intramandibular gland compounds was performed and was followed by behavioral analyses. These analyses revealed a significant increase in walking time for ants exposed to nestmate mandible extract. Fifteen different compounds were identified in workers and queens (Fig. 6). The cholesterol and sitosterol were found only in the mandibles. Results suggest that intramandibular glands compounds of *P. villosa* may play a role as indicators of nestmate recognition or worker activity. The presence of hydrocarbons and sterols in workers and queen and higher concentration of sistosterol in the mandible of queens may be associated with caste profile, since according to Blomquist & Bagnères (2010) and Howard & Blomquist (2005), behavior which require rapid dispersion of chemical signals such as alarm, may involve pheromones with small molecules and volatiles, although many other social insects present mechanisms of communication which are involved non-volatile compounds.

CONCLUSION

Studies of the ontogeny, morphology and physiology and chemical composition of intramandibular glands of ants may contribute to the elucidation of the mechanisms involving the exocrine system and its relationship to the behavioral aspects and phylogenetic in different subfamilies of Formicidae. We can infer that the intramandibula glands of different tribes and castes produce different substances, indicating different functions

ACKNOWLEDGMENTS

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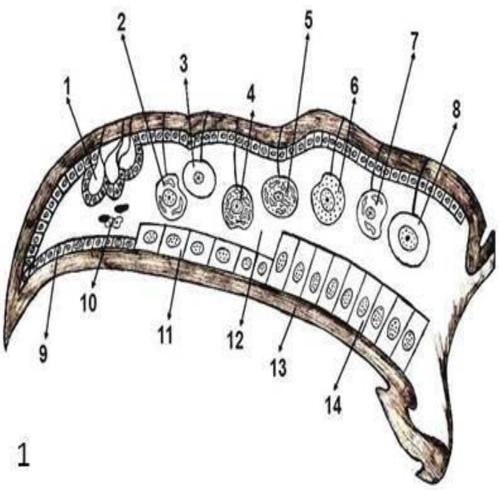

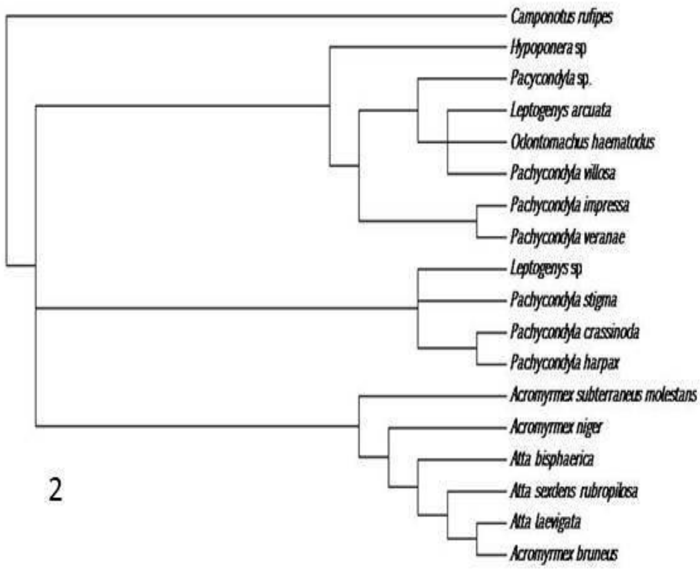

Figure 1: Mandibles of ants. Evaluated characters of the intramandibular glands for phylogenetic analysis. Schematic drawn showing the different cells found in the mandible of ants (1) epitelial glands with reservoir; (2) class-3 glands with few vacuoles and developed nucleus; (3) class-3 glands without vacuole; (4) class-3 glands with many vacuoles and developed nucleus; (5) class-3 glands vacuolated and with small nucleus; (6) class-3 glands with granules; (7) class-3 glands with few vacuoles and small nucleus; (8) class-3 glands without vacuole and developed nucleus; (9) epidermis with flattened cells; (10) other cell types; (11) class-1 glands with cuboidal cells; (12) hemocoel; (13) cuticle; and (14) class-1 glands with columnar cells. (draw without scale)].

Figure 2. Phylogenetic relationships based on intramandibular gland characters. Notice three clades: one for all Attini and another two for Ponerini.

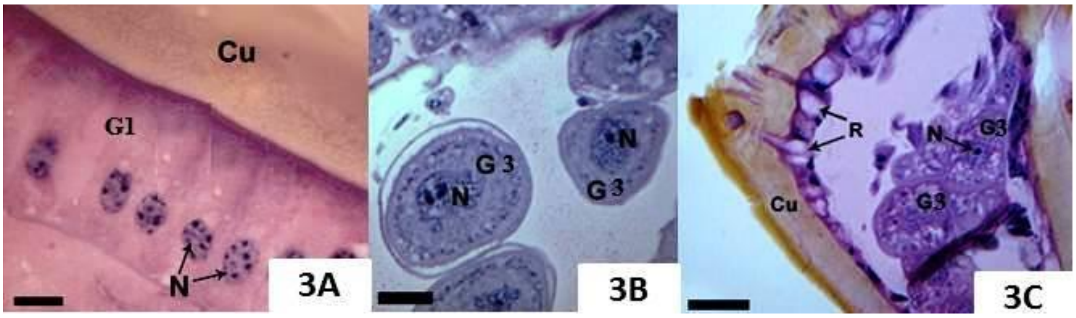

Figure 3. Histological section of the mandible. **A:** *Pachycondyla crassinoda* showing columnar cells of class-1 glands (G1) **B**: *Pachycondyla impressa* showing class-3 glands (G3). **C:** *Acromyrmex subterraneus molestans* showing epitelial glands with reservoir (R) end class-3 glands (G3). **Cu**: cuticle, **N**: nucleus.

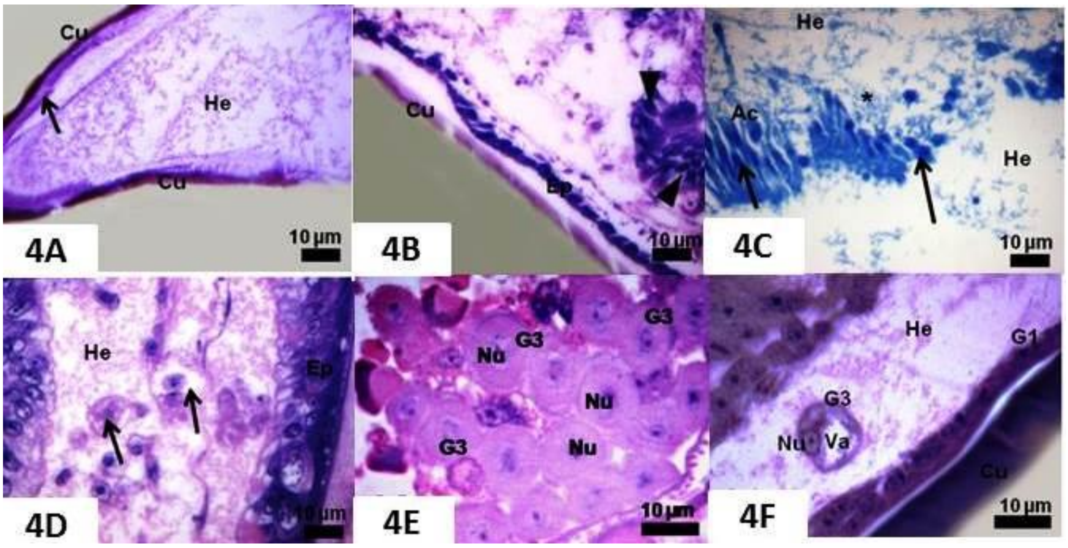

Figure 4. Histological section of mandible of *Pachycondyla verenae.* **A**: Prepupae. flattened epidermis (arrow) and mandibular cavity, hemocoel (He). Hematoxyline and eosin stained. **B**: White-eyed pupae. Epidermis (EP) with flattened cells and irregular cells in the mandible cavity with small nucleus (arrowheads). Hematoxyline and eosin stained. **C:** White-eyed pupae. Cell aggregate (Ac) and flocculent material (*) into mandible cavity positive (arrows) for protein. Mercury-bromophenol blue stained. **D:** Pink- eyed pupae. class-3 glands precursor cells (arrows) with light cytoplasm into mandible cavity. Hematoxyline and eosin stained. **E:** Black-eyed pupae. class-3 glands (G3) showing homogeneous acidophilic cytoplasm. Hematoxyline and eosin stained. **F:** Body pigmented pupa. Well developed class-1 glands (G1) and class-3 glands (G3) with cytoplasm vacuoles (Va). Hematoxyline and eosin stained. **Ep**: epithelium. **He**: hemocoel. **Cu**: cuticle. **Nu**: nuclei.

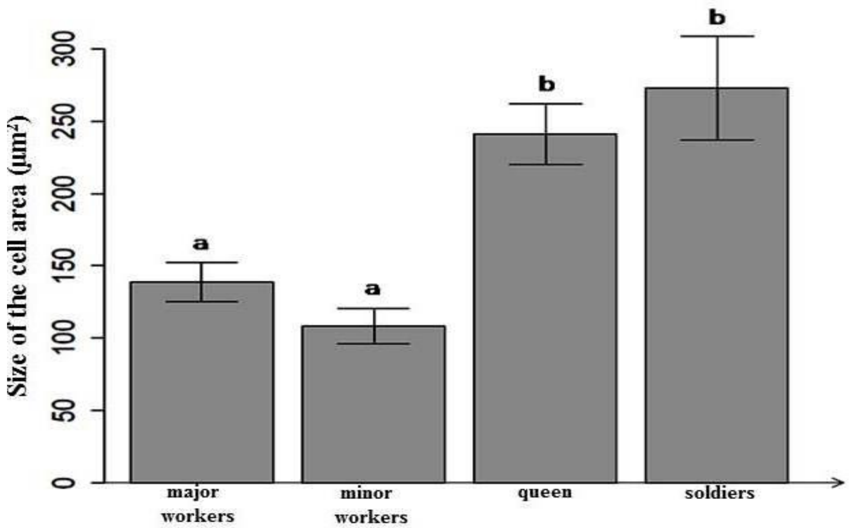

Figure 5. Morphometric ration between the size of the cell area (µm2) of class-3 glands and ant castes (queen, soldier, worker major and minor workers). The size of the cell area was significantly different between castes (p <0.0001), however, there was no difference between major worker and minor worker, nor between queen and soldier.

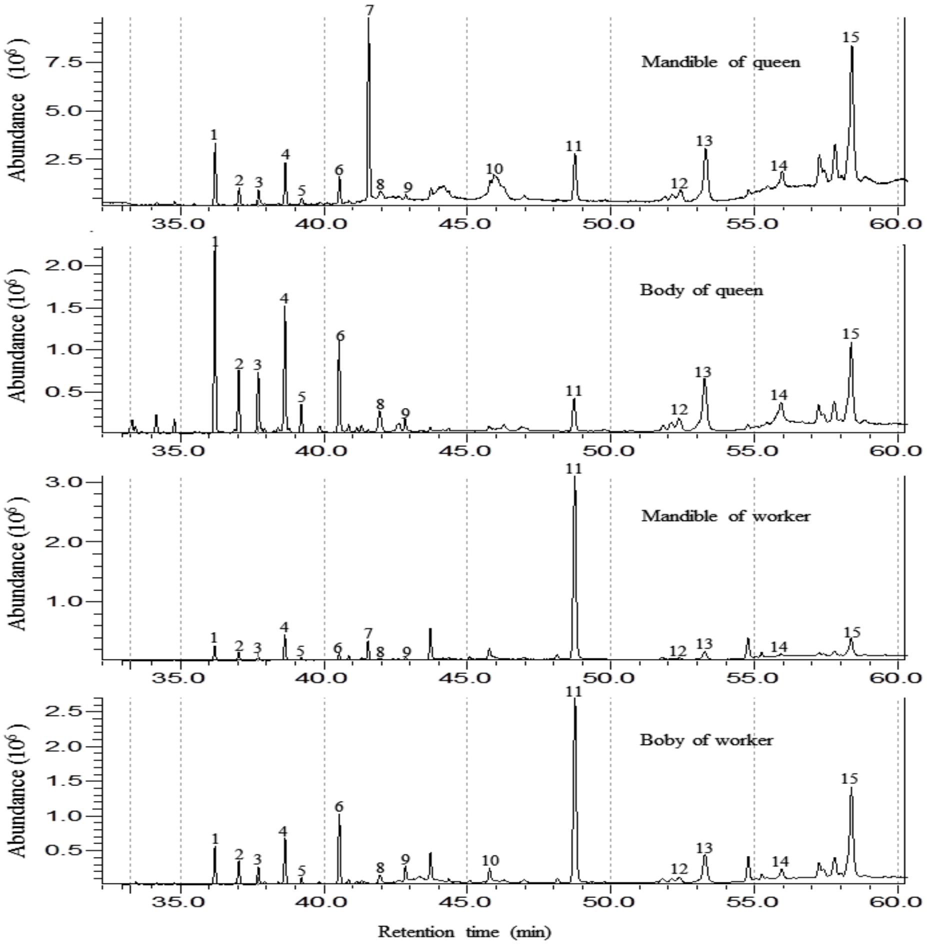

Figure 6. Chromatograms of the chemicals found in the mandible and body surface of *Pachycondyla villosa* queens and workers. Peaks: **1**= C26; **2**= C27; **3**= 13-,11- MeC27; **4**= C28; **5**= 3-Me C29; **6**= C30; **7**= Cholesterol; **8**= 13-; 11- Me C32; **9**= 13-;11-Me C33; **10**= Sitosterol; **11**= Octacocil acetate; **12**=C36; **13**= 13-MeC36 ; **14**= 15-;19-; 13-;17-DiMe-C37 ; **15**= 18-; 17-; 13-Me C38

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RT 4
BIODIVERSITY INVENTORIES AND CHARACTERIZATION OF THE ANT COMMUNITY STRUCTURE

INTENSIVE ANT BIOTIC SURVEYS: LESSONS FROM IBISCA-PANAMA AND NEW PERSPECTIVES

M. LEPONCE[1], J.H.C. DELABIE[2], W.D. DA ROCHA[2], I.C. DO NASCIMENTO[2], A.F.R. CARMO[2], J. ORIVEL[3], B. CORBARA[4,5], S. RIBEIRO[6], R. CAMPOS[6], R. DIDHAM[7], J. SCHMIDL[8], Y. BASSET[9] & A. DEJEAN[3]

[1]Biological Evaluation Section, Royal Belgian Institute of Natural Sciences, 29 rue Vautier, 1000 Brussels, Belgium, Maurice.Leponce@naturalsciences.be ; [2]Laboratório de Mirmecologia, Convênio UESC/CEPLAC, Centro de Pesquisas do Cacau – CEPEC, CEPLAC, Caixa Postal 7, 45600-970 Itabuna, Bahia, Brasil ; [3]Écologie des Forêts de Guyane (UMR-CNRS 8172), Campus Agronomique, 97379 Kourou cedex, France ; [4]CNRS - UMR 6023, Laboratoire Microorganismes, Génome et Environnement, Université Blaise Pascal, Complexe Scientifique des Cézeaux, Aubière, France, [5]Clermont Université , Université Blaise Pascal, LMGE, BP 10448 F-63000, Clermont-Ferrand, France ; [6]Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Department of Biodiversity, Evolution and Environment/ICEB, Universidade Federal de Ouro Preto, Campus Morro do Cruzeiro, Ouro Preto, MG 30400-000, Brazil; [7]School of Animal Biology, The University of Western Australia (M092), 35 Stirling Highway, Crawley Wa 6009, Australia; [8]Universität Erlangen-Nürnberg, staudtstr. 5, D-91058 Erlangen; [9]Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancon, Panama City, Republic of Panama.

We will present results from the IBISCA-Panama project on the ant distribution among forest strata (i.e., the ground, understorey and canopy) and the efficacy of a wide array of entomological methods to collect ants. The survey was conducted during one year in the San Lorenzo Protected Area, Panama, between October 2003 and 2004. The global aim of the survey was to assess the spatio-temporal distribution of a wide range of arthropod taxa and to estimate their total local species richness. We used 11 methods to sample ants from 11 sites separated from each other by less than 2 km. Some methods were focused on a single forest strata or microhabitat (*ground*: Winkler extracts of leaf-litter, pitfall traps; *understorey*: Malaise traps, palm tree inspection, ground Flight Intercept Traps; *canopy*: tree climbers, insecticidal fogging). Three methods were used at both the ground and canopy level (i.e., Berlese extracts of soil, beating the vegetation, light traps). Finally, aerial Flight Intercept Traps (aFITs) were installed at 7 different heights from the ground (0m) to the canopy level (35m). Altogether 410 species were collected. Around ¼ of the species were found foraging in all forest strata. Approximately 2/3 of the species were found either at the ground or canopy level but only 1/5 of the species were only found at one of these levels. Half of the species were found at the understorey level and 10% of the species only in this strata. The 90 aFITs used during a year (16,244 trapping days) captured more than half the local species richness. Without taking into account the sampling and processing effort, the three most efficient methods to collect ants were aFITs, Winkler and fogging. While the Winkler extraction of leaf-litter ants has long been recognized as an efficient method in the standardized A.L.L. protocol for collecting ground-dwelling ants, the efficacy of aerial Flight Intercept traps was unexpected. This method may offer a promising avenue for developing a much needed standardized protocol for collecting arboreal ants. This standardization of methods for collecting both ground and arboreal-dwelling ants would facilitate between site comparisons of species diversity. Beside traps, other approaches to collecting arboreal ants will be presented including the use of baits, canopy cranes or balloons. Finally methods that increase our knowledge of arboreal species biology will be discussed (e.g. aggressivity tests or tree felling experiments).

RAINFOREST ANTS REVEALED: A PROJECT ALAS RETROSPECTIVE

J.T. LONGINO

Department of Biology, University of Utah, Salt Lake City, UT 84112, USA, e-mail: jacklongino@gmail.com

The Arthropods of La Selva (ALAS) project was among the first large-scale inventories of insects, mites and spiders in the tropics, and ants were a major focus. The project ran from 1991–2006, at La Selva Biological Station of the Organization for Tropical Studies (OTS), funded by a series of U.S. National Science Foundation grants. Project ALAS drew together the expertise of systematists and ecologists to uniquely combine taxonomic expertise and structured sampling. ALAS carried out an intensive regimen of quantitative sampling, structured to allow species richness estimation and statistical assessment of inventory efficiency and completeness. In the process it developed novel analytical and statistical techniques and publicly available software for quantitative inventory and biodiversity statistics. The project culminated in the sampling of the Barva Transect, a continuously forested elevational gradient from La Selva to the peak of Volcan Barva at 2900m elevation. The results from the ALAS survey have made major contributions to global change biology and continue to be a long-term resource.

ANT COMMUNITIES LONG TERM MONITORING: LTER, TEAM OR SELF INITIATIVES?

S.P. RIBEIRO[1] & R. FAGUNDES[1,2]

[1]Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Department of Biodiversity, Evolution and Environment/ICEB, Universidade Federal de Ouro Preto, Campus Morro do Cruzeiro, CEP 30400-000, Ouro Preto, MG, Brazil,. [2] Post-Graduate Program in Ecology and Conservation of Natural Resources, Laboratory of Behavioral Ecology and Interactions, Universidade Federal de Uberlândia, CEP 38400-902, Uberlândia, MG, Brazil

We present preliminary results related to long term data collecting protocols, taken from two State Parks of Minas Gerais, Brazil, within the same macro river basin, at distinct altitudes: Rio Doce (200 m a.s.l., lowland semidecidual forest) and Itacolomi (1200 m a.s.l. montane forest) Parks. Data were taken with canopy beating, baits, pit-fall or winkler sampling. Protocols were part of a Long Term Ecological Research (LTER) plus a Tropical Ecological Assessment and Monitoring Initiative (TEAM) in Rio Doce, and of an independent sampling protocol in Itacolomi. From Rio Doce, data was taken from 2000-2007 and then again from 2010-2013. From Itacolomi, data collecting started in 2006 and last until the present. Except from TEAM´s winkler´s protocol, all sampling points were the same (same canopy and understorey trees and surrounding grounds) and samples were repeated twice a year. As expected, soil fauna was significantly richer than canopy fauna regardless altitude. However, high altitude montane forest was poorer in species in all habitats compared to lowland forest, and thus required fewer samples to get the species richness estimator stabilized. When samples were joined by years, we found an increase from 11.93 mean species per sample in one year to 52.64 in five years sampling. From the first to the second year the number of species more than doubled, and kept increasing steadily until the fourth year, which was not statistically different from the fifth year. Our data suggest that species shift is an intense process along time at a very local scale. However, data refining and interaction experiments are required to elucidate the mechanisms behind the found patterns. Other long term examples from Brazil are also acknowledged.

LEAF-LITTER ANT GUILD STRUCTURE AND MORPHOLOGICAL DIVERSITY IN A WESTERN AMAZONIAN FOREST SITE: FOUR YEARS OF SAMPLING.

R.R. SILVA[1] & C.R.F. BRANDÃO[2]

[1]Museu Paraense Emílio Goeldi, Coordenação de Ciências da Terra e Ecologia, Av. Perimetral 1901, CEP 66077-530, Belém, PA, Brasil, e-mail: rogeriorosas@gmail.com; [2]Museu de Zoologia da Universidade de São Paulo, Laboratório de Hymenoptera.

Biological inventory is a crucial activity in life sciences research. Long-term ecological studies are important to enable insights in ecology, environmental change and biodiversity. It is, however, time-consuming and laborious to amass representative samplings of communities, especially in the case of invertebrates. Among ants, the leaf-litter fauna is considered a hyperdiverse segment with comparatively high levels of taxonomic and morphological diversity at local and regional scales. Here we describe a regional leaf-litter ant fauna biodiversity using a morphological approach and guild classification. As a study system, we used data on the ant fauna along four years of leaf-litter surveys in sites located in the Western Amazonia. We sampled eight regularly distributed 250 m-long transects over 5 km^2 plots, spaced 1 km between them, and six 5 km^2 plots along 70 km of the Rio Madeira River, distributed at the left and right margins of the River (three paired plots). Sixteen sampling events were performed along four years (four samplings/year; two in the rainy season and two in dry period). In each sampling period, five random transects were surveyed in each plot and five 1 m^2 leaf-litter samples collected at 50-m intervals along each transect. In total, 48 250 m-long transects were sampled. After four years of plot monitoring, we accumulated 2,305 1m^2 leaf-litter samples. Each leaf-litter ant species was described in terms of morphological traits recognized as important in ant ecology. We used these two data sets (community and morphology) in a long term sampling monitoring to describe biodiversity, community structure, guild composition and sampling completeness of the leaf-litter ant fauna. We registered 23,973 occurrences of individuals belonging to 283 species. Further, each transect was characterized in terms of soil structure (relative proportion of silt, clay and sand), density of vegetation at five height classes (0-1m, 5-10m, 10-15m, 15-20m, > 20m) and topography. We discuss the importance of an objective guild determination to describe the structure of ant communities in a hyperdiverse ant fauna - the leaf-litter in an Amazonian forest. We discuss also the dynamics of guild composition along time and the importance of long term studies to describe the leaf-litter ant fauna structure. (FAPESP)

RT 5

THE IMPORTANCE OF INTEGRATIVE STUDIES INVOLVING TAXONOMY, ECOLOGY AND ETHOLOGY

"WE HAVE THE SAME ANTENAS, BUT OUR CHROMOSOMES SEEM DIFFERENT": CONTRIBUTION OF CYTOGENETICS IN ANT INTEGRATIVE TAXONOMY

C.S.F. MARIANO[1] & J.H.C. DELABIE[2]

[1,2]Universidade Estadual de Santa Cruz/DCB, CEP 45662-900, Ilhéus, Bahia, Brazil. [2]Laboratório de Mirmecologia, Centro de Pesquisa do Cacau, CEPLAC, CEP 45600-970, Itabuna, Bahia, Brazil.
camponotu@hotmail.com, jacques.delabie@gmail.com

The integrative taxonomy is characterized by the use of tools of modern biology in complementary and interdisciplinary studies whose results can be grouped and chosen as criteria for recognition of species. In this kind of approach, disciplines such as molecular genetics, ecology, behavior, cytogenetics, chemistry, among others, contribute to complete the classic approach to taxonomy. During the last 40 years cytogenetics has become one of the most proeminent discipline in integrative taxonomy Schlick-Steiner (2009) and Lorite & Palomeque (2010). Recent studies on several genera of Neotropical species of the tribe Ponerini (Ponerinae) Lorite & Palomeque (2010) have shown that these ants are more diverse than generally thought, with examples of cryptic sympatric species, or taxa constituted by allopatric (sometimes, sympatric too) populations being cytogenetically different, with or without morphological characters allowing us to distinguish them Mariano *et al*. (2006, 2012). That is the case, for example, in *Pachycondyla* spp. *sensu* MacKay & MacKay (2010) of the species groups *Harpax*, V*illosa* or A*picalis*, and in *Dinoponera* spp. Santos *et al.* (2013) or *Thaumatomyrmex* spp. of the *Mutilatus* species group. On the other hand, the same kind of studies showed that populations of some other Ponerinae and with a large distribution seem rather homogeneous from the cytogenetic point of view, even in apparently isolated populations, such as in *Odontomachus* spp. Santos *et al.* (2010), *Pachycondyla constricta* or *Thaumatomyrmex atrox*, suggesting the recent geographical expansion of these species. Our results are put in parallel with those of Imai, Crozier, Crosland and Taylor when they studied the cytogenetic structure of populations of the Australian genus *Myrmecia* (Myrmeciinae) Imai *et al.* (1988, 1994).

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UNITY MAKES STRENGTH: UNRAVELING CRYPTIC DIVERSITY IN *Pachycondyla* ANTS THROUGH A MULTIDISCIPLINARY APPROACH.

R.S. FERREIRA

Universidade Federal de Lavras, Departamento de Biologia, Setor de Ecologia, Laboratório de Ecologia e Conservação de Invertebrados, Lavras, Minas Gerais, Brasil, CEP: 37.200-000. E-mail: ronararonara@yahoo.com.br

The taxonomic challenge posed by cryptic species underlines the importance of using multiple criteria in species delimitation. Indeed, concordant changes in several characteristics of an organism, and corroboration from independent data constitute better evidence for separating species. A multidisciplinary approach can be compared to a jigsaw puzzle in which each piece has only a small part of the picture on it. However, as they are put together, we start to realize which scenario is hidden behind it. In Ferreira *et al.* (2010), we could confirm by the corroboration of acoustic, morphological and genetic data the taxonomic status of several morphs in the Neotropical *Pachycondyla apicalis* species complex as valid new species. Our results also suggested that the diversity inside this complex can reach up to nine cryptic species with varying levels of divergence. Given that these cryptic species were until recently deemed as only three distinct species (Wild 2005), their biological and ecological characteristics were always mixed together. Thus the two most widespread and studied species, *P. apicalis* and *P. verenae* were considered to present high intraspecific levels of variation in such aspects (Fresneau *et al.* 1994, Wild 2005, Delabie *et al.* 2008). However, studies on cryptic complexes of diverse groups of insects, especially herbivores and parasites, have shown that presumed generalist species were indeed groups of specialists (Hebert et al. 2004, Blair et al. 2005, Stireman *et al.* 2005, Smith *et al.* 2006, Kankare *et al.* 2005) and that some phenotypic traits, sometimes of other life stages than adults, were not only intraspecific variation but cryptic species-specificities also clearly correlated to ecological, behavioural and genetic traits (Hebert *et al.* 2004). In social insects like ants, such variations and specializations can encompass the social organization of the colonies as well as their different castes (Hölldobler & Wilson 2009). Moreover, intra and interspecific relationship in ants are much more diverse than in most non-social species, and this leads to increased complexity in the signals involved, which can provide additional cues of species diversification. For all these reasons, we explored further aspects of the biology, ecology and behaviour of the *P. apicalis* species complex searching for new evidence to facilitate the identification of these cryptic species and better understand the characteristics that can represent idiosyncrasies of each taxon. We performed a biometric study of the ants, a chemical analysis of their cuticular hydrocarbons and also a comparative study of the reproductive systems, male phenotypes as well as ecological preferences for nesting sites and foraging activity in ants from sympatric and allopatric populations in Brazil, French Guiana and Mexico. In sum, this integrative study resulted in important discoveries about cryptic speciation in the complex *P. apicalis*. It reinforces our previous findings (i.e. Ferreira *et al.* 2010) and also provides new pieces of evidence towards the resolution of the taxonomic puzzle and a better understanding of the biology, ecology, and behaviour of these cryptic ants.

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SPECIES DISCOVERY AND NATURAL HISTORY STUDIES ARE ESSENTIAL FOR UNDERSTANDING THE EVOLUTION OF FUNGUS-GROWING ANTS

T.R. SCHULTZ

Department of Entomology, Smithsonian Institution, POB 37012, NHB, CE516, MRC 188 Washington, DC 20013-7012, U.S.A., e-mail: schultzt@si.edu

Recent discoveries of new fungus-farming ant (Attini) species continue to change our models of the evolutionary histories of the Attini and of their cultivated fungi. Most recently, *Apterostigma megacephala* and a newly described genus and species have been found to occupy nearly basally diverging phylogenetic positions in the Paleoattini and Neoattini, respectively. Studies of these and other poorly known species, including *Mycetagroicus cerradensis* (Solomon et al., 2010) and Mycetagroicus inflatus (Jesovnik et al., 2013) have included descriptions of nest architecture, males, gynes, larvae, and, perhaps most interesting, cultivated fungi. Understanding the identities and associations of the attine fungal cultivars has particularly important implications for fungus-farming ant evolution.

Twenty-five years ago, the null hypothesis for the attine ant-fungus symbiosis was one of strong symbiont fidelity and tight cospeciation/cocladogenesis (Weber, 1972, Weber, 1979) because: (i) fungal cultivars are transmitted vertically from parent to daughter colonies (Ihering, 1898), (ii) ant-cultivar associations are remarkably faithful at the level of the major agricultural systems (Chapela et al., 1994), and (iii) particular associations of ants and cultivars were expected to become coadapted and "optimized" by coevolution (e.g., (Mueller, 2002, Mueller et al., 2011). Researchers were therefore surprised to subsequently discover that (i) evolutionarily frequent switching in ant-cultivar associations has occurred *within* each of the agricultural systems (e.g., (Mueller et al., 1998, Green et al., 2002)); (ii) the leafcutter cultivar is a single species that is widespread (North, Central, and South America, the Caribbean) and devoid of any detectable population structure, certainly none correlated with ant host association or geography (Mikheyev et al., 2006, Mikheyev et al., 2007); and (iii) according to one study (Mikheyev et al., 2010), this species is significantly younger than the clade of leafcutter ants (~40 species) that cultivates it. According to the same study, lower attine "Clade 2" is also significantly younger than its associated ants.

As a result of such discoveries, the current null hypothesis is one of weak symbiont fidelity and "diffuse coevolution" so that, within each of the agricultural systems, associations between ants and fungi are expected to be random (Mikheyev and Mueller, 2007, Mikheyev et al., 2006, Mikheyev et al., 2010). But this overly general hypothesis fails to capture a reality that is clearly much more nuanced. For example, unlike lower attine fungal cultivars, which are facultative symbionts capable of a feral existence apart from ants, higher attine fungi are obligate ("domesticated") symbionts that are never found apart from ants and that possess adaptations such as "gongylidia," (Möller, 1893, Wheeler, 1907) nutritious food bodies that are preferentially harvested by the ants for food and within which large quantities, relative to its expression in lower attine fungi, of a particular laccase enzyme are expressed (De Fine Licht et al., 2013). It is thus highly likely that higher attine ants and fungi are products of a prolonged period of coevolution. At least two other derived groups of ants and fungi, pterulaceous agriculture and yeast agriculture (Mehdiabadi and Schultz, 2009, Schultz and Brady, 2008), likely also originated by coevolution. If so, then in each case ancestral ants and fungi must have been intimately associated, i.e., demonstrated strong symbiont fidelity, over significant evolutionary time periods.

Recent research in the Smithsonian AntLab suggests that attine fungi should be more frequently collected and preserved in the field so that variation in symbiont fidelity across attine species may be better understood. In one study of the *Cyphomyrmex wheeleri* group of fungus-farming ants, particular ant species have been associated with particular fungal species for as many as 10 million years and rare switches in cultivar association may even have driven the origin of new ant species (Mehdiabadi et al., 2012). In a second study of the poorly known genus *Mycetagroicus,* two of the four species, separated by more than 1000 km of Brasilian cerrado, cultivate the same fungal species (Jesovnik et al., 2013). These results are consistent with prolonged, strong symbiont fidelity in these groups. Significantly, *Mycetagroicus* and the *C. wheeleri* group are thought to be the closest relatives of the higher attine ants (Schultz and Brady, 2008), suggesting that an increase in symbiont fidelity may have preceded the origin of higher agriculture.

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TROPICAL MONTANE ANTS: TAXONOMIC AND ECOLOGICAL APPROACHES

J.T. LONGINO

Department of Biology, University of Utah, Salt Lake City, UT 84112, USA, e-mail: jacklongino@gmail.com

Tropical mountains show sharp patterns of ant species richness and species turnover. Joint efforts of taxonomists and ecologists have the potential to reveal the contemporary and historical forces shaping those patterns.

Taxonomists attempt to delimit species along elevational gradients, typically using morphological characters. Characters are examined and names are applied. Species can be characterized with respect to geographic and elevational range. With increasing use of sequence data, we can more confidently examine evolutionary histories. Do species show evidence of ecological speciation along gradients, with sister taxa being lowland-upland pairs? Or are montane species more closely related to other montane species, reflecting diversification and dispersal of long-established montane lineages? Can we use molecular clocks to approximately date these events, and compare them to the ages of the mountains they inhabit?

Ecologists examine patterns of alpha diversity from lowlands to highlands, seeking explanatory environmental variables. Species are typically the fundamental unit and are treated as anonymous entities whose sole attribute is local relative abundance. Theories of resource abundance and niche partitioning predominate.

Increasingly the research agendas of taxonomists and ecologists are coming together to provide more thorough understanding of these processes. By knowing the identities and origins of montane ants, we may gain insights into physiological or behavioral adaptations to montane environments. We can more readily investigate whether montane ant diversity is controlled by (1) short-term equilibrial processes that involve limiting similarity on a restricted resource base; (2) short-term equilibrial but non-interactive processes of population colonization and extinction, like classic island biogeography; (3) long-term equilibrial processes involving differential rates of speciation and extinction; or (4) short-term equilibrium involving local species pools, but long-term non-equilibrium involving the continual evolution of montane forms.

RT 6
BEYOND WINGED QUEENS AND WORKERS: MORPHOLOGY AND EVO-DEVO TO STUDY THE DIVERSITY OF ANT CASTES

ROUND TABLE:

BEYOND WINGED QUEENS AND WORKERS: MORPHOLOGY AND EVO-DEVO TO STUDY THE DIVERSITY OF ANT CASTES

Several alternative adult phenotypes exist across the ants. Winged queens and wingless workers express an essential ant quality: the helpers combine no reproduction and no flight. However, a proportion of species deviate from this elementary dichotomy and exhibit additional caste diversity in both reproductives and helpers. This is unknown in social bees and wasps where polyphenism is constrained by the common requirement of flight.

The degree of queen-worker dimorphism increased considerably during the ants' adaptive radiation, but winged queens retained a uniform morphology (characteristic of a flying insect), presumably due to shared ancestry. In contrast, permanently wingless ('ergatoid') queens evolved repeatedly in unrelated lineages having winged queens. Ergatoid queens group together as one broad category although their origin cannot be traced back to a single ancestor. Similarly, 'soldiers' have independent evolutionary origins across the ants. Both of these categories are heterogeneous as a result of convergent evolution, but terms strictly based on morphology are the most useful for comparative studies of caste evolution.

Morphological differences in adult insects result from changes during larval development. Thus, assessing morphology and comparing it between castes and between species gives an indirect insight into the developmental processes that generate caste differences. Evo-devo is another powerful tool to reconstruct the evolutionary history of ant castes, by studying the expression (i.e. production of RNA and proteins) of gene networks. Morphology and evo-devo can help us determine what traits are shared between reproductive and helper castes, and what traits are novel.

NOVEL ANT CASTES: WHAT DO ERGATOID QUEENS AND SOLDIERS HAVE IN COMMON?

C. PEETERS

Laboratoire Ecologie & Evolution, CNRS & Université Pierre et Marie Curie, Paris 75005, France, e-mail: cpeeters@snv.jussieu.fr

Winged queens and wingless workers are the groundplan for all ants, but there is further morphological diversity in a minority of species. In species that shifted from independent foundation to colony fission/budding, winged queens have often been replaced by (or coexist with) permanently wingless ('ergatoid') or short-winged ('brachypterous') queens. In species where queens and workers differ greatly in size, there can be additional helper phenotypes with specialized functions. Based on morphology, diverse helper phenotypes appear to be generated by two or more mechanisms: (1) Workers of some species show extensive variations in size although small and big individuals follow the same allometric growth rules; (2) In other species, bigger helpers have morphological traits that are not shared with workers. The latter novel phenotypes are distributed sporadically across the ants, and may be termed "soldiers" to facilitate comparative studies. However, the behavioral functions of soldiers vary across species: defense, phragmosis, prey capture or seed-milling. These functions are associated with specialized heads, including modified mandibles attached to powerful muscles. Soldiers can also function to store food more efficiently than ordinary workers, because of a bigger gaster volume and/or more ovarioles (to lay trophic eggs). Both ergatoid queens and soldiers evolved convergently, hence their phenotypes are highly varied. Importantly, both exhibit a combination of worker-like and winged queen-like traits (Molet et al. 2012). Such mosaic castes can evolve readily in ants by uncoupling traits involved in flight and reproduction.

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EVOLUTIONARY HISTORY OF ANT CASTES: COMMON ORIGINS OR CONVERGENCE?

R.A. KELLER

Instituto Gulbenkian de Ciência, Rua da Quinta Grande, 6, 2780-156 Oeiras, Portugal, e-mail: roberto.kellerperez@gmail.com

Castes are alternative adult phenotypes that perform different roles. In categorizing caste diversity, we rely primarily on the morphology of the individuals and, increasingly, on the developmental processes responsible for their differentiation. The challenge of defining castes that can be used for comparative studies rests on creating categories (e.g., queens, workers, soldiers) that reflect underlying natural processes rather than artificial assemblages. One potential problem is that some adult phenotypes are comparable because they have a common evolutionary origin, while other forms, although morphologically similar or functionally equivalent, have multiple, independent origins and thus might not be directly comparable. For example, winged queens across all ant species can be traced back to their presence in the common ant ancestor, whereas soldiers in distantly related genera have originated independently. Phylogeny, together with morphology and development, is therefore an important component in the study of castes.

To emphasize the role of phylogeny in caste delimitation, it is important to think about castes as evolving traits of colonies. During evolution, ant colonies might evolve soldiers in response to environmental stress in the same way that solitary organisms might acquire spines for protection. Also, just as organs can become atrophied or disappear, colonies might evolve to lose the queen caste altogether when colony reproduction is performed better by other nestmates. We can apply the proper terms (homology and analogy) to castes to denote either common origin of a shared trait or similar traits with independent origins. Thus, winged queens and workers seem to be homologous across all ants. Soldiers, in contrast, are likely not homologous across all ants, and might even have multiple origins among the species of a given genus (although the developmental process that gives rise to soldiers may be homologous within the genus). Therefore, as a general term, soldier describes analogous adult phenotypes, similar in morphology, that nevertheless evolved repeatedly during ant diversification.

Caste diversification throughout the phylogenetic history of ants involves origin of new adult phenotypes (e.g. soldier), modification of existing phenotypes (e.g. gamergates), and loss (e.g. absence of winged queens). This results in a complex evolutionary pattern of adult forms that is best understood as the evolution of lineages of castes within species lineages, that is, equivalent to the evolution of genes within species. As such, the origin of new castes at a given point of phylogeny can be conceptualized as a duplication event of adult forms. Just as in gene duplication, the evolution of castes involves multiple adult forms where one copy might have retained the ancestral function (e.g., reproduction) while the other might have specialized into a novel function (e.g., food storage). Specialized terms, such as orthology (= homology due to common ancestry) and paralogy (= homology due to duplication), are therefore also applicable to castes: winged queens are orthologous phenotypes across ant species, while queens versus workers are paralogous phenotypes (i.e., they are the result of a duplication of the adult female phenotype in the common ancestor of ants). Ultimately, both the morphological and developmental components of caste delimitation should be interpreted in a phylogenetic framework in order to understand the causes of caste evolution.

EVO-DEVO APPROACHES TO UNDRESTAND THE EVOLUTIUON OF CASTE DIVERSITY IN ANTS

M. MOLET[1], J. BEHAGUE[1], S. LONDE[1] & C. PEETERS[1]

[1]Laboratoire Ecologie & Evolution, Université Pierre et Marie Curie / CNRS, 7 quai Saint Bernard, 75005 Paris, France, e-mail: mathieu.molet@gmail.com, julien.behague@gmail.com, slonde@snv.jussieu.fr, cpeeters@snv.jussieu.fr

INTRODUCTION

Studying the mechanisms that allow for the production, survival and selection of novel phenotypes is crucial to understand biodiversity and evolution. There is growing evidence that phenotypic plasticity promotes diversification and adaptation (Pfennig et al., 2010), thus such plastic species might adapt better to environmental changes or to new environments. One striking example of phenotypic plasticity is social insects. The ancestral caste system of ants is based on two alternative female phenotypes: winged queens and workers. However, as they diversified from their original ecological niche, some ants have evolved more complex castes. In particular, they repeatedly and independently evolved wingless 'ergatoid' queens as well as soldiers. These multiple evolutions suggest that some underlying mechanisms facilitate the process. Here we discuss how we use evolutionary developmental biology to understand how phenotypic plasticity in ants could generate such diversity. We review past results and expose ongoing projects. We highlight the importance of evolutionary developmental biology 'Evo-Devo' through two of its components: comparative morphology and comparative development.

ADULT MORPHOLOGY REFLECTS DEVELOPMENTAL AND EVOLUTIONARY HISTORIES

Adult ant morphology is set up during larval and pupal development. As a consequence, all morphological changes in adults result from changes in larval developmental programs. Assessing morphology and comparing it between castes and between species is thus an indirect insight into developmental processes. Using morphometric approaches, we managed to elaborate a conceptual framework of how development could generate novel castes.

Ergatoid queens and soldiers result from a queen/worker mosaic development

We compared the morphology of ergatoid queens or soldiers to conspecific or congeneric winged queens and workers in several taxa (ergatoid queens in *Platythyrea* (Molet & Peeters, 2006), *Odontomachus* (Molet, Peeters, & Fisher, 2007a), *Mystrium* (Molet, Fisher, Ito, & Peeters, 2009; Molet, Peeters, & Fisher, 2007b) and *Cerapachys*; soldiers in *Gesomyrmex* (unpublished data) and *Cataglyphis* (submitted); literature review (Molet, Wheeler, & Peeters, 2012)). These comparisons relied on multivariate 1D and 2D morphometrics (analyses of size and shape) and on the assessment of growth rules. They revealed that both ergatoid queens and soldiers recombine morphological traits from winged queens and workers. Typically, soldiers can be described as 'workers with queen head' and ergatoid queens as 'workers with queen gaster' (Figure 1). Based on these data, we suggested an evolutionary developmental scenario (Molet et al., 2012). The body of winged queen and worker castes is made of modules. Many modules are general, i.e. shared between these two castes (e.g. legs, antennae). However some modules are caste-specific: they differ between the two castes (e.g. wings, eyes). We proposed that during development, ergatoid queen and soldier larvae dissociate and recombine modules from the ancestral winged queen and worker castes, resulting in a new mosaic phenotype. Such mosaic development could enhance the production frequency of new phenotypes and increase survival since it relies on recycling of traits that have already been tested by natural selection instead of potentially lethal novel traits.

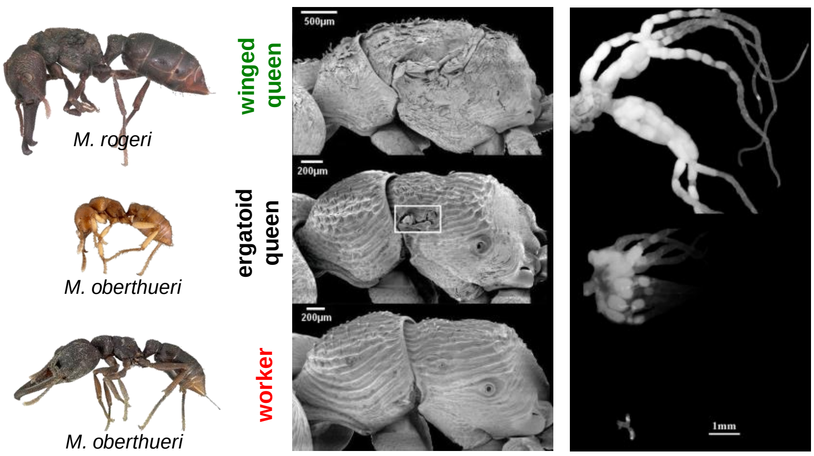

Figure 1. Ergatoid queens of *Mystrium oberthueri* look like small workers, but they exhibit winged queen modules including wing rudiments (left SEM picture) and large functional ovaries (right SEM picture).

Intercaste anomalies also result from a queen/worker mosaic development

Regular castes are not the only phenotypes that can be found in ant colonies. In many species, developmental anomalies have been reported. The most striking ones are gynandromorphs, mosaics of male and female phenotypes. In addition, intercastes also exist. They look intermediate between existing female castes, and they are thus much less striking than gynandromorphs. They can resemble large workers, or small queens with short or no wings, or any phenotype in between (Figure 2). Anomalies in general and intercastes in particular have barely been studied. We assessed their morphology in two species: *Temnothorax nylanderi* (Okada, Plateaux, & Peeters, 2013) and *Mystrium rogeri* (unpublished). Just like ergatoid queens and soldiers, we found that intercastes are mosaic phenotypes that recombine modules from winged queen and worker castes.

Because intercastes are uncommon, we lack information in literature. A webpage has been setup on Antweb in order to image specimens sent by ant researchers who would come across such anomalies and want to contribute: http://www.antweb.org/page.do?name=anomalous.

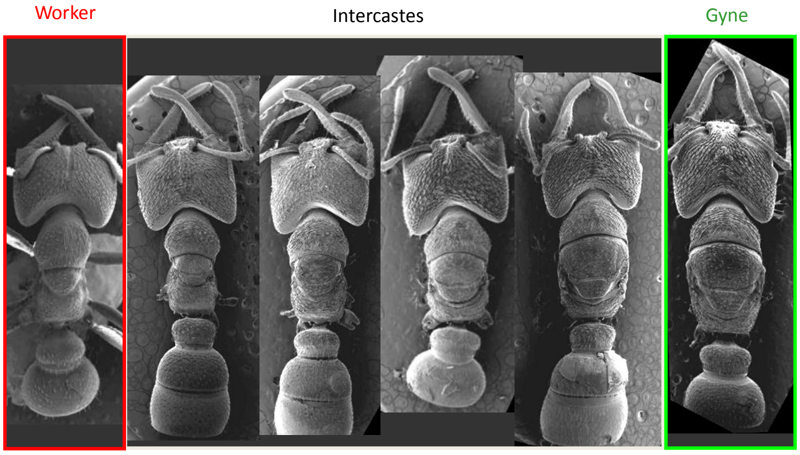

Figure 2. SEM pictures of four *Mystrium rogeri* intercastes. A worker (left) and a dealate queen (right) are shown for comparison.

Intercastes as a first step towards the evolution of novel castes

In contrast with ergatoid queens and soldiers that result from natural selection, are regularly produced and generally have a fixed phenotype, intercastes are rare and extremely variable. However, because both regular and irregular forms resemble each other, we suggest that intercastes may be selected for if they bring colony-level benefits, and they can evolve into ergatoid queen or soldier castes. If intercastes are beneficial, they may be selected for as long as their production has a genetic background, through a process of genetic accommodation. Accordingly, we aim at detecting selection on these developmental anomalies. For this purpose, we use several approaches. First, we assess fluctuating asymmetry at the individual level. Being symmetrical is an index of selection, while being asymmetrical reflects anomalous development with perturbations within the individual. We expect intercastes to be less symmetrical than ergatoid queens and soldiers, and to show different degrees of symmetry between populations and species depending on whether they undergo selection or not. Second, we measure the propensity to produce intercastes in populations that face distinct environmental pressures. Third, we estimate the benefits that intercastes can bring to colonies using ethological approaches focusing on their ability to reproduce, store food or defend nest (Figure 3).

Figure 3. A *Mystrium rogeri* intercaste in its colony (left, white arrow) and outside performing sexual calling (right). Intercastes have a spermatheca (upper right corner) and some do mate during laboratory experiments.

GENE EXPRESSION DURING DEVELOPMENT GENERATES ADULT MORPHOLOGY

Studying imaginal disc development to understand caste evolution

The mosaic nature of ergatoid queens and soldiers can also be tested directly during larval development, instead of indirectly through morphometry. The first step is to identify developmental modules that could be compared between novel castes and ancestral winged queen and worker castes. Imaginal discs are isolated groups of cells that remain undifferentiated in larvae until pupation, and then undergo rapid development in the late larva and pupa (Figure 4). Some imaginal discs turn into adult structures that are shared between castes, e.g. legs, but others develop into adult structures that are distinct between winged queens and worker, e.g. wings, eyes and genitalia. These imaginal discs are thus ideal caste-specific modules to test our mosaic hypothesis.

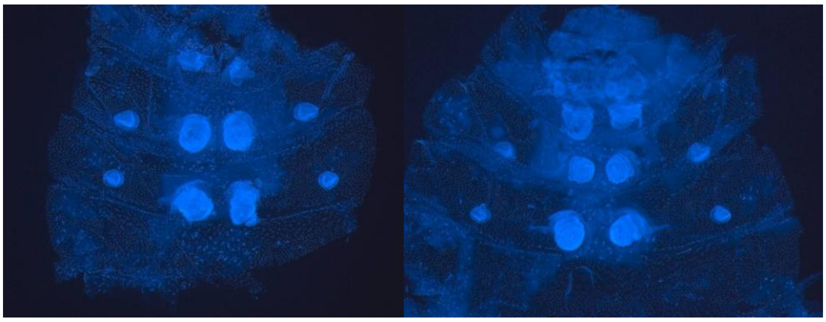

Figure 4. Dissected *Mystrium oberthueri* larvae showing the three central pairs of imaginal leg discs and the two lateral pairs of imaginal wing discs (left: ergatoid queen; right: worker). DAPI staining viewed with fluorescent microscope. Dorsal view, with head at the top.

Gene network in wing discs of ergatoid queens: novelty or recycling from workers?

Our aim is to test whether gene networks in developing larvae of ergatoid queens are recycled from existing winged queen and worker castes. We first focus on wing discs. Our hypothesis is that the lack of wings in ergatoid queens is based on the same networks of gene expression as the ones found in workers and not on new ones. We compare these networks in several species and discuss the convergent evolution of ergatoid queens in distant taxa. Gene expression, i.e. the production of RNA and proteins, is detected using labeled oligonucleotid probes to hybridize with RNA (in-situ hybridization) or antibodies to recognize proteins (immunohistochemistry).

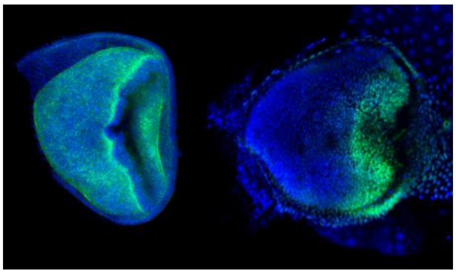

Figure 5. Expression pattern of two genes (left: *Notch*; right: *Exd*) of the imaginal anterior wing disc gene network in late larvae of *Mystrium rogeri* workers. Immunostaining (green) + DAPI staining (blue) viewed with confocal microscope.

Mitosis and apoptosis patterns in ergatoid queens: novelty or recycling from workers?

Similarly to networks of gene expression, we want to test whether wing construction and deconstruction in ergatoid queen larvae is based on the same patterns of cell division and programmed cell death as in worker larvae.

CONCLUSION

Evo-devo approaches can reveal similarities in the development of anomalies and novel castes as well as recycling and reshuffling from ancestral castes. This lets us build a testable evolutionary scenario: polyphenism facilitated the multiple independent evolutions of novel castes in ants by generating viable mosaic anomalies that can bring colony-level benefits. Evo-devo is thus a useful tool to reconstruct the evolutionary history of the ant caste system. In addition, the colonial environment protects anomalies against direct selection by buffering the external environment, and this favours their survival.

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CASTE DIFFERENCES OF SPERMATHECA DEVELOPMENT IN ANTS

J. BILLEN

University of Leuven, Zoological Institute, Naamsestraat 59, box 2466, B-3000 Leuven, Belgium, e-mail: johan.billen@bio.kuleuven.be

INTRODUCTION

Reproductive division of labour and the corresponding evolution of a queen and worker caste is one of the key characteristics of social insects (Wilson, 1971). Queens as the reproductively active caste display all anatomical features that allow them to perform the various functions of mating, sperm storage, egg development, and egg laying. Workers, in contrast, show a much reduced or even absent reproductive system, that in queenless situations may be activated. In this case, this may lead to male production, due to the haplodiploid sex determination system of Hymenoptera, as males develop from unfertilized eggs.

Since mating is a unique event that occurs in the very first weeks of the queen's adult life, and considering ant queens can reach lifespans of a couple of decades (Keller, 1998), sufficient quantities of sperm for her entire life need to be stored and kept viable after copulation. The spermatheca fulfills this crucial role, and therefore represents an organ that is of particular importance in the reproductive biology. Because of its specific role, it will be clear that ant queens possess a functionally fully active spermatheca, while workers either lack it, or at most have a non-functional spermatheca. This clear distinction between fertile queens and sterile workers becomes more subtle in a number of phylogenetically basal ant species (mainly Amblyoponinae, Ectatomminae and Ponerinae). Workers of such species may be reproductively active as well, as they are able to mate and produce worker offspring. Such mated egg-laying workers are known as 'gamergates' (Peeters, 1991). Gamergates can be found as the sole reproductive females in colonies of a number of permanently queenless species ('G-species'), while other species can reproduce through both queens and gamergates ('GQ-species'). Species displaying the common way of reproduction with winged queens only can be indicated as 'Q-species'. Besides these three categories, one may also find 'EQ-species', in which wingless worker-like ergatoid queens occur, and 'BQ-species', that have short-winged (brachypterous) queens (Peeters, 2012).

FUNCTIONAL MORPHOLOGY OF THE SPERMATHECA

The spermatheca consists of a spherical or bean-shaped reservoir, that is connected to the oviduct through a sperm duct. The ducts from two globular or tubular spermathecal glands open into the spermathecal duct near to its connection to the reservoir (Fig. 1). This region of the spermathecal duct is characterized by an extensive muscular supply or 'sperm pump', that regulates the amount of sperm that is released to fertilize eggs that pass through the oviduct. The spermathecal glands are formed by class-3 secretory cells according to the classification of Noirot & Quennedey (1974), and contain large amounts of glycogen (Wheeler & Krutzsch, 1994). The reservoir wall in the proximal 'hilar' region near the sperm duct consists of an epithelium with high columnar secretory cells (class-1 following Noirot & Quennedey, 1974), whereas the distal epithelium is formed by flattened cells (but see further). These flat cells do not display any secretory activity. In contrast, the hilar cells display the characteristics of a transporting epithelium, such as extensive invaginations of the basal cell membrane and a well developed microvillar apical border. The cytoplasm contains an end apparatus with very long microvilli, numerous mitochondria and secretory vesicles (Wheeler & Krutzsch, 1994; Gobin et al., 2006, 2008). Secretions from the hilar cells may provide nutrients to keep the stored sperm cells viable, while the two spermathecal glands are thought to activate metabolically arrested sperm cells, thus enabling them to move towards the oviduct.

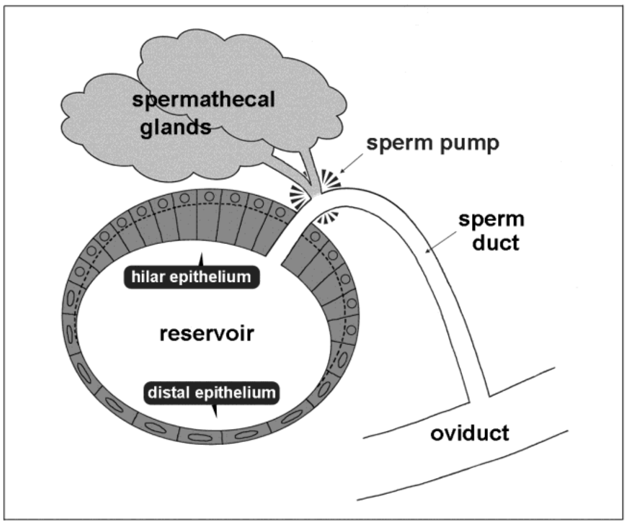

Fig. 1. Schematical drawing showing the location and anatomical organization of the spermatheca in ant queens and mated workers (gamergates). Note the differentiation of the epithelium of the reservoir wall into a columnar hilar epithelium near the entrance of the spermathecal duct, and a flattened distal epithelium. The dotted line indicates the appearance of the hilar epithelium in non-reproductive workers.

THE SPERMATHECA OF QUEENS, GAMERGATES AND WORKERS

Queens correspond to the description given above, giving them a fully functional spermatheca and hence the full capacity for producing diploid offspring. Workers in several Q- and EQ-species have lost the spermatheca, and in case they still retain it, its size is much smaller than that of the queen (Ito & Ohkawara, 1994). Besides being smaller, the reservoir of the worker spermatheca also differs from the queen's reservoir by the presence of a flattened epithelial wall both in the distal and hilar region. This lack of a glandular hilar epithelium apparently makes the worker spermatheca non-functional at the microscopical level. The non-functional worker spermatheca surprisingly contains apparently normal spermathecal glands.

The special condition of gamergates, on the one hand being workers but on the other hand being able to mate and produce diploid offspring, is reflected in their queen-like spermatheca characteristics, displaying a thick hilar epithelium (Gobin et al., 2006, 2008). The presence of such thick hilar epithelium at the ultrastructural level corresponds with a glandular capacity that is of crucial importance for the proper maintenance of the stored sperm through the effect of its secretory products.

THE SPERMATHECA OF PARTHENOGENETIC ANT SPECIES

A few ant species display thelytokous parthenogenesis, in which unmated females produce diploid daughters. Some of these species lack a spermatheca (e.g. *Cerapachys biroi*: Tsuji & Yamauchi, 1995), which is in line with their reproduction without sperm. Queens of other thelytokous parthenogenetic species, such as the myrmicines *Monomorium triviale*, *Pristomyrmex punctatus* and *Pyramica (Strumigenys) membranifera*, however, have retained the spermatheca, and moreover have it in a comparable size and with the thick hilar epithelium as have their congeneric sexually producing species. This surprising presence of a functional although never-used spermatheca is interpreted in an evolutionary context, as the occurrence of obligate thelytokous parthenogenesis in these myrmicine species may have evolved fairly recently, while the adaptation/degeneration of the spermatheca did not happen that quickly (Gotoh et al., 2011).

THE SPERMATHECA OF OTHER SOCIAL INSECTS

The general anatomical organization of the spermatheca is fairly similar in the various groups of social Hymenoptera. In the termites (order Isoptera), however, the spermatheca consists of a bean- or umbrella-shaped reservoir and a spermathecal duct. Separate spermathecal glands are not found, although the wall of the reservoir part contains abundant glandular cells. In contrast to the glandular hilar epithelium as described above for ant queens and gamergates, that is made up by epithelial class-1 secretory cells (following the standard classification of Noirot & Quennedey, 1974), the secretory cells of the reservoir wall in the termite spermatheca correspond with class-3 (Costa-Leonardo & Patricio, 2005; Raina et al., 2007). Their secretory products are equally thought to provide nutrients for the stored sperm cells, while it is interesting that large numbers of bacteria are interspersed with sperm in the spermathecal lumen (Raina et al., 2007).

Females of solitary and primitively eusocial bees (Colletidae, Megachilidae and Andrenidae) have a spermatheca with a uniformly thick reservoir wall, whereas in Halictidae a thin wall occurs (Pabalan et al., 1996). The reservoir of the queen spermatheca of eusocial bees also show a uniformly thick reservoir wall (*Apis*: Dallai, 1975; *Bombus*: Schoeters & Billen, 2000; Meliponini: Cruz-Landim et al., 2003). In honeybee workers, the spermatheca appears very reduced, with only the spermathecal duct and the muscular supply of the sperm pump that still remain intact. The reservoir and spermathecal glands have disappeared (Gotoh et al., 2013).

Among the social wasps, both reproductive and non-reproductive females of the Vespinae and Polistinae have a spermatheca with a uniformly thick reservoir wall, while in Stenogastrinae more variation occurs (Gotoh et al., 2008). The occurrence of a thick epithelium, regardless of reproductive status, can be understood for a number of Polistinae, as non-foundress females of these wasps can also mate. As Vespinae show clear morphological differences with respect to reproductive status, however, it is surprising that this is not reflected in the appearance of their spermatheca reservoir.

Our survey shows that spermatheca morphology in reproductive females of all social insect groups is well adapted for its role in sperm storage and for sperm mobilization at the time of mating. This specialization goes back to the presence of a pair of spermathecal glands (except in termites), and also to the glandular differentiation of the entire (all groups other than ants) or, in ants, of the hilar part only of the reservoir wall. Non-reproductive females can show a fully developed spermatheca, a non-functional spermatheca in various degrees of degeneration, or may have totally lost it.

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RT 7
BETA DIVERSITY: ADVANCES ON CAUSES AND APLICATION FOR CONSERVATION

DESCRIBING AND UNDERSTANDING ANT DIVERSITY PATTERNS IN THE BRAZILIAN SAVANNA CERRADO

H.L. VASCONCELOS[1], T. FRIZZO[1], R. PACHECO[1], J. MARAVALHAS[1], E. KOCH[1], K.S. CARVALHO[2] & G. CAMACHO[3]

[1]Instituto de Biologia, Universidade Federal de Uberlândia, C.P. 593, 38400-902 Uberlândia, MG, Brazil. E-mail: heraldo@umuarama.ufu.br; [2]Universidade Estadual do Sudoeste da Bahia, Jequié, BA, Brazil, [3]Universidade Federal de Viçosa, Viçosa, MG, Brazil

In addition to its relevance for the advance of ecological theory, studies of ant diversity patterns can be of great help for the formulation of proper conservation strategies. However, ants have simply never been sampled in many tropical areas. Furthermore, even where inventories have been performed the assessment of species turnover (beta diversity) and species distribution patterns is difficult. This is because ant ecologists often identify their collected specimens to morpho-species level (given the inherent difficulties in species-level identifications of several ant genera) and the morpho-species codes given by different researchers are not comparable. In addition, different researchers often employ different sampling protocols, and this also makes strict comparisons difficult. There is an urgent need for standardized inventories over multiple sites, and such inventories should be as complete as possible, given that a low sampling effort may result in inflated pseudo-turnover rates. However, a through ant inventory produces a massive amount of specimens whose morphological identification requires a daunting effort. One promising alternative is the identification of ants through DNA barcode variability. Nevertheless, at a current cost of US$ 6-7 per sample, even DNA barcoding identification can become financially prohibitive if thousands of specimens are to be identified; not to mention that only a few laboratories have the facilities for mass-throughput, automated DNA barcoding. Therefore, a balance between sampling completeness and the amount of resources employed in specimens´ preparation and identification must be sought. Here we used an interpolation approach to determine the best ant sampling and sorting strategy that would both (a) minimize the number of specimens to be sorted and yet (b) provide accurate information about the species richness and composition of the sampled assemblages. The study is part of a larger project aimed at studying the beta diversity of ants in the largest, richest, and most threatened savanna of South America, known as the Cerrado.

WILL THE STUDY OF BETA DIVERSITY SAVE ANT COMMUNITY ECOLOGY OR PROLONGD ITS LIFE?

N.J. SANDERS

Department of ecology and evolutionary biology, University of Tennessee, 569 Dabney Hal, Knoxville, Tennessee, 37996, USA, e-mail: nsanders@utk.edu

Beta diversity is a relatively old concept that, to some, quantifies turnover in composition among communities. In the past ten years or so, ecologists have begun to think about beta diversity in a new light, in hopes of addressing a series of inter-related questions: what is the appropriate metric of beta diversity? Are there spatial patterns in beta diversity? And can measuring beta diversity tell us anything about the processes that structure communities?

I maintain that the answers to these questions are “it depends, yes, and no.” Nevertheless, ant community ecologists have begun to jump onto the beta diversity bandwagon in the hope that we can learn something about communities of our favorite taxon. What if we can’t? Is it really possible that a particular way of measuring beta diversity will provide an answer to one of the big questions in ecology - why the number of species varies from place to place on the planet? Of course not.

To me, the larger issue is that ant ecologists are not setting the research agenda in community ecology. Instead, we simply follow the lead of other (usually plant) ecologists. Why is that? Most of us start a sentence in our manuscripts with a phrase along the lines of “Given their ubiquity and abundance, ants are a model taxon for...”. What are the big questions in ecology and evolution that we have used ants to address? There are many! But most of the time, we already had a pretty good answer based on work in another system with another set of organisms. What are the unanswered questions in ecology and evolution that we can use ants to address? Truthfully, I don’t know, and that’s what I want to talk about. But, whatever those questions are, studying beta diversity of ants is probably not going to answer them.

EFFECTS OF MESOSCALE ENVIRONMENT HETEROGENEITY IN GROUND-DWELLING ANT ASSEMBLAGES IN AMAZON FORESTS

F.B. BACCARO[1] & J.L.P. de SOUZA[2]

[1]Departamento de Biologia, Universidade Federal do Amazonas (UFAM), Av. General Rodrigo Octávio, 6200, CEP: 69077-070 - Manaus, Amazonas, Brazil, e-mail: fabricera@gmail.com. [2]Laboratório de Sistemática e Ecologia de Invertebrados do Solo, Coordenação de Biodiversidade, Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, AM, Brasil.

Ants interact with their environment at multiple spatial scales. Once established, the colonies generally interact with the surrounding environment through foraging activities of workers, and winged adults can interact with the environment at relative broader scales. Therefore, ground-dwelling ant composition in tropical forests is highly structured by environmental predictors at both, local and large scales. However, at the mesoscale, the role of environmental factors and habitat complexity on ant assemblages is still poorly understood. Using a mesoscale spatially structured sampling design (25 km^2), we evaluated the relative importance of environmental factors on ground-dwelling ant assemblages composition in Central Amazonia. Particularly, we quantified the influence of topography, vegetation structure, soil properties and geographic distance to measure their influence on ant assemblage composition in sites with different degrees of environmental heterogeneity (low, medium and high heterogeneity). As predicted, the relationships between ant beta-diversity and the environmental predictors were stronger in more heterogeneous environments. In fact, the environmental variables were found to be better predictors of changes in ant community composition than the geographical distances between sampling plots. Among environmental variables measured in this study, topography was consistently the best predictor of ant assemblage composition changes even for the more topographical homogenous site. However, the process that accounted for the variation in ant composition related with topography may not be universal. In more rugged terrain, the topography variation reflects changes in soil characteristics, creating a gradient of poorly drained areas concentrated on valleys and relatively dry areas on plateaus. The interaction of those variables creates different microhabitat conditions that may shape ant activity, richness and composition. In more plain areas, the water table depth may be the main force shaping ant composition compared with variation in microhabitat conditions. This suggests that species-sorting mechanisms mediated by environmental filtering are important structuring forces for ground-dwelling ant assemblages at mesoscales. (CNPq, CAPES, INCT-CENBAM, PPBio)

PARTITIONING OF ANT BETA DIVERSITY: SPECIES REPLACEMENT AND SPECIES GAIN/LOSS ALONG RECOVERY GRADIENTS

F.A. SCHMIDT[1,2,3], C.R. RIBAS[2], R.R.C. SOLAR[4,5], A.C.M. QUEIROZ[6], E.O.CANEDO-JÚNIOR[6] & J.H. SCHOEREDER[1]

[1]Departamento de Biologia Geral. Universidade Federal de Viçosa, Viçosa, MG, Brasil, e-mail: schmidt.fa@gmail.com; [2]Setor de Ecologia, Departamento. Biologia, Universidade Federal de Lavras, Lavras-MG, Brasil; [3]Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre, Rio Branco, AC, Brasil; [4]Departamento de Entomologia. Programa de Pós Graduação em Entomologia, Universidade Federal de Viçosa, Viçosa-MG, Brasil. [5] Lancaster Environment Centre, Lancaster, UK [6]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

Changes in species composition have been one of the most widely used diversity parameters to compare ant assemblages among several habitat types. Thus, several studies have shown changes on species composition among ant assemblages inhabiting different vegetation strata, sites with different structural conditions or conservation status. In general, several types of ordination analyses that used similarity or dissimilarity indices as a proxy of the distance among the studied assemblages are used to detect differences on species composition. Measures of similarity/dissimilarity could be an additional meaning to the Whittaker's seminal concept of beta diversity as an estimate that compares inventory diversity at two different spatial scales (alpha and gamma diversity). Although, it has known that beta diversity should be derived from two different phenomena: nestedness and spatial turnover their relative contribution to beta diversity patterns were not computable until the innovation proposed by Baselga (2010). The author derived a nestedness-driven dissimilarity (β_{nes}) from the relationship between Sørensen dissimilarity (β_{sor}) - overall beta diversity - and Simpson dissimilarity (β_{sim}) – spatial turnover-driven dissimilarity – allowing to identifying the relatively most important phenomena for beta diversity. In this talk I will show the results of beta diversity partitioning in ant assemblages along four recovery gradients: (i) forest natural recovery after agricultural usage, (ii) forest natural recovery after forestry usage, (iii) natural recovery of savanna sites after fire disturbance and (iv) implemented forest recovery in sterile piles of mining usage. We expected in all gradients that the overall beta diversity (Sørensen dissimilarity - β_{sor}) increases with the recovery age of sites between the impacted site (or younger recovered site) and the under-recovery sites. Additionally, we verify the relative contribution of spatial turnover and nestedness-driven components to the increasing of overall beta diversity along the gradients. Based on this *a priori* assumption, we drawn a flowchart that encompass alternatives hypotheses associated with the contribution only one component (β_{sim} or β_{nes}) or to the combined contribution of both components to overall beta diversity (β_{sor}). In all hypotheses, we verify the response of ant species richness and ant species frequency to the gradients and verified whether changes in the resource quantity and conditions, and in the structural and resource heterogeneity that also could occur along the gradients could explain the *a priori* assumptions. In the talk, besides presenting the main results of each study I would also present a general pattern of ant beta diversity along recovery gradients. (CAPES, CNPq, FAPEMIG, VALE S/A)

RT 8
EFFECTS OF HUMAN DISTURBANCE ON SEED DISPERSAL BY ANTS

EFFECTS OF DISTURBANCE ON SEED DISPERSAL BY ANTS IN AUSTRALIA

A.N. ANDERSEN

CSIRO Ecosystem Sciences, Tropical Ecosystems Research Centre, PMB 44 Winnellie, NT 0822. Alan.Andersen@csiro.au

Australia is a global hotspot for myrmecochory, harbouring thousands of plant species with seeds adapted for dispersal by ants. Myrmecochory is especially prevalent in sclerophyllous heathlands and woodlands of temperate southeastern and southwestern Australia, but is ubiquitous in open habitats throughout the continent. Seeds are dispersed by ants from very many genera, but by far the most important is the equally ubiquitous *Rhytidoponera*, whose hundreds of Australian species are typically among the largest ants of local communities. In this presentation I will review the effects of disturbance on seed dispersal by ants in Australia, focusing on responses relating to distance dispersal. I will specifically address the effects of disturbance on (1) the composition of seed-dispersing ants, (2) rates of seed removal, (3) rates of mutualism cheating by non-removing ant species, and (4) seed-removal distance. I will draw on the very extensive literature on responses of Australian ant communities to disturbance, as well as a range of case studies looking explicitly at the effects of disturbance on distance dispersal, covering fire, mining and weed invasion. I will conclude by discussing the implications for plant recruitment at disturbed sites.

THE VULNERABILITY OF FYNBOS MYRMECOCHOROUS PLANTS TO EXOTIC ANTS

W.J. BOND

Department of Biological Sciences, University of Cape Town, Rondebosch 7701, South Africa, e-mail: William.bond@uct.ac.za

The Cape fynbos shrublands of South Africa are a global biodiversity hotspot and, along with similar vegetation in Australia, a world centre of myrmecochorous plants. Some 1300 species in 80 genera and 30 families of myrmecochores occur in fynbos. A number of features make these plants particularly vulnerable to disruption of dispersal by exotic ants. Fynbos is a flammable ecosystem with fires occurring every 5-50 years. Many plants species are killed by fire relying entirely on seedbanks for post-fire regeneration. On the nutrient-poor soils, seed production is low, especially in larger seeded myrmecochorous species. Distribution ranges of myrmecochores are often small. As an extreme example, the spectacular *Mimetes stokoei*, recently re-discovered after it was assumed extinct, has a population of < 50 plants in < 1ha. These features make larger-seeded myrmecochores particularly vulnerable to disruption of the seed dispersal process by the Argentine ant, *Linepithema humile*. The ant displaces the dominant native seed dispersing ants and its failure to disperse the seeds leads to high seed predation by rodents and increased seed mortality in high intensity burns. Exotic ant invasion is greatest in areas habitually used by people, such as picnic sites and settlements. Fortunately, many of the larger seeded Proteaceae are in remote areas which have not been invaded. Smaller seeded species are also less vulnerable to mutualism collapse because they are dispersed by native ants that survive with *Linepithema*. Although the effects of Argentine ants on myrmecochory in the Cape have been known for decades, the magnitude of their current and future threat to the biodiversity of the region remains poorly explored.

ANTHROPOGENIC DISTURBANCE REDUCES SEED DISPERSAL SERVICES FOR MYRMECOCHOROUS PLANTS IN BRAZILIAN CAATINGA

L.C. LEAL[1], A.N. ANDERSEN[2] & I.R. LEAL[3]

[1]Programa de Pós-Graduação em Biologia Vegetal, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego s/n, Cidade Universitária, 50670-901, Recife, PE, Brazil (lacaleal@gmail.com); [2]CSIRO Ecosystem Sciences, Tropical Ecosystems Research Centre, PMB 44 Winnellie, NT 0822, Australia (Alan.Andersen@csiro.au); [3]Departamento de Botânica, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego s/n, Cidade Universitária, 50670-901, Recife, PE, Brazil (irleal@ufpe.br)

Anthropogenic disturbance can have important indirect effects on ecosystems by disrupting species interactions. Such interactions are increasingly susceptible to human disturbance with increasing specialization of partner species, as responses to environmental change are limited with low flexibility. Myrmecochory is generally considered a diffuse mutualism because seeds are transported by a wide variety of generalized ant species. Therefore, it is expected to be highly resilient in relation to human disturbance. However, recent studies have shown that large-bodied ants are strongly related to the distance that seeds are dispersed, an important component of seed disperser quality. As large-bodied species might be particularly affected by human disturbance, changes in ant species composition with disturbance may therefore have important implications for the effectiveness of seed dispersal. Hence, we examine the effects of anthropogenic disturbance on distance dispersal by ants for the diaspores of myrmecochorous Euphorbiaceae in Brazilian Caatinga focusing on the seed dispersal services provided by large-bodied ant species. Rates of diaspore removal and distances removed of *Croton sonderianus* and *Jatropha mollissima* were observed at 24 sites ranging from low to very high disturbance (primarily grazing by livestock, hunting and firewood collection). Large-bodied ants preferentially remove diaspores with a high elaiosome proportional biomass. We thus used two constrasting diaspores: those of *C. sonderianus*, with a tiny elaiosome (3% of total diaspore mass), and *J. mollissima*, with a large elaiosome (20% of total diaspore mass). Despite a large number of seed disperser ant species, there were only two species providing high quality distance dispersal services, *Dinoponera quadriceps* (40% of all observed seed removals) and *Ectatomma muticum* (33%). *Dinoponera quadriceps* was responsible for 97% of all removals >2 m, and 100% of all removals >5 m. Removal rates did not vary with disturbance for *C. sonderianus* (small elaiosome), but declined with increasing disturbance for *J. mollissima* (large elaiosome). The number of removals by *Ectatomma* was highest at intermediate levels of disturbance, whereas those by *Dinoponera* decreased systematically with increasing levels of disturbance. Mean dispersal distance was four times higher at sites experiencing low disturbance, where removals >5 m represented a third of all removal events, compared with very highly disturbed sites, where no removals >5 m were observed. Despite high overall diversity there is very limited functional redundancy in disperser ant species, resulting in low disperser resilience in relation to disturbance. In particular, the species responsible for most long-distance dispersals is highly sensitive to disturbance, and so distance dispersal decreases markedly with increasing disturbance. This is likely to have important implications for recruitment by myrmecochorous plants, and therefore on vegetation composition and structure, at sites subject to high anthropogenic disturbance.

ANT-FRUIT INTERACTIONS IN A FRAGMENTED LANDSCAPE OF THE BRAZILIAN ATLANTIC FOREST

A.G.D. BIEBER[1], P.S.D. SILVA[2], S.F. SENDOYA[1,3] & P.S. OLIVEIRA[1,4]

[1] Depto. de Biologia Animal, Universidade Estadual de Campinas, C.P. 6109, 13083-862, Campinas - SP, Brasil, gabieber@hotmail.com; [2] Depto. de Estudos Básicos e Instrumentais, Universidade Estadual do Sudoeste da Bahia, BR 415, Km 03, 45700-000, Itapetinga - BA, Brasil, paulosavio@uesb.edu.br; [3] sebasendo@gmail.com; [4] pso@unicamp.br

INTRODUCTION

Plant diaspores typically dispersed by ants (i.e., myrmecochores) are characterized by the presence of a lipid-rich appendage known as elaiosome attached to relatively small seeds (Rico-Gray & Oliveira 2007). Species with this syndrome are especially frequent in arid and semi-arid environments (Rico-Gray & Oliveira 2007). However, ants not only interact beneficially with this type of plant diaspores, rather they are also very common attendants of vertebrate-dispersed fleshy fruits (Rico-Gray & Oliveira 2007), which is the most prevalent plant dispersal syndrome in tropi

cal humid forests (Frankie *et al.* 1974). Small vertebrate-dispersed diaspores (up to 1 g) may be carried to distances greater than 10 m either by one solitary forager of bigger ant species (*e.g.*, *Atta* spp., *Odontomachus* spp., and *Pachycondyla* spp.) or by many recruited individuals of smaller species (*e.g.*, *Pheidole* spp., *Solenopsis* spp., and *Brachymyrmex* spp.) (Rico-Gray & Oliveira 2007). Some examples of plant species whose diaspores are known to be actively carried by ants are: *Cabralea canjerana* (Meliaceae; Pizo & Oliveira 1998), *Clusia criuva* (Clusiaceae; Passos & Oliveira 2002), *Commiphora guillaumini* (Burseraceae; Böhning-Gaese *et al.* 1999), *Guapira opposita* (Nyctaginaceae; Passos & Oliveira 2004), and *Miconia rubiginosa* (Melastomataceae; Christianini & Oliveira 2009). In the above cited species, benefits to seeds brought by ants arise from (1) directed dispersal to nutrient-rich microsites (*i.e.*, ant nests), (2) dispersal away from the parental crown and/or (3) seed removal from bird droppings. However, many vertebrate-dispersed fruits are excessively large to be carried by ants. In this case, ant attendance may benefit those diaspores by pulp/aril removal *in situ*, limiting fungal contamination and increasing germination success (Oliveira *et al.* 1995). This type of benefit was already proven for the species *Hymenaea courbaril* (Fabaceae; Oliveira *et al.* 1995) and *Nephelium lappaceum* (Sapindaceae; Ohkawara & Akino 2005). This benefit may be brought by different ant species, especially those capable of recruiting a large number of workers (Rico-Gray & Oliveira 2007).

Several of the above cited works have been carried out in Brazil, especially in the Atlantic Forest and the Cerrado savanna. In particular, those studies carried out in the Atlantic Forest were performed at two well preserved sites in São Paulo State, the “Parque Estadual de Intervales” (Pizo & Oliveira 2000) and the “Parque Estadual Ilha do Cardoso” (Passos & Oliveira 2003). Due to its high biodiversity (including an elevated percentage of endemisms) and having already lost most of its original area (ca. 150 million ha), this biome is considered one of the world’s most threatened ecosystems (*i.e.*, biodiversity hotspots; Mittermeier *et al*. 2005). Currently, only 13% of its original forest remains interspersed in a highly fragmented landscape (Ribeiro *et al*. 2009). Besides the many negative impacts of forest fragmentation *per se*, most of the remaining Atlantic forest is also threatened by other human-associated disturbances (Tabarelli *et al.* 2010), such as: hunting pressure, selective harvest of wood and palm heart, pesticide use in adjacent areas and invasion by exotic species. In view of the divergence between the conservation status of this biome and the *quasi* optimal conservation of those two areas where ant-fruit interaction studies were realized, the necessity to perform more studies on a fragmented Atlantic Forest landscape emerged. Since this interaction also involves vertebrate frugivores (birds and mammals), a group particularly threatened in fragmented forests (Chiarello 1999), knowing if ant-fruit interactions are maintained in fragmented landscapes achieves an even higher importance to those plant species which might benefit from ant services.

Based on the exposed arguments, the doctoral thesis of the first author of this communication aimed at understanding the variations on ant-fruit interactions between fragmented and continuous forests (see Bieber 2012). Here, we explore the results of two experimental approaches used in this thesis. In the first experiment, we used a synthetic fruit with the purpose of controlling the quantity and quality of offered fruits, thus aiming to see if there were differences in the ant community attracted (unpublished data; but see Bieber 2012). We expected to find similar values at fragments and continuous forests in terms of general ant attendance to 'fruits' (*i.e.*, number of stations visited and species density per station). However, we also expected a shift in ant species composition, which could lead to a decrease of important services to plant diaspores. In the second experiment, we tested whether ant access to fallen fleshy fruits of a model plant species is affected by previous handling by frugivorous birds (already published; see Bieber *et al.* 2013). Our expectations were that fruits not handled by vertebrates (*i.e*., a possible outcome of forest fragmentation) would be less attractive to ants.

STUDY SITE

This study was carried out in the municipalities of Piedade and Tapiraí (23°50'S, 47°20'W) at São Paulo State, Southeast Brazil. Native vegetation is classified as lower montane Atlantic rain forest, with altitudes ranging from 750 to 1,000 m a.s.l. The climate is characterized by a warm rainy summer (October to March) and by the absence of a true dry season during winter (April to September). Monthly mean temperatures vary from 15° to 22°C and rainfall is ca. 1,800 mm yr^{-1} (see Banks-Leite *et al*. 2010). Our fragmented landscape presents ca. 50% of remaining forest cover, divided in fragments of secondary forests of various sizes and at various successional stages, from 25 to more than 60 years old. We used four forest fragments (FFs) ranging from 91 to 146 ha, surrounded mainly by herbaceous cropland and/or by pastures (Banks-Leite *et al*. 2010). Located just 5 km from this fragmented landscape, the continuous forest (CF) inside the preserve 'Parque Estadual de Jurupará' (PEJU) was used as our control area. This continuous forest area consists of a 26,000 ha of old-regrowth secondary forests in a late successional stage (Banks-Leite *et al*. 2010). Replications for the continuous forest were obtained by selecting four areas inside PEJU at least 1.5 km apart from each other, which were considered as spatially independent.

EXPERIMENT 1: DOES ANT ATTENDANCE TO LIPID-RICH SYNTHETIC FRUITS DIFFER BETWEEN FRAGMENTED AND CONTINUOUS FORESTS?

Methods

Here, we used synthetic fruits instead of natural plant diaspores because we needed a large quantity of fruits in the same condition. These synthetic fruits (hereafter referred as 'fruits') contained a lipid-rich 'pulp', since ants show a high preference for lipid-rich plant diaspores (Pizo & Oliveira 2000; 2001). The synthetic pulp recipe followed Raimundo *et al.* (2004). As 'seeds', we used red plastic beads with 3 mm diameter. Each synthetic fruit contained one ‘seed’ entirely covered by the whitish ‘pulp’, with a total weight of ca. 0.2 g and 8 mm diameter, a size which allows many ant species to remove the ‘fruits’ (see Pizo & Oliveira 2000; 2001). In each of the eight study areas, we established 30 sampling stations 10 m apart from each other along one transect. In each station we deposited, on the ground, five synthetic fruits on a piece of white filter paper to facilitate visualization. ‘Fruits’ were covered with a wire cage to exclude vertebrate access. The experiment was set at 10.00 h and ant attendance to ‘fruits’ at sampling stations was checked at 11:00 am, 01:00 pm, 03:00 pm, and in the following day at 08:00 am. During each sampling, we recorded the attracted ant species and their behavior toward the ‘fruits’. At the end of the experiment we also checked the number of synthetic fruits either cleaned (i.e., more than 75% of the ‘pulp’ detached) or removed by ants, as well as fruit removal distance. The eight study sites were sampled on consecutive days (March 2010), under similar weather conditions.

Results

A total of 51 ant species were attracted to the lipid-rich synthetic fruits. Ant richness ranged from 16 to 24 species per forest site, being in general higher at more preserved sites. *Pheidole* and *Solenopsis* presented the greatest number of species in both habitat types. Moreover, some of the most frequent species (recorded in more than 10% of stations) belonged to these genera, also including the species *Pachycondyla striata* and *Wasmannia affinis*. Overall, the mean number of species per station was higher in continuous than in fragmented forests (ANOVA; $F_{1,\,222} = 4.89$, $P < 0.03$), with no nested effect of the forest site.

Continuous forests presented a higher proportion of stations with ‘fruits’ removed by ants compared to fragmented forests (Chi-square test; $\chi^2 = 64.29$, $P < 0.0001$). Moreover, the number of ‘fruits’ removed by ants per sampling station was higher at continuous than at fragmented forest sites (GLMM; Wald’s $Z = -2.76$, $P < 0.01$), but ‘fruit’ removal per station also varied greatly among the four fragmented sites. Displacement distances ranged from 1 to 165 cm (n = 188 synthetic fruits). Again, ‘fruits’ were displaced by ants to greater distances at continuous than at fragmented forests (GLMM; Wald’s $Z = -2.79$, $P < 0.01$) and there was a significant heterogeneity among fragment sites. Two large ponerines, *Pachycondyla striata* and *Odontomachus chelifer*, and a few large species of *Pheidole* (body length ≥ 3 mm) were the most frequent removers of synthetic fruits. While the two ponerines were more frequent in continuous than in fragmented areas (29 vs. 12 records; $\chi^2 = 4.5$, $P < 0.04$), these large *Pheidole* spp. were equally frequent in continuous and fragmented forests (70 vs. 65 records; $\chi^2 = 0.18$, $P = 0.67$).

Finaly, the proportion of sampling stations with entirely cleaned ‘seeds’ did not differ between continuous and fragmented forests (31% in CFs vs. 22% in FFs; $\chi^2 = 0.98$, $P = 0.32$). The ant species most commonly seen cleaning the ‘pulp’ were *Megalomyrmex iheringi*, and a few species of *Pheidole* and *Solenopsis*. However, most ant species (70%), especially the small ones, were neither capable of displacing synthetic fruits nor of entirely detaching its ‘pulp’ during the experiment’s period.

EXPERIMENT 2: DO ANTS PREFER VERTEBRATE-HANDLED FLESHY FRUITS?

Methods

In this experiment, only one forest fragment was used. Our model species, *Psychotria suterella* (Rubiaceae), is a common understory treelet in the study area and its fruits are frequently exploited by ants on the forest floor (Bieber, 2012). Fruits are medium-sized purple succulent berries (diameter, 12.65 ± 1.86 mm; mean ± SD) containing two seeds, whose fruit coat is not considered hard. Intact fruits of *P. suterella* were collected on the ground or directly from trees. These fruits were randomly submitted to distinct procedures in order to simulate the three most common conditions in which they are encountered on the ground: intact, opened by vertebrates (*i.e.*, mandibulated), and embedded in vertebrate feces. "Intact" fruits presented no marks or holes of any kind, and received no additional treatment. "Mandibulated" fruits were produced by making an opening with a forceps to simulate the mark left by the beak of a bird. Fruit passage through bird guts ("feces-embedded" fruits) was mimicked by smashing an intact *P. suterella* fruit and mixing it with fresh feces of curassows (*Crax* spp. and *Mitu* spp.). Experimental fruits were placed on the leaf litter at stations 5 m apart from each other along one transect. At each station, three fruits submitted each to one of the above treatments were placed separately on pieces of filter paper. After setting the fruits at 9:00 am, the attracted ants and their behavior were recorded in four scan samples taken at 1-hour intervals from 10:00 am to 1:00 pm. A total of 40 stations were accompanied, divided into two days with similar weather conditions, on February 2009.

Results

Twenty-three ant species were attracted to the fruits of *Psychotria suterella*. *Wasmannia affinis* and one species of *Pheidole* were the most frequently registered visiting the fruit stations (16 and 15 records, respectively). As expected, there was a significant difference among fruit treatments in relation to the number of stations with ants: "feces-embedded" and "mandibulated" fruits presented higher frequencies of ant visitation (26 and 23 stations, respectively) compared to "intact" fruits (12 stations) (G_{adj} = 10.93, P < 0.005).

DISCUSSION

The approach adopted in our first experiment revealed that habitat fragmentation exerts a marked impact on the interaction of ants with fallen fruits on the ground of the Atlantic Forest, even when the same quantity and quality of fruits is available. In undisturbed sites we registered higher numbers of ant species per sampling station, higher rates of 'fruit' removal by ants, and longer 'fruit' displacement distances than in the fragmented sites; although 'seed' cleaning frequency did not differ between the two forest types. Specifically, the decreased frequency of a particularly beneficial ant group (*i.e.*, large ponerines) in fragmented forests corresponded with a decline in the ants' potential dispersal benefit to plants (*i.e.*, less frequent dispersal and shorter displacement distance of 'fruits'). Evidences for negative effects of human-induced habitat disturbance (edge effects) on potentially beneficial services of ants to non-myrmecochorous diaspores have recently been provided for tropical semi-deciduous forests (Guimarães & Cogni 2002) and savannas (Christianini & Oliveira 2013).

The spectrum of genera recorded at synthetic fruits is analogous to other Neotropical studies on the ant fauna interacting with fleshy diaspores of local floras (Pizo & Oliveira 2000; Passos & Oliveira 2003), thus suggesting that the adoption of synthetic fruits may be useful to reveal patterns of ant attendance to fleshy fruits in variable ecological settings (see also Raimundo *et al.* 2004). The adoption of this approach in future studies should help circumvent practical problems in the field such as fruit scarcity, or poor fruit quality resulting from infestation by insect larvae or fungal infection.

Our second experiment showed that fruit attractiveness to ants was facilitated by previous handling by vertebrate frugivores. Field observations suggest that the mandibles of most ant species were not able to tear the coat of intact *P. suterella* fruits. On the contrary, "mandibulated" and "feces-embedded" fruits were readily accessible by ants. The higher frequency of ant visitation likely increases the chance of a diaspore being attended by those species capable of providing important services such as seed cleaning and/or removal (Rico-Gray & Oliveira 2007). Despite our focus on only one species, a preference by ants for vertebrate-handled fruits should be expected for other plant species whose fruits are soft-coated berries or drupes (A.G.D. Bieber, pers. obs.).

CONCLUSIONS

In spite of the recognized opportunistic nature of ant interactions with fleshy non-myrmecochoric fruits (Rico-Gray & Oliveira 2007), our two experiments showed that Atlantic forest fragmentation negatively impacts this loose mutualistic relation. Although we standardized the number and quality of fruits offered, ant-fruit interaction patterns were markedly different between fragmented and continuous forests. The first experiment also evidenced that ant-derived benefits to seeds largely depend on the identity of the interacting ant species (see also Christianini & Oliveira 2009; Passos & Oliveira 2002, 2004), whose frequency in turn may vary, as registered here, with the degree of habitat disturbance. Moreover, results of the second experiment suggest that in vertebrate-impoverished forest fragments, which probably present lower frequencies of vertebrate-handled fallen fruits (especially large diaspores), fruits would have a lower probability of attracting ants. The potential decrease in the benefits resulting from ant-fruit interactions in forest fragments adds up to the already pessimistic scenario faced by vertebrate-dispersed plants (Cordeiro & Howe 2003), since vertebrate frugivores are among the first to disappear from human-disturbed remnants (Chiarello 1999).

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RT 9
FORAGING STRATEGIES IN ANTS

FORAGING STRATEGIES IN *Dinoponera quadriceps*

A. ARAÚJO

Laboratório de Biologia Comportamental, Universidade Federal do Rio Grande do Norte, Caixa Postal 1510 – Campus Universitário, CEP 59078-970 - Natal, RN, Brasil, e-mail: arrilton@gmail.com

Every animal carries out daily activities such as foraging and looking for partners, but also leaves some time to rest. The activities performed away from the place of rest or the nest may have risks can bring risks that endanger the survival of the individual. An imminent risk is predation; even an animal that is identified as a predator, depending on the environmental context, may become a potential prey. However, the benefits gained in such activities are likely to outweigh the costs and make it worthwhile for the animal to risk. To minimize risks, the animals use strategies that provide maximum use of time and energy, especially in foraging which is one of the most important activities related to the survival of any animal.

When exploring a particular area during foraging, the decision of the animal represents the time it should spend in that area. The decision of a forager could be structured in relation to the time spent in the chosen area; however, this assumption is misleading when there is no link between length of stay and amount of food purchased locally. Time is a critical variable for the animals. The type of diet influences the foraging per se (searching for food) and time spent in foraging. Foraging can be lonely, if each individual seeks and ingests the food found alone, or social, in which there is a mutual dependence of the rewards. A functional consequence of social foraging is the fact that an individual depends on his own actions and on the behavior of other foragers.

Foraging is a central component of animal behavior. During foraging animals seek the most efficient way, i.e. focus on maximizing its benefits. Foraging behavior of social insects is highly flexible because it depends on both individual and collective decisions. This flexibility allows a colony of social insects to quickly adjust the foraging strategy according to the variations that occur in the environment. From an adaptive view, more flexible foraging behavior, allows the colony to quickly adjusting to new/variable conditions.

Decisions at the individual level are based on cognitive processes that can be relatively simple or relatively complicated depending on the species and the environment. Collective decisions on the other hand, are based on self-regulating processes and they arise from the exchange of information between individuals through communication. The colony functions as a decentralized system for the information. A decision by an individual that leads to a solitary error has impact only on itself. On the other hand, a social individual who makes a decision that results in an error will be penalizing itself and the colony at the same time, leading to a decrease in inclusive fitness. Foraging by ants is a complex process in which individual and social aspects interact to determine how much food will be needed for the colony and for that particular individual. Ant colonies have a wide range of cooperation strategies based on finding and obtaining food.

Thus it is important to understand how workers make decisions during foraging in order to measure the collective consequences in ant colonies. Studies in our laboratory have shown that *Dinoponera quadriceps* presents solitary foraging, its diet consisting of remains of animals or live prey (approximately 80 %) and small fruits (about 20 %). Regardless of the size of the transported food to the nest, we have never observed recruitment of individuals during capture and/or transportation. Workers move on average 18 m from the nest during search for food (range: 1-50 m). Larger preys are usually found at bigger distances and are transported to the nest, but very small prey can be ingested at the place in which they are found. This suggests a probable assessment of prey size, distance traveled and therefore optimizing the costs-benefits by the workers themselves, although the speed to transport the items does not depend on prey size.

Each *D. quadriceps* worker keeps fidelity to its hunting area for months, resulting in a much larger area to the colony as a whole in order to optimize foraging activity. The workers forage during the light phase, presenting peaks during the morning and mid-afternoon, during lower temperature times. Accordingly, foraging activity is more intense at the beginning of the dry season. Workers who return repeatedly to the colony without food present reduction in their body weight, although intra-nest workers can also present weight reduction. Initial results from our laboratory, lead us to consider the possibility that workers of *D. quadriceps* can adopt risk-aversive strategy during foraging activity. The individual keeps fidelity to the feeding site during consecutive trips if there is a positive reinforcement, but maintaining a standard random search within its search area if the rate of prey capturing is reduced. This indicates a acquired information processing about the captured prey and/or the environment by workers who individually take upon/adopt foraging strategies that may have collective consequences.

PLASTICITY OF FORAGING BEHAVIOR IN LEAF-CUTTING ANTS

A.M. VIANA-BAILEZ

Laboratório de Entomologia e Fitopatologia, Universidade Estadual do Norte Fluminense (UENF/ CCTA) Av. Alberto Lamego, 2000 - Pq. Califórnia 28013-602 - Campos dos Goytacazes / RJ. Email: amaria@uenf.br

INTRODUCTION

Search and food gathering correspond to a typical behavioral sequence named foraging.

In social insects, foraging is a flexible behavior. This flexibility allows the colony to quickly adjust its foraging strategy in accordance with changes in the environment (Dussutour et al. 2009). Foraging is a complex activity that involves a self-organizing system that can be studied at the level of the individual, of the colony or of both (Schlindwein, 2004). In ant society not all individuals participate in food gathering. Forager workers that perform this task are frequently the oldest and largest ones (Hölldobler & Wilson, 1990).

During foraging activity the workers use different strategies to find, transport and store food. Ants usually display spatially fixed nests, so collecting resources can be done by a strategy called central-place foraging in which the material collected in one location can be transported and stored in another (Hölldobler & Wilson, 1990). In this case, foragers move long distances from the nest to obtain food resources and are more selective in regard to the quality and quantity of the collected resource (Detrain, 2000). In the cases that polymorphism occurs, the larger workers would have proportionately greater efficiency in terms of energy return that would outweigh the increased investment in the production of these workers (Hölldobler & Wilson, 1990).

Another model used for source obtaining is the optimal foraging model, which among various aspects, measures the individual efficiency in food search. In this model, the greater the distance traveled between the nest and the food resource is, the more selective the food supply choice should be (Hölldobler & Wilson, 1990).

FORAGING STRATEGIES IN ATTINI

In ants in the tribe Attini, foraging is a complex process that consists of food resource exploration involving selection, cutting and transporting to the nest (Della Lucia & Oliveira, 1993, Ribeiro & Marinho, 2011). These ants use varied substrates for the development of fungal symbiont which provides food for the colony. The most derived genera, *Atta* and *Acromyrmex*, mainly exploit fresh plant material, while basal genera such as *Cyphomyrmex*, *Mycetarotes*, *Mycocepurus*, *Apterostigma*, and *Myrmicocrypta* use decaying vegetable parts, feces, dead insects (Leal & Oliveira, 2000). In basal genera usually does not occur live vegetation cutting. Workers forage individually, do not have a foraging trail and fidelity to the type of food collected (Waller, 1989). In *Cyphomyrmex*, foraging is individual, does not occur recruitment of forager workers and the area in which these are distributed is radial to the nest entrance (Leal, 1998). In the genus *Trachymyrmex*, foragers of some species may forage over long distances, climb plants and cut flowers, but, unlike species derived from the tribe Attini, these behaviors occur individually and without recruitment of nestmates (Leal & Oliveira, 2000).

Ants in the genera *Atta* and *Acromyrmex* considered the most derivatives are known as leaf-cutting ants. These exploit and cut large amounts of leaves, flowers and fruits and use a relatively extensive foraging area exploring a great diversity of plant species that is why they are considered polyphagous herbivorous (Della Lucia & Oliveira, 1993, Cherrett, 1986).

Leaf-cutting ants are selective and prefer soft and young plant parts, like flowers and new leaves. They can also express preference for the type of plant monocotyledons or dicotyledons (Lima et al., 2001). The foraging is accomplished mainly through trails marked chemically and by well-defined physical tracks (Weber, 1972; Viana-Bailez et al., 2011). Workers use different strategies for collecting and transporting plant material. After explorers detect a food source they recruit companions from the colony (Wilson, 1971).

In the species *Atta laevigata*, bigger workers climb plant stem and cut the leaves, and smaller worker cut the fallen leaves and transport them to the nest. Such transport may take more than a day. The strategy of not carrying the leaf fragments shortly after the cut would cause wilt of leaf blades and so some repellent substances would evaporate or be less effective; in addition, changes in nutrients and water content can make withered leaves more palatable (Vasconcelos & Cherrett, 1996).

Atta sexdens rubropilosa workers can change their foraging pattern in response to resource spatial distribution. Leaf-cutting ants have foraging pattern well defined through chemical trails, however, experiments in lab with this species of ant have shown that the trail construction is only evident when the resource is focused on foraging arena, when the resource is already dispersed foraging happens at random without formation of the trails (Sousa-Souto et al., 2008).

The foraging strategy in *Atta vollenweideri* is multistage, that is, a worker cuts, and other two or three transport the load. Larger workers cut fragments of grass and the smaller ones transport the fragments to the nest. The foraging depends on the distance from the nest to the exploited vegetation. When the distance between the nest and the plant is greater than 28m chain transport occurs, with the participation of two to five workers. However, when the exploited plant is located less than 10 m of the nest, the same worker cuts and carries this load (Röschard & Roces, 2003).

FLEXIBILITY OF FORAGING BEHAVIOR IN LEAF-CUTTING ANT *Atta robusta*

Foraging behavior can vary within the same species depending on the environment and the adaptive capacity of the ants (Lopes, 2007). Obstacles on the trail of ant *Atta colombica* modified the behavior at individual and collective level. At individual level, height limitations of the passage through the trail led to a decrease in the size and shapes of the leaf fragments. However, at the collective level they caused an increase in the proportion of laden ants (Dussutour et al. 2009). Thus, the ants compensate the reduction in the size of the load, by bringing more fragments to the nest. This shows that the workers of this species display flexibility in cutting behavior and that the size of the fragments is not restricted to the size of the worker.

The leaf cutter ant *Atta robusta* is an endemic specie from Brazil “restingas”. This ant was recently included in the endangered species list. We described foraging behavior of *A. robusta* in different plant species and this study showed the behavioral plasticity to explore different resource.

A. robusta explores more than 32 taxa of sandbanks plants but can modify their foraging strategy according to the type of plant operated. Two main strategies for cutting and transporting were checked. When these ants explore cactus (*Cereus fernambucensis Lem.*)

and grass (*Cynodon cf. dactylon* (L.) the "individual transport" occurs, in which the same ant cuts and carries the load to the nest. In cactus foraging, the foragers shave the juicy part of phylloclade with the mandible, and with the help of front legs they make small bundles of fibers that are transported by the same ant to the nest. In brazilian pepper tree (*Schinus terebinthifolius Raddi*), brazilian cherry (*Eugenia uniflora* L.) and dollarweed (*Hydrocotyle umbellata* L.) the strategy used is the "transport chain" in which a worker climbs on the plant, cut and drop the leaf or flower to the ground and other workers, which stay on the ground, cut the fragments and they or other ants carry the fragments to the nest (Endringer, 2011).

These examples of behavioral plasticity in leaf-cutting ants illustrate the adaptive capacity that these insects have to solve problems by making complex behavioral adjustments both individually and collectively to adopt the most appropriate strategy to efficiently explore different food sources.

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CONTRASTING FORAGING STRATEGIES IN ANTS WITH LARGE VERSUS SMALL COLONIES: FORAGING AND ECOLOGY OF THE GIANT HUNTING ANT *Dinoponera australis*

A.V. SUAREZ[1], C.V. TILLBERG, P.E. HANISCH[3], C. PARIS[4] & C.R. SMITH[5]

[1]Department of Entomology, University of Illinois, Urbana, IL 61801, USA, email: suarez2@illinois.edu. [2]Department of Biology, Linfield College, McMinnville, OR 97128, USA. [3]Museo Argentino de Ciencias Naturales ‘‘Bernardino Rivadavia’’ CONICET, Buenos Aires, Argentina. [4]Departamento Ecología, Genética y Evolución, Universidad de Buenos Aires, Ciudad Universitaria Pabellón 2, Piso 4, Lab 28, C1428EHA, Buenos Aires, Argentina. [5]Department of Biology, Earlham College, Richmond, IN 47374 USA

A central goal of ecology is to understand the mechanisms behind variation in the abundance of species in tropical ecosystems. Food web theory predicts higher biomass for animals at lower trophic levels. However, some high trophic level species may reach great abundance via highly efficient foraging behaviors. We evaluated these mechanisms in the giant tropical ant *Dinoponera australis* by determining its distribution and abundance, documenting its foraging behavior, and measuring its trophic position. We found that *D. australis* colonies are hyper-dispersed, and the species reaches a wet biomass of more than 2.5 kg/ha at this site. *Dinoponera australis* foraging behavior is characterized by route fidelity of individual workers, with different individuals specializing on different areas around the nest. Finally, stable isotopic evidence and direct observation suggest these ants are among the top predators in this terrestrial invertebrate community. We interpret our findings in the context of how the behavior of an abundant top predator creates an exception to the usual tradeoff between biomass and trophic level. Together these data provide insight into the biology of one of the world’s largest ants and why they may be able to attain such high densities where they occur.

FORAGING STRATEGIES OF ANTS ON SOIL MICROARTHROPODS

G. CASTAÑO-MENESES[1,2]

[1]Unidad Multidisciplinaria de Docencia e Investigación, Facultad de Ciencias, Universidad Nacional Autónoma de México, *Campus* Juriquilla, Querétaro, México, e-mail: gabycast99@hotmail.com, [2]Ecología y Sistemática de Microartrópodos, Depto. Ecología y Recursos Naturales, Facultad de Ciencias, Universidad Nacional Autónoma de México, Ciudad Universitaria, México, D. F., México.

In soil ecosystems, microarhtropods, mainly springtails and mites are a very important, integral and beneficial component in the decomposition and humification of organic matter process (Van Amelsvoort et al. 1988, Nielsen et al. 2011). In addition to their importance in decomposition, they are very important in flux nutrients in edaphic environment, due their high density and abundance, making them a potential food resource for many invertebrate and vertebrate predators (Bilde et al. 2000, Wolters 2001). The ants in soils have a very important role in the ecosystem due their variety of feeding habits, including herbivores, omnivores, predators and secondary predators. Most of predatory ants are considered generalist and can consume about 40% of prey biomass by season in forest ecosystems (Petal 1980), having therefore an important effect on microarthropod communities (Wardle 1999). Nevertheless, there are some ants, as Dacetine tribes that are recognized by their highly specialized mandibles , most of them being specialized predators of springtails (Brown & Wilson 1959). However, in some genera as *Pyramica*, which show short mandibles, gamasid mites, diplurans and symphylans have been recorded as preferred prey (Masuko, 2009). Other ants inhabiting soil, as *Solenopsis*, *Wasmania* and *Pheidole* genus, are generalist and prey on mites and springtails and other mesofauna organisms, with different effect on soil communities, depending of their strategies and predation impact on the population of decomposer and grazers. In most cases, increased predation rate of ants on microatrhopods results in retardation of decomposition rate. Nevertheless, recent studies show that important acceleration in that rate is due the predator action of ants on decomposer, acting as pruning effect (McGlynn & Poirson 2012).

Ants without modified mandibles have developed more visual based and active strategies in order to caught small and speedy prey like springtails, or more sclerotized and slowly prey like oribatid and some uropodid mites.

The role of ants as microarthropods predators in soil community have important impact on belowground food webs and in maintaining of integrity and health of the soil ecosystem.

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RT 10
ANT-PARASITOID INTERACTIONS

Acromyrmex PHORIDS IN ATLANTIC FOREST: FOLLOWING THE FOOTSTEPS OF THOMAS BORGMEIER

L. ELIZALDE[1] & J.M. QUEIROZ[2]

[1]Laboratorio Ecotono, Universidad Nacional del Comahue, Pasaje Gutiérrez Nº 1125, Bariloche, 8400, Argentina, luelizalde@gmail.com; [2]Departamento de Ciências Ambientais, Instituto de Florestas, Universidade Federal Rural do Rio de Janeiro, BR 465, KM 7, Seropédica, RJ, 23890-000, Brazil, jarquiz@gmail.com.

INTRODUCTION

Phorids (Diptera: Phoridae) are one of the most important families of insects because of the large number of species and the diversity of life forms (Disney 1994). Traditionally, they were considered saprophytic insects, however, one of the most common habits in this family is the parasitoid one (Disney 1994). In fact, there are at least 36 genera of phorids that are parasitoids, nearly 72% of which have infrequent hosts for the parasitoid life habit: adult ants (Disney 1994).

Associated with leaf-cutting ants there are two types of phorids, those species who spend most of their life cycle within the nest and those with females that are parasitoids. The first group of phorids is assumed to feed on the abundant resources that are within the nests of leaf-cutting ants (i.e. fungus culture). These myrmecophile phorids may be important from an applied perspective since they may transmit pathogens among ant colonies. However, very little is known about their biology. The other group, those who are parasitoids of leaf-cutting ants, are known since 1900 but scientific studies began in 1923 with the pioneering work done by Borgmeier in Brazil (Borgmeier 1931; Borgmeier 1929; Borgmeier 1928). This author described three of the seven genera that parasitize leaf-cutting ants, and a total of 26 species. These parasitoid females search for worker ant hosts to oviposit in foraging trails, cutting sites and external refuse dumps (Elizalde and Folgarait 2011). Once they selected a host ant, they deposit an egg within the body, in different places according to the species, using a sclerotized ovipositor. A larva emerges from this egg that eventually kills the host just before pupation (Elizalde and Folgarait 2011; Tonhasca et al. 2001; Tonhasca 1996). The pupa may be formed inside the ant's body, either in the head or thorax (reviewed in Elizalde & Folgarait 2011), or can leave the ant body to pupate outside the host. In the case of the species that pupate outside the host, more than one can be formed by ant larva host (Elizalde and Folgarait 2011; Erthal and Tonhasca 2000). The life cycle is detailed in Figure 1.

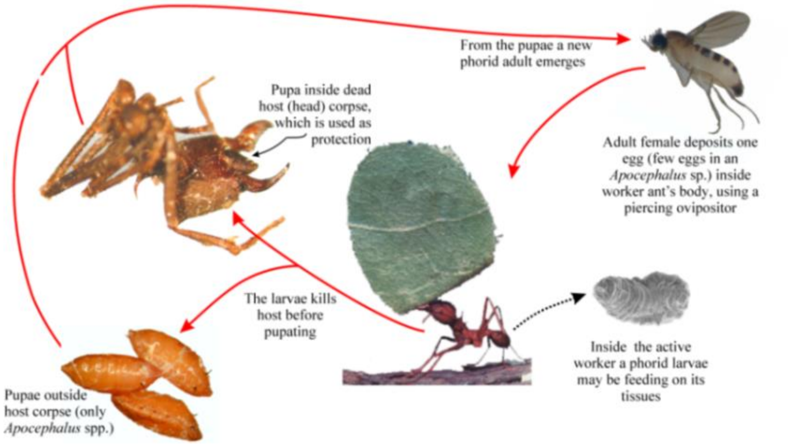

Figure 1. Generalized life-history of a phorid parasitoid of leaf-cutting ants.

While Borgmeier's work on phorid parasitoids of leaf-cutting ants was taxonomic, his research was motivated by the potential to use these parasitoids for biological control of leaf-cutting ants (Borgmeier 1931), which are a major agricultural pest in Brazil and throughout its distribution (Della Lucia 2003). Borgmeier knew that to use enemies as biological control it was necessary to know the biology of natural enemies in detail, but the first step was to study their diversity and describe new species. Despite these ideas clearly expressed in his publications, research on behavior and efficiency of these parasitoids as natural control agents did not start until the 90's, and took place mainly in Brazil. All these studies focused on parasitoid species attacking *Atta* ants (Bragança et al. 2009; Bragança et al. 2003; Bragança et al. 2002; Bragança and Medeiros 2006; Erthal and Tonhasca 2000; Tonhasca et al. 2001; Tonhasca 1996), but parasitoids interacting with *Acromyrmex* are almost unknown in Brazil, except for the pioneering work done by Borgmeier. Interestingly, an important number of phorid species associated with leaf-cutting ants that were described by Borgmeier parasitize ants of the genus *Acromyrmex*.

Borgmeier describes many phorid species associated with leaf-cutting ants from south-east Brazil, mainly from Rio de Janeiro State. There, the Atlantic Forest is severely affected by habitat fragmentation, and what remain exists as small–medium sized fragments surrounded by a deforested matrix. In fact, the Atlantic Forest in Rio de Janeiro State suffered a reduction of 32% of its cover (Hirota 2003). The matrix is used as pasture for cattle ranging, but once was used for coffee plantations (Francelino et al. 2012). Forest remnants represent 15.7% of the vegetation cover of the area, and is mostly represented by secondary lowland and submontane semi-deciduous forests (Oliveira-Filho & Fontes 2000; Francelino et al. 2012). Several studies have shown the negative effect that habitat fragmentation has on parasitoids (reviewed in Tscharntke et al. 2002). Phorid parasitoids are expected to be more susceptible than their leaf-cutting ant hosts to habitat fragmentation because of their narrow niche-breadth (Cagnolo et al. 2009; Henle et al. 2004) and their small body size (Elizalde & Folgarait 2011). Body size correlates positively with dispersal abilities (Blackburn et al. 1999) and adult phorid parasitoids do not have special long-dispersal means, thus making dispersal throughout a hostile matrix a risky task for phorids. In fact, there is some evidence that phorid parasitoids of *Atta* leaf-cutting ants are negatively affected by habitat fragmentation (Almeida et al. 2008; Rao 2000).

Here, we evaluate whether habitat fragmentation is a negative factor affecting the interactions between phorid parasitoids and their *Acromyrmex* leaf-cutting ant hosts. We first described the quantitative interactions among *Acromyrmex* ants and their parasitoids in Atlantic Forest, and compare our findings with Borgmeier's work for these phorids in the area. Then, we compared parasitoid species richness, abundance and proportion of nests with parasitoids in fragmented and well-preserved forests. Thus, the focus of this work is on *Acromyrmex* ant hosts, which do not share phorid parasitoid species with *Atta* (Elizalde & Folgarait 2011).

METHODS

The study was conducted in two areas within the Atlantic Forest of Rio de Janeiro state, chosen based on their different degree of fragmentation: the Vassouras-Barra do Piraí area was selected as the highly fragmented forest, and the continuous forest is located in a NGO reserve, Reserva Ecológica de Guapiaçu—REGUA. Eleven fragments were selected in the fragmented area, with a range of size variation of 0.1–10.6 km^2 and spanning over an area of 726 km^2. Two areas of the continuous forest were selected, separated by 2 km and covering an area of 9 km^2.

Walking along transects of known length we counted all *Acromyrmex* nests and collected phorids attacking over ants, to later identify them in the laboratory. Later, we obtained ant species density by dividing the number of ant species in each transect by its area. We evaluate the effect of forest fragmentation over parasitoid species richness, phorid abundance over each nest, and the proportion of nests with parasitoids.

RESULTS AND DISCUSSION

***Acromyrmex*-parasitoid interactions**. We found five *Acromyrmex* species. *Acromyrmex niger* was by far the most abundant species (Table 1). The other species collected were *A. subterraneus*, with three subspecies (A. *s. brunneus*, *A. s. molestans*, *A. s. subterraneus*), A. *coronatus*, *A. aspersus,* and *A. disciger* (Table 1). Seven species of phorid parasitoids were found, with five of them attacking exclusively *A. niger* (Table 2). Only one phorid species was attacking *A. disciger* and another was attacking *A. coronatus* only (Table 2). None of the subspecies of *A. subterraneus* nor *A. aspersus* were attacked by phorids. The parasitoids *Apocephalus lutheihalteratus* and *Myrmosicarius catharinensis* were the most abundant species, and they used *A. niger* as host. The other parasitoid species had very low abundance (Table 2). Only five nests from *A. niger* in the continuous forest had more than one phorid species attacking at the same time (*Ap. lutheihalteratus* and *M. catharinensis* found together in four nests and *Ap. lutheihalteratus* and *Neodorhniphora similis* in the other nest).

Surprisingly, we collected all phorid species attacking *Acromyrmex* that Borgmeier reported in the region (Borgmeier 1928, 1929, 1931). This suggests that our sampling was enough, but also that parasitoid communities remain similar even after 70 years and a considerable reduction in forest cover. The only exception was *Ap. lamellatus*, a phorid species that we did not collect and Borgmeier recorded it in association with *A. niger* (Borgmeier 1926). In addition, it was notable that few nests had two phorid species attacking ants at the same time, and this only occurred in the continuous forest.

Effect of forest fragmentation on ant-phorid interactions. Ant communities in the fragmented and continuous forests were similar. Only *A. disciger* and *A. s. molestans* were not collected in the continuous forest (Table 1). All *Acromyrmex* species were present in the fragmented forest, when all fragments were pooled. In fact, ant species density was higher in the fragmented forest ($U = 20$, $P = 0.03$). However, nest density of all *Acromyrmex* species did not differ between forest types ($U = 18$, $P = 0.12$) nor for *A. niger* ($U = 12$, $P = 0.75$).

Only 37.5% of the fragments with *A. niger* had phorids attacking it. Rarefied phorid species richness in continuous forest was 4.81 (lower 95% confidence interval = 3.51), higher than the three species gathered over *A. niger* in the fragmented forest. In addition, parasitoid abundance over nests was 12 times higher than that found in fragmented forest (Kruskal-Wallis $\chi^2_1 = 12.9$, $P = 0.0003$). Continuous forests also had a 4 times higher proportion of *A. niger* nests with parasitoids than fragmented forest ($\chi^2_1 = 7.06$, $P = 0.008$). In fact, phorids attacking ants were collected only in 3 from the 8 forest fragments sampled, where *A. niger* was present.

Only two phorid species were abundant enough for comparisons at phorid species level, *Ap. lutheihalteratus* and *M. catharinensis*. The first species was not present in the fragmented forest, and in the continuous forest 17.3% of the *A. niger* nests sampled had this species attacking, with most of these nests having only one *Ap. lutheihalteratus* attacking (except for two nests). Meanwhile, *M. catharinensis* in the continuous forest was present in 26.9% of the *A. niger* nests sampled, and typically two phorids were attacking per trail (two phorids in median, range 1–6); however, in the fragmented forest only 5.9% of the nests had phorids of this species and in all cases only one individual was attacking ants.

Table 1. Mean (standard error) relative abundance (%) for *Acromyrmex* taxa in fragmented and continuous forests in Rio de Janeiro, Brazil. Number of transects for each forest type is indicated in square brackets.

Forest type	***A. niger***	***A. subterraneus***	***A.s. brunneus***	***A. s. subterraneus***	***A. s.molestans***	***A. disciger***	***A. coronatus***	***A. aspersus***
Fragmented [11]	54.31 (11.19)	29.96 (5.70)	15.61 (4.69)	4.03 (3.62)	3.12 (2.13)	6.83 (4.71)	3.86 (2.80)	0.40 (0.40)
Continuous [2]	82.92 (0.42)	12.20 (0.30)	9.82 (2.68)	2.38 (2.28)	0	0	3.69 (1.31)	1.19 (1.19)

Table 2. Interactions between *Acromyrmex* and phorid parasitoid species in two localities (+: presence; -: absence), percentage relative abundance for parasitoid species over each host (between parentheses, pooled number of parasitoids gathered

Ant species	**Phorid species**	**Forest type** Fragmented	**Forest type** Continuous	**% relative abundance over each host**
Acromyrmex coronatus	*Myrmosicarius persecutor*	+	+	100 (2)
Acromyrmex disciger	*Neodohrniphora acromyrmecis*	+	-	100 (1)
Acromyrmex niger	*Apocephalus lutheihalteratus*	-	+	32 (21)
	Myrmosicarius catharinensis	+	+	47 (31)
	Myrmosicarius simplex	-	+	3 (2)
	Myrmosicarius tarsipennis	+	+	11 (7)
	Neodohrniphora similis	+	+	7 (5)

These results show that habitat fragmentation had a negative effect on phorid parasitoids of *Acromyrmex*, mainly affecting abundance. However, their ant hosts were not noticeably affected by forest fragmentation. The effect on phorids was particularly evident for the number of adult parasitoids attacking ants and the proportion of nests with parasitoids. Although species richness was also lower in the fragmented forest, the difference was due to two species, one of them with low abundance (*Myrmosicarius simplex*). Thus, our results add to the body of knowledge that posits parasitoids as very susceptible animals to this type disturbance (Cagnolo et al. 2009; Kruess and Tscharntke 2000).

In conclusion, our work showed that even when phorid abundance is considerably reduced in forest fragments, possibly because of their inability to reach fragments, phorids of some species are able to live there. Because agricultural activities are among the main drivers of habitat fragmentation (Foley et al. 2005), it is necessary to understand how leaf-cutting ants' natural enemies such as phorids are affected by forest fragmentation. An important management tool to control pests in agricultural croplands is to leave fragments of native forest around crops, which function as refuges for natural enemies (Bragança et al. 1998; Zanetti et al. 2000). Results from this work suggest that these fragments would not represent important refuges for these phorid parasitoids. However, since some parasitoids were able to live on fragments, more studies on the population dynamics of these phorids on fragmented landscapes are necessary to understand if and how forest fragments could function as reservoirs for parasitoids of leaf-cutting ants. We are working on this line, following Borgmeier's footsteps and ideas about the importance of *Acromyrmex* phorids, with an effort to reach his proposed goal: evaluate carefully whether these are proper tools to control leaf-cutting ants.

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HOST SPECIFICITY IS THE FUNDAMENTAL QUESTION IN ANT-PHORID INTERACTIONS

D.H. FEENER JR.[1]

[1]Department of Biology, University of Utah, 257 S 1400 E, Salt Lake City, Utah, 84112 USA, email: donald.feener@utah.edu.

In this talk, I argue that understanding the behavioral and physiological mechanisms underlying host specificity in ant-phorid interactions is the key to understanding the diversification of the parasitoids, their ecological and evolutionary effects in ant communities and their potential for biological control of pest ant species. First, I review the evidence for host specificity of phorid parasitoids of ants. These parasitoids comprise several hundred species in the Neotropical Region, most of which are extremely specialized, attacking one or a few closely related ant species. Then, I argue that three features of these host-parasitoid systems are responsible for the extreme specificity of the parasitoids. First, female parasitoids typically use specialized social pheromones of ants to find hosts suitable for oviposition. Because these communication signals are by their nature “reliable” and “detectable” indicators of the presence, identity, density, availability and suitability of the host ants, parasitoids may not need other more generalized olfactory cues to find hosts. Second, use of adult ants as hosts requires uniquely modified ovipositors to pierce the intersegmental membranes of heavily sclerotized exoskeletons and specialized oviposition behavior to counter the mobility, agility, and social defenses of ant hosts. Third, males of many of these parasitoids are also attracted to hosts where they compete for, court and mate with receptive females. Host location behavior by males in search of mates and females in search of oviposition sites may thus reinforce one another, leading to population isolation and the potential for sympatric speciation. I conclude by arguing that only with more studies on host location, oviposition and mating behavior of these parasitoids will we come to understand their diversification, their impact on ant communities and their potential for biological control of bothersome ant species.

TACTICS AND STRATEGIES IN PHORID-ANT RELATIONSHIP

O. BAILEZ

Laboratório de Entomologia e Fitopatologia, Universidae Estadual do Norte Fluminense
Av. Alberto Lamego 2000, Campos dos Goytacazes. E-mail: obailez@uenf.br

Phorids are small flies that belong to the family *Phoridae*. Approximately 3,000 species have been described but it is estimated that the real number exceeds 20,000 (Brown 1992, 2004). This group of insects has great interest due to its use in forensic medicine because larvae of some species feed on decaying animal tissue (Disney & Manlove 2005). In addition to a large number of saprophytic species, there are also fungivorous, herbivorous or also predators, parasites or parasitoids species (Brown 1992, Jessa *et al.* 2007, Erler *et al.* 2009). The latter may have a wide host range as myriapods, arachnids or insects as lepidopterous, coleopterous, termites, wasps, bees or ants (Brown 1992, Disney 1994, Feener & Brown 1997).

STRATEGIES *VS.* TACTICS

In the analysis of any phenomenon it is essential to use standardized terminology. However, in the description of various phenomena the term "strategy" is often inappropriately used to describe simple acts of choice or as a synonym for tactic (Brockmann 2001, Plaistow, *et al.* 2004, Andales *et al.* 2006). Tactic seeks to achieve the best move to solve immediate situations. It represents short-term, opportunist and conditional variables actions. Strategy on the other hand produces long-term effects and usually arises when there is no possibility of action. A strategy leads to a positional improvement that will be explored at the time of the conflict. According to Savielly Tartakower chessplayer "strategy establishes what to do when there's nothing we can do" while "Tactics tries to find out what do when there's something we can do". Thus strategy aims to generate opportunities and tactics take advantage of them. Strategy is linked to what to do, tactic to the how-to. Strategies are known for their efficiency and tactics for effectiveness.

Phorids' parasitoidism strategy must lead to sequences of actions that increase the chances of finding and attacking appropriate hosts, equating as efficiently as possible the invested time, energy cost, and survival risk. Ant's strategy helps to promote actions that reduce the chances of parasitoids oviposition or their consequences.

Tactics of the phorids are variable behavioral acts that can increase the effectiveness of finding and attacking the host. These may be part of a strategy or not. To the host, the tactics represent acts or sequences of these, which may promote the failure of the phorids actions.

Parasitoids can perceive cues that indicate host presence (Feener & Brown, 1997, Wite et al 2010) and they trigger a behavioral sequence that can be broken down into three phases: search, inspection and attack (Gazal *et al.* 2009). The time and energy spent to complete this process should be divided in these three phases. However, the proportion invested in each one will change according to the strategy used by phorids.

PHORID TACTICS AND STRATEGIES

Regardless of the strategy adopted by phorids, generally, we can distinguish two host search tactics that can be modulated depending on the situation: active search, and passive standby or ambush (Elizalde & Folgarait 2012). Other actions that can also be understood as tactics, as long as they can be modulated, are the choice of the place for attack, the way of approach to

the host, the exact location of oviposition or the size, color or moves of the chosen host (Wuellner *et al.* 2002, Silva *et al.* 2008, Mathis & Philpott 2012).
Active search tactic assumes that the parasitoid has ability to develop fast and long flights but will have an ephemeral life due to the intense expenditure of energetic reserves (Porter & Gilbert 2004). This tactic would be adopted in cases in which there are plenty of hosts distributed across variable distances.

Waiting for the host tactic (*passive standby*) would be adopted when there is low availability of hosts in the environment. This allows phorids maximize the energy investment at a time of low probability of success to find the host (Hölldobler & Wilson 1990). The strategies that comprise this search tactic shall have suitable mechanisms to increase effectiveness of choice and attack on the host. These strategies can be visualized in leaf-cutting ants' parasitoids which use larger and less abundant workers as hosts (Feener & Brown 1993, Tonhasca 1996, Gazal *et al.* 2009, Bragança *et al.* 2002, Elizalde & Folgarait 2011).

Phases of inspection and attack of the host can also be determinants of high efficiency degrees in parasitoidism strategy. Phorids, in general, lay an egg per host and this will require repeated contacts to ensure abundant offspring. However, host defense behavior represents a critical element to be overcome by phorids due to multiple risks that derive from these contacts (Feener & Brown 1997). To reduce the risks phorids should develop strategies based on attack tactics which favor secure attempts (Gross, 1993). However, time-consuming processes of choosing the attacking time could increase the effectiveness but the higher invested time can reduce efficiency (Erthal & Tonhasca 2000).

The ant *P. dentata* is dimorphic specie with minor and major workers. Two species of parasitoids that attack this ant show markedly different parasitoidism strategies. Establishing efficiency comparisons between these strategies requires a thorough understanding of the involved behaviors of both individuals that take part of the relationship phorid-ant, and an evaluation of the performance of both populations.

Apocephalus feeneri is a phorid that parasites the major worker class of *P. dentata*. This parasitoid search the host through exploratory flights hovering the food source or the trails. Among these flights, the phorid remains at rest for long periods perched on litter. Once phorids find *P. dentate* ants they hover over potential hosts for a few minutes. After the host choice, several approach flights without physical contact precede the attack. This attack tactic decreases ant reactions and reduces risks to be attacked by ants.

This sequence of search, choice and attack of host allows us to suggest that *A. feeneri* has a strategy that comprises a host search tactic that combines the wait at rest with occasional environment explorations. In addition, detailed selection of the host and lengthy attacks reduce the risk of ant´s attack contributing to high efficiency of parasitoidism. The high time invested in the last two phases is offset by lower spending on search phase, which also helps to keep the body fat reserves and thus enables a relatively long period of activity (greater than two days) in order to use all of their eggs (*approx.* 20).

Apocephalus sp1 is another phorid that attacks *P. dentata* but not actively looking for the host. This phorid attacks brood and differently from *A. feeneri* it is not displayed on the trails, or on food sources, or in the nest's vicinity. However, when an ant nest is disturbed and the offspring is exposed, mass attacks occur after just a few minutes. The pace of attack is frenetic and the choice of host quick. Multiple attacks to brood are carried out in a few minutes while are transported by workers to protected sites.

The strategy adopted by this phorid apparently comprises passive search tactics in which the phorid lands and wait until the appearance of the cues that indicates the location where there are exposed hosts. It seems that these cues are chemical signals (Brown & Feener 1991; Feener *et al.* 1996) because it takes several minutes to the parasitoids to reach disturbed nests. This strategy saves energy in search and host selection phases but invests more in the attack phase. These insects have outstanding flight capability to attack hosts including within partially exposed nests. They perform large number of attacks in short lapses of time and have a relatively high number of eggs (> 100). The fact of attacking brood while is being loaded by workers also reduces the risks for phorids. The eventual low effectiveness of attacks that this strategy can present would be offset by the high number of ovipositions that can be carried out due to the high number of eggs and the low risk of being attacked.

HOST TACTICS AND STRATEGIES

Ants can adopt strategies for escaping parasitoids. Changes of activity rhythm help to avoid periods of parasitoid activity, adoption of camouflage, thanatosis behavior, and traffic for less exposed trails, fugues, hiding and defense tactics could be some reactions to phorids attack.

Another strategy adopted by some ant's species to avoid parasitoidism would be to avoid the effects of the attack and not the attack itself. The largest investment would be in developing parasitoids larvae growth inhibition mechanisms. Adaptations that promote the encapsulated of larvae through immunological mechanisms fit this case (Salt, 1970, Vinson & Iwantsch, 1980).

Facing this ants defense strategy, parasitoids may respond with physiological and morphological changes that represent adaptive solutions to this host immunological response. Possible responses of parasitoids to these defenses are to attack brood or new individuals with probably lower immune response, initial occupation of organs with lower immune response, capsule destruction, minimization of immune response by injecting virus along with their eggs (Gross, 1993).

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LEAF-CUTTER ANT FORAGING AFFECTED BY PARASITOID DENSITY: IMPLICATIONS FOR BIOLOGICAL CONTROL

P.J. FOLGARAIT & A.C. GUILLADE

Laboratorio de Hormigas, Departamento de Ciencia y Tecnología, Universidad Nacional de Quilmes. Roque Saenz Peña 352, Bernal (1876), Buenos Aires, Argentina, e-mail: patricia.folgarait@gmail.com, andreaguillade@gmail.com

Percentages of natural parasitism of adult ants are generally low (lower tan 2%). Leaf-cutter ants, however, exhibit greater rates, ranging from 5 to 35% depending on the species and the weather conditions, particularly water availability. Despite these higher numbers it is difficult to find more than one adult parasitoid at a single nest simultaneously. One of the reasons that can account for it is a low abundance of parasitoids. If this were the case, the use of parasitoids as biological control agents would require several introductions of parasitoids in order to increase parasitoid populations. Still, considering the sparse distribution of leaf-cutter nests/ha, it may not be easy to effectively increase their populations. Therefore, a valid question from a practical perspective is to find out the efficiency of different adult parasitoid densities on leaf-cutter ants. We pursued this question by performing a manipulative experiment in the field using 0, 1 or 4 parasitoids per 3 m of foraging trail of 24 *Atta wollenweideri* nests. Mentioned trails were enclosed in a tunnel to control densities. We took measurements every 30 m during 1.5 h, after which we removed the parasitoids and took the last set of measurements 30 min afterwards. Measurements included registering ant traffic/minute, collecting ants to measure their size, and collecting ants that were transporting leaves which were individually placed in separated containers; for the latter each ant head size was measured and the piece of leaf carried was dried and weighted. We found no differences between the treatment 1 and 4 parasitoids, although both produced a significantly different effect than the control with no parasitoids. When parasitoids were present, the traffic diminished as well as the size of the foraging ants, and the amount of plant material carried. We also found a positive correlation between the size of the ants and the weight of the plant material carried, which implied that the pieces of plant material carried were smaller in the presence of these natural enemies. Therefore, the input of plant material transported into each colony diminished drastically. The experiment was performed with *Eibesfeldtphora trilobata*, a relatively big parasitoid that prefers to attack the bigger foraging ants, and its continuous presence produced an increasing reduction of the big ants as time passed, by producing a reduction of ants available for oviposition by this species. After removing the parasitoid, the negative effect remained only for the 4 parasitoids treatment. Our results are encouraging from a biological control perspective, as the effect of a single parasitoid per foraging trail may be able to shut down the colony activity and eventually produce its mortality through inanition plus parasitism.

RT 11
ANTS AS PREDATORS: A BEHAVIOURAL ECOLOGY APPROACH/PERSPECTIVE

GROUND-DWELLING PREDATORY ANTS OF THE CERRADO SAVANNA

N.B. ESPÍRITO-SANTO[1], V. FOURCASSIÉ[2] & P.S. OLIVEIRA[3]

[1] Programa de Pós-Graduação em Ecologia, Instituto de Biologia, Departamento de Biologia Animal, Universidade Estadual de Campinas, C.P. 6109, 13083-862, Campinas, SP – Brasil (nadiabarbosa@yahoo.com.br); [2] Centre de Recherches sur la Cognition Animale UMR CNRS 5169, Université de Toulouse III, Toulouse, France ,vincent.fourcassie@univ-tlse3.fr); [3] Departamento de Biologia Animal, Universidade Estadual de Campinas, C.P. 6109, 13083-862, Campinas, SP – Brasil (pso@unicamp.br).

Poneroide and Ectatomminoide ants are predominantly found in tropical and subtropical regions (Hölldobler & Wilson, 1990). The representatives of these groups are known to have several morphological and behavioral plesiomorphies such as the construction of simple nests, little differentiation between castes, small colonies, solitary foraging and rudimentary chemical communication (Hölldobler & Wilson, 2009). Regarding their dietary requirements, Poneroide and Ectatomminoide ants are mostly predators that feed on arthropods, other species of ants and/or termites (Hölldobler & Wilson, 1990; Hölldobler & Wilson, 2009). While some species are extremely specific in their choice of prey, others feed opportunistically on a wide variety of food items, presenting a combination of carnivorous, frugivorous, and nectarivorous habits (Ehmer & Hölldobler, 1995; Hölldobler & Wilson, 2009; Leal & Oliveira, 1995; Oliveira & Fourcassié, 2002; Peeters & Crewe, 1987).

The Cerrado savanna hosts a large number of ant species that forage on leaves, where they search for liquid food sources such as extrafloral nectar and insect exudates. Consequently, there is intense activity of foliage-dwelling ants interacting with exudate-producing Hemiptera and Lepidoptera larvae, acting as predators, consuming nectar, fruits, or seeds (Del-Claro & Oliveira, 1999; Oliveira & Freitas, 2004). Thus Poneroide and Ectatomminoide ants play relevant roles in the functional processes of the ecosystem, regulating arthropod populations, dispersing seeds, and promoting physical changes in the cerrado environment (Christianini *et al*., 2007; Del-Claro & Oliveira, 1999; Pie, 2004; Oliveira & Freitas, 2004,).

Given the ecological role that these ants play in tropical environments, the aim of this study was to investigate in detail the ecology, behavior and natural history of predatory ants in cerrado savanna, focusing in the Ponerinae (*Pachycondyla striata* and *Odontomachus chelifer*) and Ectatomminae (*Ectatomma edentatum* and *E. permagnum*). More specifically, we investigate the activity schedule of selected species, highlighting temporal segregation/overlap among them and seasonal variation, food items retrieved to nest, and their seasonal home ranges.

Field work was carried out at the Biological Reserve of Mogi Guaçu – SP, in an area of cerrado *sensu stricto*, which consists of a dense scrub of shrubs and trees. The climate is mesothermal with two distinct seasons: a dry cold season between April and November, and a rainy warm season between December and March. The annual average temperature is 20.5 º C.

Ant nests were located using sardine baits, and tagged. Four nests of each species were selected for the study of the activity schedule, which was determined by recording the number of foragers coming in and out of the nests over 24 hours. This sampling was carried out in continuous sessions of 20 min, at 2 hour-intervals, during 24 hours. Data were analyzed using repeated measures ANOVA.

Two nests of each species were selected to evaluate the home range. Nests were monitored in two consecutive hours per day, totaling 42 hours of observations for each species in each season. Workers were followed and their routes were marked with small flags on the ground. At the end of the observations we measured the distance and the angle of the nest entrance to each flag. Each marked point was transformed into x and y coordinates, and the total foraging area was estimated by joining the external points. The area of each species was compared between stations using ANOVA.

Ant diet was investigated daily through continuous monitoring of nest entrances for two hours, during the activity peak of each species. Each species was sampled for 80 hours (40 per season). Food items brought by ants were collected, preserved in alcohol, and identified to order level.

Natural availability of food items was evaluated using pitfall traps distributed regularly in the study area. Paired traps were set at distances of 5 m-intervals from one another during a period of 48 hours (N=40 traps). Samplings were performed in the dry and rainy seasons.

Ant activity varies widely through 24 hours, with each species foraging more intensively during certain hours of the day or night (ANOVA, $F_{11,308} = 2,22$, $p = 0,01$). The number of foragers was significantly different between seasons, and generally during the rainy season the ants increased their activity (ANOVA, $F_{1,330} = 7,18$, $p = 0,01$). *Ectatomma edentatum* and *Pachycondyla striata* showed greater activity in the rainy season (*E. edentatum* – ANOVA, $F_{1,66} = 10,09$, $p = 0,01$; *P. striata* – ANOVA, $F_{1,66} = 15,61$, $p = 0,007$) with no preferred daily period for foraging. *Ectatomma permagnum* and *Odontomachus chelifer* showed a preferred foraging time (*E. permagnum* – ANOVA, $F_{7,42} = 4,28$, $p = 0,001$; *O. chelifer* – ANOVA, $F_{11,66} = 4,46$, $p < 0,001$), which did not change between the seasons. The foraging period of species is directly linked to their physiological characteristics and tolerance to fluctuations in temperature and humidity throughout the day (Hölldobler & Wilson, 1990). But variations in the activity schedule can also be a reflection of the behavior in the face of environmental conditions such as the availability of prey, presence of predators, or competing species (Hölldobler & Wilson, 1990).

The foraging areas differed among species (ANOVA, $F_{3,12} = 5,70$, $p = 0,01$) but did not vary between seasons for all species. *E. permagnum* had the largest foraging area (5,12 and 4,24m^2), whereas *E. edentatum* had the smallest (1,33 and 0,98m^2). The home range can vary according with the number of workers in the colonies and also with the availability of food in the environment (Breed *et al*. 1990). As reported for other ponerines elsewhere, our study species in cerrado presented relatively small home range (1.80 to 10 m^2) (Dejean *et al*., 1993, Medeiros & Oliveira, 2009).

The two *Ectatomma* species consumed predominantly fruits and seeds (*E. edentatum* – 22.2% and *E. permagnum* – 37.1%), followed by other ants and termites. Diptera, Blattodea and Araneae were also frequent items in the diet of *E. edentatum*. For *Odontomachus chelifer*, predominant items were fruits, seeds, Hemiptera and termites, which accounted together for 67.5% of the items retrieved. *P. striata* consumed mainly termites (34.8%), Hemiptera, fruits and seeds. The data on ant diet did not match the availability of potential prey collected by pitfall traps. Although the abundance of *Pheidole* and *Solenopsis* ants in traps was around 50% in both seasons, *Camponotus* ants were most consumed prey item by the predatory ants. Hemiptera, Diptera, Araneae, Coleoptera and Collembola were the most abundant arthropods in trap samplings. Our data indicate that *Ectatomma edentatum*, *E. permagnum*, *Odontomachus chelifer* and *Pachycondyla striata* can be considered opportunistic predators of ground-dwelling arthropods, with fruits and seeds comprising as well for a large part of their diets in cerrado. Additional samplings and an assessment using stable isotopes should provide a more detailed picture of the dietary requirements and trophic role these species. (CNPq, FAPESP, CNRS).

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ANTS PREYING ON ANTS: REPRODUCTIVE CONSTRAINTS ASSOCIATED WITH OBLIGATE MYRMECOPHAGY

N. CHALINE

Laboratoire d'Ethologie Expérimentale et Comparée, EA 4443, Université Paris 13, Sorbonne Paris Cité, 99, Avenue JB Clément, 93430 Villetaneuse, France, email: nchaline@hotmail.fr.

Ants have evolved various feeding habits, ranging from generalist species to extreme specialists, for example seed-eating or fungus growing. These specializations lead to specific selective pressure which may influence other life-history traits of these species. The ant Cerapachys biroi exhibit such a specialization, feeding exclusively on the brood of other ants which they hunt during raids on colonies of other species. This very particular ecology is combined with cyclic reproduction, clonality and intracolonial aggression raises the question of the importance of foraging habits on other traits. In this talk, I will review recent findings from my group on C. biroi, a new model system for social evolution and detail how foraging and reproductive ecology interact to create a unique social phenotype. I will also discuss how different reproductive strategies can evolve in the different existing clonal line and the strong regulation mechanisms at work to allow the ecological success of this invasive species.

RT 12
USE OF ANTS FOR BIOINDICATION

BIOINDICATION OF ABIOTIC CHANGES IN RESTORINNG AND PRESERVED FLOODING ECOSYSTEMS USING ANT ASSEMBLAGES AND SPECIES

S.P. RIBEIRO[1] & C.B. da COSTA-MILANEZ[1,2]

[1]Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Department of Biodiversity, Evolution and Environment/ICEB, Universidade Federal de Ouro Preto, Campus Morro do Cruzeiro, Ouro Preto, MG, Brazil, 30400-000; [2]Post-Graduate Program in Ecology and Conservation of Natural Resources, Laboratory of Behavioral Ecology and Interactions, Universidade Federal de Uberlândia, Uberlândia, MG 38400-902, Brazil

We show results from two study cases in Minas Gerais, Brazil. The first case is an evaluation of the response of ant species to the abiotic components of a river bed restoration project, after 11 years of dredging. The second case is a study of ant species responses to eucalyptus impact on the vereda ecosystem, an important cerrado wetland. Case 1- We studied the influence of the river's flooding zone, the distance from native vegetation, and the sedimentary grain size on ant species diversity, abundance and composition. In total, 10.784 ants were sampled, belonging to 6 subfamilies, 24 genera and 45 morphospecies. The ant species richness was greater in the savanna area than in the restoration habitats, and equivalently greater in the ecotone and intermediate zones than on the beach. *Atta sexdens rubropilosa* indicated a peculiar condition related to small forest remnants having well-structured soil. On the other hand, ants with a body size of under 0.5 cm (*Dorymyrmex pyramicus* and *Pheidole fallax*) predominated in sandy areas where the majority of the granules were the finest. The lack of organic matter and soil structure may prevent large ants from colonizing such areas, and thus inhibit the advance of natural succession. Case 2 - To assess how habitat within different veredas and plantations surrounding them affect ant assemblages, we selected four independent vereda locations, two impacted by *Eucalyptus* monoculture and two controls, where the wetland was surrounded by cerrado vegetation, using three complementary methods, namely baits, pitfall traps, and hand collection, in the wetland and in the surrounding habitats. A total of 7,575 ants were sampled, belonging to seven subfamilies, 32 genera and 124 species. Ant species richness and abundance did not differ between vereda locations, but did between the habitats. When impacted by the monoculture, ant species richness and abundance decreased in wetlands, but were less affected in the cerrado habitat. Ant species composition differed between the three habitats and between vereda locations. *Eucalyptus* plantations had an ant species composition defined by high dominance of *Pheidole* sp. and *Solenopsis invicta*, while natural habitats were defined by *Camponotus* and *Crematogaster* species. *Atta sexdens* was strictly confined to native habitats of non-impacted "veredas". *Eucalyptus* monocultures require high quantities of water in the early stages, which may have caused a decrease in groundwater level in the wetland, allowing hypogeic ants such as *Labidus praedator* to colonize this habitat. We conclude that any information available on ant species biology is an essential tool for habitat interpretation when considering bioindication. Classical community ecology statistics, such as species richness and similarity, may not be enough to provide some of the most relevant results of interest for restoration or habitat impact long term monitoring.

ANTS AS INDICATORS: WHEN, HOW AND WHY TO USE THEM

C.R. RIBAS[1], F.A. SCHMIDT[1,2,3], R.R.C. SOLAR[4,5], A.M. RABELLO[1,6], A.C.M. QUEIROZ[1,6], C.J. LASMAR[1], R.G. CUISSI[1], E.O. CANEDO-JÚNIOR[1,6] & D.L. BRAGA[1]

[1]Universidade Federal de Lavras, Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Lavras, MG, CEP: 37200-000, Lavras, Brasil, e-mail: crribas@gmail.com. [2] Departamento de Biologia Geral. Universidade Federal de Viçosa, Viçosa, MG, Brasil. [3]Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre, Rio Branco, AC, Brasil. [4]Departamento de Entomologia, Universidade Federal de Viçosa, Viçosa, MG, Brasil. [5]Lancaster Environment Centre, Lancaster University, UK. [6]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

Bioindicators are organisms that respond rapidly to habitat modifications and are used to detect these changes or to monitor the recovery after disturbance. In this sense, ants have been successfully formally used as bioindicators since 1983. In Brazil, although ants are widely used as bioindicators, several issues have been leading to confusing interpretations of general results, such as the lack of proper *a priori* hypothesis tests, weak sampling designs and unsuitable or no statistical analysis at all. In this talk I will discuss some ways of overcoming many of the drawbacks related to the robustness of the results and to reduce the financial, logistic, and time costs involved in studies using ants as indicators. First, I will present some ideas regarding when is necessary to use ants (or other organisms) as bioindicators. They should be used only if the direct measure of the disturbing factor in the environment is not easily perceived, or if there is not a clear and measurable link between the presence of the disturbing factor and its effect in the environment, also they are an alternative if it is too expensive to measure the impact. Theferore, we should use ants as bioindicators to detect or monitoring environmental impacts and its effects or recovery only when: i) this is the more viable solution; ii) the biological response is clear and consistent, discarding the situations above and not just based on the researcher's belief that collecting ants will give some idea about environment situation. Following the same rationale, there is a lot of improvement that could be incorporated at how to use ants as bioindicators. In a recent review published by me and colleagues, we discuss some of these potential improvements that will be presented in the talk, such as proper a priori hypotheses testing, more robust and appropriate sampling designs and statistical analyses, standardized methods, and choice of the diversity metric with the more clear response. Finally, I will discuss some theoretical reasons about why to use ants as bioindicators instead of other organisms, and present other practical ideas showing some case studies of my research team regarding several environmental impacts, such as: mining and its recovery, agriculture and pasture, fire, and other soil uses and its natural forest recovery. (CAPES, CNPq, FAPEMIG, VALE S/A)

ANTS AS BIOINDICATORS OF HABITAT DISTURBANCE IN BRAZIL: WHERE DO WE STAND?

R.I. CAMPOS

Laboratório de ecologia de Formigas, Departamento de Biologia Geral, Universidade Federal de Viçosa, Ed. Shotaro Chimoya, s/n, Campus Universitário, Viçosa-MG, Brasil, CEP: 36570-000, e-mail: ricardo.campos@ufv.br

Brazil is considered one of the richest countries in terms of species biodiversity but, since the middle of last century, Brazilian natural habitats have suffering accelerated structural modifications caused by anthropogenic activities. These human modifications seem to have a strong and negative effect on biodiversity and the ecosystem services performed by species. Based on this scenario, one of the fastest and cheapest tools that can be used to measure habitat disturbance is bioindication. Among the groups of organisms used as bioindicators, ants are considered excellent because they are extremely abundant, easy to sample and mainly, seem to be very sensitive to different kinds of environmental disturbances. In Brazil, although the study of ants as bioindicators being relatively new, some papers have shown promising results. For instance, ants have already been used as indicators in studies of forest fragmentation, fire, selective logging, intensive agriculture, urbanization, river dredging, mining and use of insecticides, among others. Moreover, some new approaches are worth to be cited, for example, the use of ants as bioindicators of nutrient cycling modification. Based on a recent revision for Brazil, among all the community structure parameters, ant species composition appears to be the most suitable metric to evaluate the effect of human disturbance on natural ecosystems. This same paper also point out that some analytical approaches based on species habitat preference (e.g. IndVal index) are also powerful tools in monitoring studies. In conclusion, regardless the recent advances in the study of ants as bioindicators in Brazil, some aspects need improvements. Among them it can be pointed: i) an increase in the number of papers on bioindication, specially published in English; ii) use of ants as bioindicators in different kinds of human disturbances and iii) an increment in the number of different habitats studied. Besides, is also necessary to follow the example of some countries more experienced in biomonitoring studies (e.g. Australia), setting up prior hypothesis, objectives and experimental design more coherent for studies of bioindication. (FAPEMIG, CAPES e CNPq)

ANTS AS BIOINDICATORS? ARE THEY THE BEST?

J.D. MAJER[1,2]

[1]Department of Environment and Agriculture, Curtin University, PO Box U1987, Perth, WA 6847, Australia. Email: J,Majer@curtin.edu.au
[2]Biomonitoring International, 45, Ranford Way, Hillarys, WA 6025, Australia. Email: Biomonitoring-international@bigpond.com

Most of us here are committed myrmecologists. A major research endeavour over the past 30 years has been the use of ants as bioindicators, either of ecological conditions, environmental conditions, or as surrogates for the biodiversity of other groups. My Google alert seems to turn up at least one new paper per week where ants have been used as indicators of some sort of environmental condition. Although other groups are also used as bioindicators, ants seem to be paramount. But is this justified, or have we simply done a good job of promoting out favoured group?

This presentation will evaluate the effectiveness of ants.

RT 13
DIRECT AND INDIRECT EFFECTS OF LEAF-CUTTING ANTS ON PLANTS

DIRECT AND INDIRECT EFFECTS OF LEAF-CUTTING ANTS ON PLANT ASSEMBLAGE

I.R. LEAL[1] & R. WIRTH[2]

[1]Departamento de Botânica, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego, s/n, Cidade Universitária, 50670-901, Recife, PE, Brazil, e-mail: irleal@ufpe.br; [2]Plant Ecology and Systematics, University of Kaiserslautern, P.O. Box 3049, 67663 Kaiserslautern, Germany, e-mail: wirth@rhrk.uni-kl.de

Leaf-cutting ants (*Atta* spp.) became a topical issue in neotropical ecology, particularly because they reach hyper-abundance due to escalating levels of fragmentation in recent years. We compile quantitative results on the manifold impacts leaf-cutting ants exert on Brazilian Atlantic Forest plant assemblage via direct (i.e. the trophic impact of herbivory and seed dispersion) and indirect (i.e. ecosystem engineering promoted by changes in microclimate and edaphic conditions) effects. We show that both types of impacts negatively influence plant performance of (1) plant species bearing ant-targeted seedlings; (2) small-seeded tree species without resprouting abilities, (3) light-sensitive, shade-tolerant species; and (4) plant species whose seeds require undisturbed habitats for better germination. In view of their omnipresence and ability to affect plant performance (from individual to assemblage level), leaf-cutting ants shed new light on the relevance of insect herbivores for the functioning and the successional trajectory experienced by novel tropical forest ecosystems.

INFLUENCES OF LEAF-CUTTING ANTS ON VEGETATION RECOVERY AFTER FIRE IN AMAZONIAN TRANSITIONAL FOREST

K.S. CARVALHO

Universidade Estadual do Sudoeste da Bahia, UESB, Campus Jequié, Av. José Moreira Sobrinho s/n, CEP 45200-000 – Bairro Jequiezinho, Jequié, BA, Brasil, e-mail: ksczool@yahoo.com.br

In this study we investigated the role of leaf-cutting ants in the post-fire vegetation recovery in a transitional forest, where the southern Amazon forest meets the Brazilian savanna. We hypothesized that a forest plot submitted to annual fire presents: (1) higher abundance of leaf-cutting ant nests; (2) higher removal of seeds; and (3) higher herbivory rates of leaf-cutting ants, when compared to the forest plots without fire (control). Because the leaf-cutter ants remove leaf litter and woody debris—potential fuels—in and around their nests and foraging trails, we tested whether leaf-cutter ant nests and trails (i) inhibit fire spread due to a lack of fuels, and (ii), thereby, reduce the total burned area during these experimental low-intensity fires, particularly at forest edges where leaf-cutter ant abundance is higher. The leaf-cutting ant nests were sampled, mapped, and checked up (after 17 months) to register their activity and new colonies emerging from the plot. We made comparative experiments of seeds removal and seedlings herbivory in two 50 ha plots, one submitted to annual fire and another without fire. In order to test the effect of ant nests on fire spread, two measurements were taken: (1) quantification of the amount of fine and small-medium woody fuels which dry faster than large woody debris on the forest floor on and near ant nest mounds and soil, and (2) calculation of the total area of bare soil created by nests and trails. The abundance of leaf-cutting nests was higher in the plot submitted to fire than in the control plot. The species found were: *Atta cephalotes*, *A. laevigata*, and *A. sexdens*, being the latter the most abundant and the one that showed an increase of active colonies after 17 months. The plot submitted to fire showed a higher abundance of seeds removed by leaf-cutting ants than the control. While more than two leaves were ripped per seedling in the plot under fire, less than one was registered in the control plot. It was also observed that the average abundance of seedlings attacked by leaf-cutting ant in the fire plot was higher than in the plot without fire. Fine-medium fuel mass increased with an increase in distance from ant nest, and the mean area of bare soil was greater on nests than on the forest floor. Between 60 to 90 percent of the unburned area was within 30m of ant nests, and burned area significantly increased with increasing distance to ant nests. In addition, the number of ant nests declined with increasing distance from the forest edge, and, with exception of the first experimental fire, burned area also increased with increasing distance from the edge. This study shows that the leaf-cutting ants may reduce seed germination and seedling recruitment, affecting the reproductive success and the composition of vegetation recovering from fire. Alternatively, the leaf-cutting ants may also speed up the regeneration process of unpalatable plant species. In this sense, we may conclude that the presence of leaf-cutting ants may interfere in the species composition of post fire forest. Moreover, the present study provides new insight to fire ecology in Amazon environments.

THE ROLE OF THE LEAF-CUTTING ANT *Atta sexdens* IN A DISTURBED CAATINGA AREA

P.S.D. SILVA[1], G.V. OLIVEIRA[2], T.N.N. CARMO[2], F.R.S. MARTINS[3] & M.M. CORRÊA[3]

[1]Departamento de Estudos Básicos e Instrumentais, Universidade Estadual do Sudoeste da Bahia (UESB), BR 415, Km 03, s/nº 45700-000 - Itapetinga, BA – Brazil. paulosavio@uesb.edu.br, [2]Especialização em Meio Ambiente e Desenvolvimento, Departamento de Estudos Básicos e Instrumentais (DEBI), Universidade Estadual do Sudoeste da Bahia (UESB). Praça da Primavera 40, Bairro Primavera, CEP 45700-000, Itapetinga, BA, Brasil. [3]Laboratório de Biodiversidade do Semi-Árido (LABISA), UESB, Estrada do Bem Querer, Km 04, Bairro Universitário, 45083-900, Vitória da Conquista, BA.

Leaf-cutting ants are becoming hyper-abundant in human-disturbed habitats such as tropical fragmented landscapes. Despite their recognized role as dominant herbivores promoting drastic changes on plant assemblages and the relatively good scientific knowledge about these insects in some Brazilian biomes (i.e., the Atlantic and Amazon Forests and the Cerrado savanna), little is known about their ecological role in the semi-arid Caatinga. Since 2010, we are studying the role of *Atta sexdens* in a degraded area of Caatinga in the municipality of Contendas do Sincorá, Bahia State. This area is located next to the Floresta Nacional (FLONA) Contendas do Sincorá, a well-preserved remnant of Caatinga with 11.034 hectares. Basically three questions have been focused by us: (1) What factors promote the establishment of *Atta sexdens* colonies in this degraded area? (2) Why *A. sexdens* does not occur in the FLONA? and (3) What are the direct and indirect impacts of foraging activity in this degraded area? Here, we report some preliminary results. The density of *A. sexdens* colonies in this degraded area reach 2.96 colonies ha^{-1} contrasting with the FLONA, where no colony was found at more than 13 hectares. A total of 103 plant individuals distributed within 18 species were identified during the foraging activity of five *Atta* colonies. The most foraged plant species was *Senna acuruensis* (Fabaceae), followed by *Croton argyrophyllus* (Euphorbiaceae) in the dry season and *Thiloa glaucocarpa* (Combretaceae) in the wet season. Workers collected not only pieces of fresh or dry leaves (accounting to 61% and 34% of harvested items, respectively), but also floral parts (4%) and seeds (1%). In these same five colonies, the 1-yr cumulative mean of foraging area size was 1028.82 ± (SE) 241.27 m^2, varying from 280.67 to 2592.78 m^2. Considering mean foraging area and colony density, we estimate that ants access ca. 30% of the entire degraded area. Based on the literature about the effects of leaf-cutting ants in Atlantic forest and Cerrado remnants and because the leaf-cutting ants can function as ecosystem engineers at different spatial scales, it is reasonable to expect environmental shifts as well as negative effects on plant assemblage structure caused by direct and indirect effects of *Atta* foraging activity. In this sense, we expect that *A. sexdens* presence will act as a potential environmental filter favoring the establishment and/or permanence of some plant species and, thus, altering the course of secondary succession in this degraded Caatinga area. (FAPESB)

THE INFLUENCE OF LEAF-CUTTER ANT NESTS ON SOILS AND VEGETATION IN CENTRAL BRAZIL

H.L. VASCONCELOS[1], A.N. COSTA[2] & E.M. BRUNA[3]

[1] Instituto de Biologia, Universidade Federal de Uberlândia (UFU), C.P. 593, CEP 38400-902, Uberlândia, MG, Brazil, email: heraldo@umuarama.ufu.br; [2]Universidade Federal de Goiás, Catalão, GO, Brazil; [3]Dept. Wildlife Ecolgy & Conservation, University of Florida, Gainesville, FL, USA.

The density of leaf-cutter ant nests can be quite high in many areas of the Brazilian Cerrado, but few studies have examined the influence of these nests on soil properties, microclimate, and especially on the structure and dynamics of the vegetation. We compared soil temperatures, humidity, toughness, and nutrient content between plots located in the center of *Atta laevigata* and *Atta sexdens* nests, in the edge of the nests, and away from nests. We also compared the abundance and species richness of woody plants at different distances from nests. Comparisons were performed both for active and inactive (dead) nests in three different Cerrado physiognomies: open savanna, closed savanna and semideciduous forest. A total of 60 nests were studied. Additional observations and experiments were conducted with 15 *A. laevigata* nests. More specifically, we evaluated the influence of nest distance on natural rates of seedling emergence and mortality, on seed germination, and on the survival of protected and unprotected transplanted seedlings. Soil toughness, humidity, and nutrient concentrations were significantly lower in the center of the nests than at the edge or away from nests, whereas soil temperatures were much higher. Similarly, the density of woody seedlings (< 20 cm in height) and saplings (21-120 cm) was lower in the center of active nests than away from these nests. Seedling density, however, did not differ in relation to distance from abandoned nests. Seed germination, and rates of seedling emergence and survival were significantly lower on nest mounds than away from nests. In spite of differences in soil conditions, growth and survival did not differ between seedlings planted in nest and non-nest soils. Intense defoliation of plants growing on top of the nests, seedling burial, and elevated soil temperatures (especially in the more open savannas) were the main factors explaining the low abundance of seedlings on active nests. Overall, our findings indicate that *Atta* nests have a very local, but pronounced effect on soils and on the structure and dynamics of the vegetation. (CNPq, CAPES)

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MULTIDISCIPLINAR STUDIES ON BRAZILIAN PONEROMORPH

TEMPORAL STRUCTURATION IN NETWORKS OF ANT-PLANT INTERACTION

G.M.M. SANTOS[1*], W. DÁTILLO[2] & S.J. PRESLEY[3]

[1]Universidade Estadual de Feira de Santana, Programa de Pós-Graduação em Zoologia, Feira de Santana, Bahia, Brazil, e-mail: gmms.uefs@gmail.com. [2]Universidad Veracruzana, Instituto de Neuroetología, Xalapa, Veracruz, Mexico. [3]Center for Environmental Sciences and Engineering and Department of Ecology and Evolutionary Biology, University of Connecticut, USA

The main structuring factors of natural communities are temporal patterns of resource use by coexisting species, habitat selection and diet preferences. A few decades ago, it was believed that the composition of ant communities was not variable over time. The high energy investment of the ants in their nests was used as a possible explanation for these organisms were semi-sessile and relatively faithful to their habitats. More recent studies have shown that different species respond differently to variations in environmental factors, both seasonally and throughout the day; a temporal segregation of the species may lead to a temporal partition of resources, which decreases direct competition among them. Hence, data on the time schedule of the activities carried out by different species may help to understand the relationship between environmental factors and the biology of these species, as well as niche partitioning in natural communities. Ants and plants interact in different ways, and studies focused on these interactions have made a great contribution to our current understanding of ecological interactions. Recently several studies have focused on the structure of ecological interactions using an approach derived from network theory. However, little is known about the effect of temporal variations on the topology of these networks. We evaluated how strong seasonality in resource availability in a semi-arid tropical environment affects the structure of ant-plant networks. We constructed interaction networks for flower-visiting ants in the *Caatinga* (steppe) of northeastern Brazil separately during the dry and green seasons. In general, the strong seasonality in the Brazilian *Caatinga* influenced the level specificity in ant-plant interactions and the overall complexity of the ant-plant networks. During the dry season, networks were more connected and less modular, reflecting in the greater niche overlap of ants during this season. Moreover, resource utilization by ants during the dry season tended to be more aggregated. These findings indicate that during the dry season, the ant species tended to share great number of resources, despite lower overall resource availability during this season. Species composition was highly season-specific; however, a central core of same generalist species was present during both seasons. The temporal stability of these generalists could strongly affect the ecological and evolutionary dynamics of these interaction networks. (CNPq, FAPESB, PELD, PRONEX)

SOME ADVANCES IN THE GENETICS OF PONERINAE ANTS OF THE BRAZILIAN ATLANTIC FOREST

M.A. COSTA[1], I.S. SANTOS[1], J.H.C. DELABIE[2], C.F. MARIANO[1], J.G. SILVA[1]

[1]Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz, Ilhéus, BA, Brazil, e-mail: costama@uesc.br; [2]Centro de Pesquisas do Cacau, Laboratório de Mirmecologia CEPEC/CEPLAC, Ilhéus, BA, Brazil.

Ponerinae comprises a subfamily of predatory ants widely distributed in different continents and have an abundant ant fauna in the Neotropics. It is a group of highly diverse morphology and behavior. In this group are found species whose nests ranging from tens to thousands of individuals, species of small size and others are among the largest ants, such as *Dinoponera*, the giant ant from the central corridor of the Brazilian Atlantic Forest that can reach up to 4 cm length. According to Bolton (2003), 25 genera of this subfamily are separated into tribes Thaumatomyrmecini, Platythyreini and Ponerini. As in various groups of Hymenoptera, Ponerinae is still little studied for genetic aspects, which leads to questions about how this diversity may be underestimated. Ponerinae presents many taxonomic problems and contains groups whose relationships are still unknown or very confusing. The genetic studies involving molecular and cytogenetic markers have contributed significantly in this matter. Analysis of fragments of mitochondrial genes cox1, Cox2 and Cytb in *D. lucida*, endemic of the central corridor of the rain forest revealed a high genetic divergence and population structure in this species. This population structure seems to be correlated with the maintenance of populations of this species in possible small refuges in south of Bahia. Cytogenetic studies of *Odontomachus* and *Anochetus* give support to a previous morphological analysis that suggests the origin of *Ondontomachus* from a lineage of *Anochetus*. In *Dinoponera*, the characterization of the karyotypes of four species, *D. australis* Emery, *Dinoponera gigantea* Perty, *Dinoponera lucida* Emery, and *Dinoponera quadriceps* Santschi, revealed a high number of chromosomes of small size (*D. australis*, 2n = 114; *D. gigantea*, 2n = 82; *D. lucida*, 2n = 118/120 , *D. quadriceps*, 2n = 92), being among the largest recorded for ants. *D. lucida* also showed a trend of numerical differentiation in the north-south of its distribution in the central corridor of the Atlantic. The emphasis that the karyotypes of ants evolve mainly by centric fission generating high numbered karyotypes with the characteristics of *Dinoponera* has been given by some authors. However closely related groups have also shown reduced numbers and large chromosomes, indicating that evolutionary pattern may be more complex. The presence of a chromosome pair distinguished by its larger size in all species *Dinoponera* may represent a cytotaxonomic marker for group. Preliminary analysis by microdissection and chromosome painting indicated a different content from the rest of the genome. The refinement of this technique may provide new information about the organization of the genome in these species and allow comparative analysis with related species such as the *Pachycondyla* species. (Projeto PRONEX CNPq/FAPESB)

IMMUNITY AND SOCIALITY IN PONEROMORPHA

D.J. de SOUZA

Fundação Universidade Federal do Tocantins – Campus de Gurupi – 77402-970, Gurupi, Tocantins, Brazil. danival@uft.edu.br

The colonial lifestyle has ecological and evolutionary advantages, but it increases the risks of pathogen transmission. Considering social insects, like bees, wasps, and ants, they are particularly vulnerable to the threat posed by parasites. Colonies are made up of many highly related individuals that live in close proximity in a comparatively stable environment. Consequently, the colony becomes a very attractive resource for other living beings, commensal and parasite organisms, including viruses, bacteria, fungi, protozoa, helminthes and parasitoids and even other social species (Schmid-Hempel, 1998). Characteristics of the host population or of its habitat can affect the diversity and the abundance of parasites. Predictions derived from epidemiological models assume that parasite abundance and parasite species richness should increase with increasing host population density, at least for directly transmitted parasites. Ants from Poneromorpha complex, particularly the subfamily Ponerinae, are a group of special interest to study the evolution of sociality and mechanisms of immune defense in social insects because they exhibit great diversity of social organization and size population. Most species have relatively small nest populations and their foragers are usually solitary huntresses and engage in no recruitment communication (Hölldobler & Wilson, 2008). For example, the genus *Thaumatomyrmex* forms small population units made up of less than five individuals (Brandão *et al.*, 1991; Jahyny *et al*., 2007) and the population of the asian species *Leptogenys processionalis distinguenda* can reach 30,000 workers. Hölldobler & Wilson (2008) call attention to the diversity of social organization found in a single genus: *Pachycondyla*. There are small monogynous societies, as that of *Pachycondyla apicalis* (~ 100 adult workers), up to gigantic colonies of *Pachycondyla tarsata* (their colonies can reach 2,500 individuals with a single queen). Some of the most important questions in the field of evolutionary ecology have been to understand why immune responses vary among host species and vary with many other factors, such as environment, stage of the host's life cycle or infection by different parasite types. Immune defence strategies in Poneromorpha are poorly known, despite the fact that it constitutes an ideal model to test the effects of population size and social organization on the immune system of social insects. Also, nest architecture is another important factor in controlling the spread of diseases that require contact for transmission. Nests having even a simple spatial separation of chambers could delay the spread of infection and diminish the severity of an outbreak (Pie *et al.*, 2004). In Poneromorpha, we can find a considerable variation in nest architecture, both in form and in size. In general they are very profound and the increase of ant density leads to an increase in the number of chambers, as well as nest depth. Some species, as *Ectatomma vizottoi*, constructs specific chambers for detritus.

Hygienic behaviour is an important trait in social insect colonies. Behavioural repertoire of some species of Poneromorpha has been described, but there is a lack of comparative studies among ant subfamilies that could point the evolutionary trend of this behaviour. The smaller population of these ants, compared to species having thousands or millions of individuals in the population, would imply less need for hygienic behaviour. Farish (1972) made a comparison of several families of Hymenoptera and included a comparison of different subfamilies of Formicidae. He found remarkable qualitative grooming differences at the subfamily level in the Formicidae. Based on these qualitative differences, the Ponerinae, Myrmeciinae, and Pseudomyrmicinae were considered primitive. Conversely, the Myrmicinae, Dolichoderinae and Formicinae appear to be specialized. Although these data are considered only suggestive, at the same time, they indicate considerable value in pursuing these investigations further. The elaboration of complete ethograms to Poneromorpha, as that done by Miguel & Del-Claro (2005) in *Ectatomma opaciventre*, will be important to understand the evolution of hygienic behavior in this group.

Social insects have developed several behavioural and physiological defence mechanisms, including using protection provided by other organisms. Metapleural glands (MG) are unique to ants and basal in the evolutionary history of ants. Their secretion has important role against microorganisms living in the ant and on the colony. MG secretions are highly acidic (Maschwitz, 1974) and their antimicrobial effects may be largely due to this acidity. In diverse ponerine workers the pH of the MG secretions ranges from 3 to 4. It is necessary to investigate if other glands could also produce antiseptic substances against hazardous microorganisms. For example, ponericins are antibacterial and insecticidal peptides that were isolated from the venom of the ant *Pachycondyla goeldii* (Orivel *et al.,* 2001). Attygalle *et al.* (1996) investigated the intersegmental gland complex of *Pachycondyla tridentata*, but the nature of the substances identified does not suggest that these organs are sources of antibiotics. However, the functions of the secretions from several exocrine glands found in the ants remain unknown. In addition to their own antibiotics, some species of ants utilize antimicrobial substances of vegetable origin and others harbour antibiotics-producing bacteria to control parasites (Currie *et al.*, 1999). The presence of these symbionts modulates and improves the immune system of their hosts (de Souza et al., 2009; de Souza *et al*., 2013). For example, the presence of the endosymbiotic bacteria *Blochmmania* has been associated with an increased ability of *Camponotus* ants (Formicinae) to encapsulate foreign implants (de Souza *et al.*, 2009). Endosymbiotic bacteria in Poneromorpha are less studied. Caetano *et al.* (2009) reported the first occurrence of endosymbionts in the midgut cells of the primitive ponerine ant *Odontomachus bauri*. The presence of these microorganisms in the midgut of *O. bauri*, including inside cells, suggests their participation in food digestion. However, as pointed by the authors, their role in the life cycle is very difficult to be determined due to a wide variability, lack of a specific location and knowledge on the diet, behavior and anatomy of the host species. Like other symbiotic bacteria present in the gut of insects, these microorganisms could affect the immune system of these ants, either directly, producing antimicrobial molecules, or indirectly, by a nutritional effect.

In the queenless poneromorph species, the totipotency of workers induces potential conflicts over reproduction. Bocher *et al.* (2008) verified that stress from conflict could induce immunosuppression in workers of *Diacamma* sp. Simple techniques to evaluate immunocompetence, as encapsulation bioassay, will be valuable to determine how immunity acts in establishing dominance hierarchy in queenless ant.

Poneromorph ants are highly diverse and yet unknown. The way parasites pressure and immune defences affect the evolution of this group depends on comparative studies that cover the different social organizations found in this fascinating group of ants.

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MORPHOLOGICAL DIVERSITY AND SITE CHARACTERISTICS OF PONEROMORPH ANTS IN TWO SOUTHEASTERN BRAZIL ATLANTIC FOREST AREAS

R.R. SILVA[1] & M.S.C. MORINI[2]

[1]Museu Paraense Emílio Goeldi, Coordenação de Ciências da Terra e Ecologia, Av. Perimetral 1901, CEP 66077-530, Belém, PA, Brasil, e-mail: rogeriorosas@gmail.com; [2]Universidade de Mogi das Cruzes (UMC), Núcleo de Ciências Ambientais (NCA), Laboratório de Mirmecologia, Mogi das Cruzes, SP, Brasil.

The use of functional traits to explain species assemblages along environmental gradients is a current trend in community ecology. Studies of trait-environment links are important because they may contribute to the understanding of ecosystem functioning and allow predictions of how environmental changes can alter assemblage composition, promoting theoretical advances. Ant ecology studies could benefit from a trait-based framework to further develop predictions of ant communities' characteristics under various environmental conditions. Recent studies on ant morphology and community structure have helped to link morphology and habitat complexity, morphology and habitat filtering, as well as functional diversity and disturbances. Poneromorph ants are in general predators, although some feed also on plant nectar, fruits, and the hemipteran honeydew secretions. As a predator group, poneromorph ants may impose complex and strong effects on lower trophic levels. In this study we aim to analyze the relationship between poneromorph morphology and determinants of species distribution in datasets describing morphology-community-environment links in 180 plots of 30 sites. In the first study (eucalypt forests dataset) we sampled ant communities in 20 sites along a regeneration gradient of Atlantic Forest in eucalypt plantations, representing four vegetation types; five sites being sampled in each vegetation type. In the second study (Atlantic Forest dataset) we sampled 10 sites of Atlantic Forest in southeastern of Brazil to model the relationship between ant diversity and environment at local and regional scales. In each study, six 50 cm^2 plots distant 50 m one from each other were set at each site and the ant fauna and other invertebrates extracted from litter samples using Berlese funnels; the ant species nesting in twigs were also sampled and determined to species level. We measured environmental variables to analyze the relationship between morphology and environment (litter density, litter weight, litter pH, vegetation structure, soil and particles size); further, bacteria and fungi diversity were quantified from litter samples in the Atlantic Forest survey. We collected 15 and 18 poneromorph ant species in the eucalyptus and in the Atlantic Forest areas (total ant species richness= 68 and 66 species, respectively). In total, we captured 4,375 ants and 5,253 invertebrates in 120 samples from the eucalyptus areas, and 3,403 ants and 8,075 invertebrates in 60 samples from the Atlantic Forest areas. Each poneromorph species was described in terms of the 22 morphological traits recognized as important in ant ecology. In this study we discuss the relationship between poneromorph morphology, habitat characteristics and invertebrates composition at small scales. We discuss also the contribution of poneromorph ants to the morphological morphospace in ant communities. (FAPESP)

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THIS SPECIES IS MINE! ADVENTURES AND MISADVENTURES OF THE TAXONOMIST MINORITY

A WISH-LIST FROM TAXONOMISTS TO ECOLOGISTS

R.M. FEITOSA

Universidade Federal do Paraná, Departamento de Zoologia, Caixa Postal 19020, 81531-980, Centro Politécnico, Curitiba, PR, Brazil. Email: rsmfeitosa@gmail.com

Brazilian myrmecology is witnessing an impressive increase in the number of contributions and specialists in ant ecology. In fact, most of the myrmecologists working on the Brazilian ant fauna are community ecologists. On the other hand, it is possible to count on the fingers of one hand the number of ant taxonomists actively working in Brazil. In this text, I present my perspective as a taxonomist on the relationships between ecologists and taxonomic specialists.

Much research in community ecology relies on an accurate enumeration of coexisting species and their relative abundances (Morin, 1999). Studies in community ecology require, ideally, that the individuals in a sample be properly counted and identified to the specific level. Therefore, all of community ecology depends very much on current species classification and taxonomic tools for identification, which means that community ecology is closely linked to work in taxonomy and species identification.

Considering the interaction between ecologists and taxonomists, Gotelli (2004) published a wish-list of phylogenetic and taxonomic needs for community ecology. In this list Gotelli mentions the need of (1) well-written taxonomic keys based on morphological characters for species-level identifications; (2) a current and comprehensive nomenclature, and a historical record of previously used nomenclature, so that present species lists can be easily compared with those generated in the past; (3) access to museum and herbarium records to be able to compile species occurrence records with spatial and temporal data that are physically associated with the specimen or collection; and (4) to know the current classification of our species and to have a resolved phylogeny (with confidence measures) that illustrates sister taxa and the phylogenetic status of species and entire communities.

More than fair, Gotelli's requests are necessary and urgent. Taxonomists must be engaged in providing immediate access to scientific names and, most importantly, ensure that a scientific name will be the most rapid and reliable access to a number of biological information. However, it is important to note that in the same way that taxonomy is important for ecology, information from ecological studies are extremely useful in taxonomic works, and more than that, the material from such studies is often what feeds the database of taxonomic revisions.

In many cases, taxonomists only have access to this material when it is sent to them for identification or species confirmation. The definition of the terms in which this service will be done is on account of a prior agreement between the parties involved and is usually a delicate matter which may be considered a service provision involving values or authorship or it can be considered a mere favor, in which the taxonomist believes that to access the material would be a "fair wage". In this sense, I present here a list of requests from taxonomists to community ecologists in templates developed by Gotelli (2004) which aims not only benefit the taxonomic community, but science as a whole.

Fixing and storage

Taxonomists require that the material to be examined has been fixed properly, so that during the collecting events the fixative substance and its concentration are compatible with exposure time and storing of samples. This simple task may prevent the decomposition of the material, which in turn compromises the following processing steps. Today we recognize the great importance of molecular biology to the different areas of science and, of course, taxonomy has increasingly benefited from this tool. Thus, it is essential that ecologists consider the importance of storing the material into substances that allow the use of samples for molecular studies. In this aspect 90% ethanol lends itself well to paper and does not cause the stiffness of specimens as, for example, absolute ethanol (King & Porter, 2004).

Mounting and labeling

With an emphasis on my personal experience as a taxonomist and curator, I can say that few feelings are as frustrating as receiving a shipment of material for deposit or identification with inappropriate mounting and labeling. Especially when this material comes from a locality of primary taxonomic interest. It is a fact that the time invested in a good processing of material directly reflects in the ability to identify the species. In the rush to quickly process the material and thus get rid of this “tedious” part of work to finally devote to what "really matters", some ecologists can feel tempted to practice an uncompromised processing of samples resulting in a material of poor quality and, in some cases, not identifiable. Abound in the literature and internet sources with procedures for proper mounting and labeling of ants (e.g. Lattke, 2000; 2003), as well as national and international courses which train young myrmecologists for this task. The material of which mounting does not allow precise identification and labels with missing data (or only containing collection codes) are virtually useless from a scientific standpoint.

Deposit of vouchers

One of the basic principles of any scientific study is replicability. To ensure the validity and reliability of a scientific work it is necessary for the author to provide the reader with information to enable that the experiments of this work can be redone, which theoretically allows that the results achieved could be tested. This information is usually presented in the Materials and Methods section of most papers. In this sense, it is essential that ecologists undertake to give a suitable destination to the material used in their research and let it clear in their work. In addition to ensure the correct processing of the material it is important that the specimens are deposited in a location which provides an proper storage and simultaneously permits access by interested researches at any time. Only in this way ecologists ensure that in case of contestation of their results or even if the material is of interest to another type of research, the specimens will be well preserved and available for future studies.

Recognition of taxonomic work

Fortunately, the increasing devaluation of taxonomy in the scientific scenario does not seem to affect the global vision that ecologists have of this that is the basis for all other areas of biological sciences. Personally, I never came across an ecologist who does not recognize the importance of taxonomy. Yet, traditionally, taxonomic papers are used only as a reference source. Researchers interested in identifying certain taxa resort to a paper that contains an updated taxonomic key and after naming their species simply do not matter to cite this work as part of the methodology used in their work. Besides the ethical question behind this common practice, that is to use a scientific work without giving it due credit, the consequences of this act directly reflect in the current crisis that taxonomy is facing.

In a world where the value of a journal is measured by its impact factor and the value of a researcher is measured by one of several indices created to quantify the penetration of its production (number of citations), the taxonomist is in a paradox where for more than the ecologists recognize its importance, there are only a small group who bother to formally cite taxonomic works used in their research. Consequently, it creates a class of "low impact" researchers that will certainly face strong difficulties in getting financing for their projects and for the maintenance of collections for which they are responsible. Without recognition and, more importantly, without the support of ecologists, the taxonomic crisis will soon give way to what is already being called a mass extinction of taxonomists. Thus, using the words of Garnock Jones (2013), here I leave a last request of taxonomists for ecologists: “if you value the taxonomic system that enables you to describe and interpret your research, cite at least one taxonomic paper that underpins each paper you publish, and commit to never omitting any relevant ones. It's a small thing to do to support the discipline that supports your work”.

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INTEGRATING KNOWLEDGE: THE ROLE OF TAXONOMISTS AGAINST OTHER SCIENTIFIC DISCIPLINES

F. CUEZZO

Instituto Superior de Entomología "Dr. A. Willink" (INSUE), Facultad de Ciencias Naturales e IML, Miguel Lillo 205, T4000JFE, San Miguel de Tucumán, Tucumán, Argentina-CONICET. E-mail: cuezzof@yahoo.com.ar

Taxonomy is a part of biology that explores, discovers, represents, names and organizes the life by its process of origin (Ebach *et al*., 2011).

In a society, a taxonomist performs various tasks that pass frequently unnoticed. Basic tasks of a taxonomist include two main: one, more devoted to the scientific community, is to delimit and classify the basic units of biodiversity, the species, and other, open to the rest of the community, is to give a name to this entities and provide tools to facilitate the identification of the species (or other taxon) in form of descriptions, reviews, monographs and taxonomic keys.

Then, it is important to recognize that: a) a taxonomist is not a simple "giver of names", anchored to the past and b) the only interest of his life is not to make lists of species. If the latter were true, every taxonomist could be easily replaced by a machine, as the mythical, but fabulous, bar-code portable lector created to identify species at the ground with only one pass.

Research made by taxonomist involve much more than those above mentioned. In the process to describe and represent a new organism or the diversity of life, a taxonomist makes comparisons with other organisms, but not arbitraries, assuming a unity of origin; establishing relationships in function of an objective and concrete value of the shared homologies. The taxonomic classifications have this predictive value, not only by those that include, but also by these that not include in it (Platnick, 2009) and create a theoretical framework within which to develop projects and research.

The lack of taxonomist and funding to the development of his work, in the last two decades, was named as "taxonomic impediment". This "impediment" has, however, several faces, and one of this is to find ways to accelerate the process to describe and delimit the taxonomic units, the species, facing to the community that require this names as base of its own researches.

A possible way to solve this impediment is to establish a more close collaboration between researchers in several disciplines, such as ecologists, biogeographers, morphologists, chemists, and taxonomists, between others. If information and specimens are shared is possible to advance faster.

Taxonomists share the same basic object of study with several other researchers, but differ in the objective of his studies and in the languages used to face his own research. Thus, an ecologist interested in community studies or diversity, look for the species not as single units but as members of a community and try to build models that explain, for example, the structure of the community, with a more statistical or mathematical thinking. The same community, studied by a biogeographer will be seen from a totally different perspective, interested in the spatial distribution of these species than in the functioning or structure of the community. A taxonomist, however, seek to interpret the affinities between the species in that community and if they share common histories that have led to coexist in the same space.

To share experiences from different fields of research can help to accelerate the complex process of knowledge of the planet's biodiversity. But first, we need to learn how to communicate our interest to other researchers in the clearest way possible.

An ecologist or biogeographer, for example, needs to learn the “taxonomic language”, spending some time reading reviews or keys, making a fluid dialog with taxonomists, clearly telling which is the purpose and why they need to know the identity of the taxa studied. And the taxonomists need the same to communicate efficiently with their counterparts.

If a researcher has no expertise in taxonomy and he or she will need species identification (or at least to corroborate it), and other information that could be given by a taxonomist, they first needs to do some homework before to contact a specialist. It is necessary to remember that the taxonomist need help to help.

A first step to help is to provide samples as clean as possible. It is important to separate from the original sample, a sub-sample of well curated specimens, part of which will be send to the taxonomist and the other part will constitute a reference collection that will be really useful for future research. If the material cannot be curated, at least could be sorted as much as possible and labeled.

To do the first sort to morphospecies, researchers must take advantage of the multiple resources available in the World Wide Web. In the case of the myrmecological works, there are several data bases that are really useful to provide reliable identifications, at list at generic rank. Excellent examples are: antbase.org (the first impressive base that join a big amount of taxonomical papers catalogued by authors and taxon); antweb.org (images); antcat.org (taxonomic references, an online catalog to ant references), the gap initiative: gap.entclub.org (a list of ant taxonomists and much more), etc. It is important to recognize that a good image alone is not enough to identify correctly a species, but is a really useful tool to provide us a first approach. Try to identify these samples using available keys, it will reduce the labor of the taxonomist. Unfortunately, the automated ID is not always possible today (Gaston, 2004).

Spend some time to learn some basic characters used in the group. Some ecologists take courses or send students to learn more about a specific taxonomic group. Hymenopterists has the advantage to have excellent experiences in this kind of courses: Antcourse, Hymcourse, and local versions of those in several countries that deals specifically with local fauna.

Establishing a fluid contact with the specialist (in that case a taxonomist), will be another good choice. Usually the taxonomist can provide a lot of information that is not published anywhere and is part of their experience in their daily work, and, if possible, visit local museums or collections to compare your samples with the specimens deposited there.

Think to preserve your material for future research, invest time to prepare and deposit vouchers from your ecological study, a practice well implemented between taxonomists, but not always follow by other researchers. And finally, as Gotelli (2004) clearly says: “collaborations between taxonomist and ecologists (or, as I think, other researchers such as biogeographers) will strengthen both research programs”. Collaborative efforts could increase benefit, and contribute to shovel the taxonomic impediment that is evident in our day.

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SAFEGUARDING AND COMMUNICATION SCIENTIFIC COLLECTIONS. HOW AND WHY TO COLLECT?

C.R.F. BRANDÃO

Museu de Zoologia da universidade de São Paulo, av. Nazaré 481, Sâo Paulo, SP, Brasil, 04263-000, crfbrand@usp.br

Natural history collections in museums are a three-dimensional archive of the natural world and the relationships of societies with their environments. In many cases, they may document a world that no longer exists. As such, these collections should be treated with the care and attention merited by such an important resource (ICOM NAT HIST, 2013).
Collections of organisms are organized and maintained with three basic objectives: to support scientific programs, to serve as testimonies allowing the replication of scientific work, and to maintain the stability of Zoological and Botanical Nomenclature by keeping and allowing the study of types under their guard. More recently, institutions that maintain collections of organisms have been increasingly considered as legal depositories for purposes of benefit-sharing by land owners or by traditional communities that own knowledge important in different contests. The maintenance of collections of organisms requires specialized training of personnel both in collection techniques and collections maintenance, but also in scientific interpretation. All these tasks lead to ethical issues; given the growing legal regulations and standards, the present essay intends to stimulate the debate on organisms' collection by biologists without, however, discuss legal aspects linked to this activity.

The goal here is to seek contributions for a reflection on aspects that we must bear in mind when planning the withdrawal of an organism from nature. For everyone, but especially for a biologist, such act implies awareness of impacts to individuals and to the environment and on the liability that the professional training demands. The projects should be treated, at least initially, in the field of ethics. Ethical principles established by the society for the scientific collection of organisms are from where regulatory standards and laws must derive. In Brazil, by contrary, normalization began before the debate, often generating conflicting relations between the scientific community and the Governmental organs responsible for environmental preservation and monitoring of actions that cause potential impact. While some institutions already have a code to which they adhere, the standard is not universal. Thus, the objective is to establish a minimum standard of practice which can be built on by individual institutions.

Ethical dilemmas regarding the withdrawal of organisms from nature for purposes of scientific study are resolved in exercising critical judgment about human values, in turn consecrated by uses and customs, resulting ultimately in codes of conduct. We need to build a code of ethics concerning the various actions involved in the activities of organisms' collection even if only to build a conceptual framework and a common language in the discussion of the procedures and researcher's attitude vis-à-vis the nature organisms. The definition of this ethical posture would contribute and facilitate the resolution of disputes with the other many actors involved in the negotiations about the scientific collection. An ethical exercise demands respect to the possible different points of view and, if necessary, course corrections based on the classic benchmarks of bioethics. These general principles, adaptable to various situations to guide conducts, must be adjusted to the present case. The general principles that orient these special classes of ethical dilemmas are the non-maleficence, namely the preferential option for non-harmful actions to organisms and to the environment around them, the beneficence, derived from the critical analysis of risks and benefits; and the principle of Justice.

The activities of collection and research on organisms in Brazil are regulated or suffer effects of rules issued by organs that belong to different ministries: Justice, with regard to compliance with the laws that govern the matter; of Foreign Affairs, when there is any exchange of biological material with institutions abroad; of Health and of Agriculture, Livestock and Food supply, when it comes to organisms of medical, veterinary and agricultural interest; the Environment and Science and Technology, for being our research of strategic interest to the country, to meet the need for improvement of scientific knowledge about the components of our biota and to its conservation, not to mention other interfaces of our activities with the Government in its various spheres.

In 2005 UNESCO adopted the Universal Declaration on Bioethics and Human Rights, addressing ethical 14 principles related to medicine, life sciences and associated technologies as applied to human beings, taking into account social, legal and environmental dimensions. Three of these principles relate to the subject hereof, namely: a. one must ensure the relationship between human beings and other forms of life, b. to protect future generations, one must consider the impact of life sciences and, finally, c. the benefits resulting from scientific research should be shared with the society as a whole and within the international community. It is important to bear in mind, however, that although this declaration has a universal scope; countries continue to be independent to set their own policies.

In Brazil we have seen, from the date of publication of the resolution 196 of the National Council of Health in 1995, the creation of more than 500 committees accredited, congregating almost 7000 people who discuss ethical aspects linked to the research with humans. The collection of organisms in nature did not receive, so far, the same attention.

The good scientific practice determines that collection activities incorporate research protocols defined from clear and explicit assumptions. Ethical concerns must be present in the initial discussions for the preparation of projects, allowing adjustments that limited potential risks to the components of flora and fauna, when preventable. A way to mitigate the effects of new collections is to use existing information on collections, focusing on updating and/or completing collections. Alternatively, one should consider the possibility of developing alternative methods, such as mathematical models and/or computer simulations, thus reducing the number of collected specimens. The same concerns should guide the elaboration of protocols for collections that captures a single organism to the floristic and faunal surveys of whole biomes.

Only from clearly formulated questions and on the basis of a careful assessment of technical conditions and staffing of the involved laboratories, it will be possible to quantify how many and which specimens should be collected. It is necessary to evaluate clearly the technical capacity to process the material to be removed from nature and also the number of copies required for the intended work, weighting the implications of these actions. This makes it essential to plan the activities according to the efforts and attention one can devote to the material, avoiding excessive collection and, in particular, the unnecessary disposal of copies.

Different techniques for collecting and handling specimens cause different results as regards the potential for suffering, which at all times should be minimized and, if possible, completely avoided. In cases where the sacrifice is essential, it should be quick and painless, aside from the choice of processes that preserve the integrity of the individual. One way to minimize population effects of these activities is selecting for collection or sacrifice, exemplars of elderly, sterile or post reproductive age.

Massive collection techniques, like non-specific traps are often required to answer certain questions, but one must prioritize techniques that preserve information on interspecific relationships of organisms with the environment where they were found. Accurate and complete documentation on all stages ensures not only the possibility of eventual repetition of procedures, but allows one to keep valuable information about specific conditions. Currently, this documentation may involve the georeferencing, precise registration in databases and related images, in addition to the definitive and complete labeling of information along with the specimens, so as not to allow the information to be separated from bearers. The same cautions are required for animal products, their nests, eggshells, sounds, images, in short any and all records. In the case of division of the material in sub-samples, the documentation shall enable the rescue of information relating to the original specimens.

It is important to keep the same ethical criteria for treating any biological material. Because of the generalized anthropocentrism, in several instances species more socially “accepted” or those more similar to man receive special attention, in detriment of organisms considered "not so important", those which cause repulsion, or even those that cause negative economic importance, such as the so-called agricultural, medical or veterinary pests.

Working with organisms means acknowledging that the current concept of species is not always amenable to practical application, not only because of its complexity, but because many times we have no way of knowing the reproductive status of individuals and their relationships with others of the same species. Species represent amplitudes of variation in characters of all sorts and documenting these variations is often the goal of a research program, which requires appropriate sizing of the collections. Recognizing our difficulty to determine clearly, in many cases, the taxon with which we are working, and to allow for clarification in the future, makes essential to keep testimony material in collections to ensure proper technique and persistent curation to allow access to material to researchers recognized by the community interested in this exam. Taxonomic concepts change over time and only the examination of the material originally studied by authors can confirm the identity of the taxa. The same care should be extended to the research of any living organisms. It's still quite frequent that the copies are disposed after experiments or observations, without the worry of keeping material testimony in collection-bearing institutions.

One of the main arguments that the scientific community has used in discussions with preservation agencies, is that scientific collections have negligible effect on natural populations, despite the lack of reliable data on this. Even if true (and it should be in most cases), it does not diminish the responsibility of the researcher and the need to fix the appropriate collection effort to each situation and the questions one wants to answer.

Transporting the collected material to its destiny institution, especially living organisms, and their maintenance in captivity must also conform to the standards that ensure correct conditions, comfort, avoidance of stress and the reproduction as accurate as possible of the most appropriate biotic and abiotic environmental cycles, the quantity and quality of food and water availability appropriate to the concerned species.

It is incumbent upon the researcher to extract as much information as possible from a research program based on organisms and, when applicable, to share copies with other researchers or use them in other experiments, or as educational material, minimizing, thus, the effects of the collections, even if in our eyes, these are negligible.

Teaching collections can and should be useful to several classes of students at the same time and/or be used continuously, therefore deserving the same treatment and respect that the scientific and/or permanent collections receive. In practical classes, it is necessary to apply anesthetics (even for invertebrates) in potentially painful procedures, or even, for eventual sacrifice and discard.

Finally, any research program only has meaning if the results are published and shared with the society, which supports the research and deserves to benefit from the progresses derived from the scientific research. Often, the results have no immediate application, or are difficult to understand by the non-specialist. It is worth remembering that the dissemination of preliminary results or on which one is not yet sure, can lead to misunderstandings; it is necessary to qualify what is being circulated and take care to at least warn users of these uncertainties. Names of organisms are powerful indexers; to publish erroneous identifications can lead others to illegitimate conclusions. It is interesting to note the increasing efforts made by the press today, in order to translate scientific data of highly specialized publications to the general public. It is worth noting, lastly, that scientific publications reach restricted portions of the community and that there are more comprehensive ways of disseminating information, appropriate to each case and purpose.

Unfortunately Brazil opted for a legal system that focuses on a few federal agencies the responsibility to legislate, certify, authorize and monitor any and all activity related to collecting organisms, contradicting public administration manuals. Notwithstanding this unwelcome concentration, being a biologist means often - using a current definition – remove organisms from *in situ* conditions to keep them in *ex situ* conditions. i.e., it is inherent to the activity of the biologist, and essential for scientific analysis, to manipulate organisms. We can no longer evade, however, the discussion of the ethical responsibilities involved in our actions.

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RT 16
CONTROL OF PEST ANTS AND INVASION PROCESSES

A NEW ANT SPECIES INVADING THE BRAZILIAN HOUSEHOLDS

A.E.C. CAMPOS, R.K. RONSINI, R. HARAKAVA, F.J. ZORZENON & A.M. ALENCAR

Instituto Biológico, Av. Conselheiro Rodrigues Alves, 1252. São Paulo, SP, 04014-002. E-mail: anaefari@biologico.sp.gov.br

Solenopsis species are common in urban environments, especially in highly disturbed habitats. The true fire ants (*Solenopsis saevissima* and *Solenopsis invicta)* are easy to find in squares, gardens, sidewalks, and yards. Thief ants are less common and hardly collected in urban surveys in Brazil. In 2010 we received some samples from a "stinky ant" that was causing annoyance in urban areas in the city of Niteroi, state of Rio de Janeiro. Besides its strong smell of feces, the workers were invading households, causing damage to the electrical wires and were stinging. After this first registration, three similar observations were recorded in the state of Rio de Janeiro and in 2011 in Itatiba, state of São Paulo. All infestations had similar complaints and the species was the same, a thief ant, but apparently not described yet. Collections were made in Itatiba, SP and since August 2012 we have been monitoring the infestation. The species invades *Cornitermes cumulans* (Isoptera) nests to accommodate their brood, but shallow nests beneath the soil surfaces are also found in external gardens, under flower pots and inside electrical conduits, in the households. During the lecture it will be discussed the recent knowledge on this species and its impact on the myrmecofauna and human lives. (CNPq)

THE EVOLUTION OF TRAITS CONFERING INVASION SUCCESS IN THE ANT GENUS *Linepithema*

J. HOLLEY, A.L. WILD & A.V. SUAREZ

Department of Entomology, University of Illinois, Urbana, IL 61801, USA, email: jholley@life.illinois.edu; suarez2@illinois.edu.

Biological invasions are a leading threat to biodiversity yet we still do not have a predictive understanding of why some introduced organisms are successful at establishing in new environments while other are not. Ants are among the most notorious invaders and several life history traits are correlated with their success. For example, invasive ants often have large networks of nest (polydomy), reproduce by budding, have many egg-laying queens (polygyny), and can reproduce within the nest. A key approach to understanding the success of invaders is comparing their traits to related species that are not invasive. However, there are few studies on the biology of close relatives of invasive ants; subsequently studies using this approach to understand invasions success from a broad marco-evolutionary perspective are lacking. We examined how morphology and colony-level traits associated with invasive success evolved across the genus *Linepithema*. Independent contrasts indicate male *L. humile* mesosoma length is larger than in closely related species while accounting for phylogenetic signal. The enlarged mesosoma in *humile* males may indicate an increase in flight capabilities and may have evolved as a morphological adaptation corresponding to queen flightlessness, a character unique to the invasive lineage. This trait corresponds to the mating behavior of queens; unlike many other species in the genus, *L. humile* females mate within the nest and establish new nests by budding. In terms of colony size, our research indicates that the large colonies typical of *L. humile* is unique in the genus, but there may be a stepwise trend for larger colonies and increased polydomy in species closely related to *L. humile*. Species of *Linepithema* in the "humile" clade are often polydomous, however, only introduced populations of *L. humile* were truly unicolonial. Moreover, across the entire genus, the nine species examined exhibited colony structures ranging from monodomy, to weak polydomy (2-3 nests/colony), to extreme polydomy. Together, these findings suggest the evolution of unicoloniality in *L. humile* involved a shift from monodomy and limited polydomy throughout the genus, to extreme polydomy in *L. humile* via a gradual change in the 'humile' species group.

ADVANCES IN ALTERNATIVE CONTROL OF LEAF CUTTING ANTS

J.B. FERNANDES[1], O.C. BUENO[2], M.R. FORIM[1], F.C. PAGNOCCA[2], A.P. TEREZAN[1], P.C.VIEIRA[1], M.F.G.F. DA SILVA[1], A.L.F. SARRIA[1], R.O.S. KITAMURA[1] M.N. FERNANDES[2] & R.M. CARLOS[1].

[1]Chemistry Department - Universidade Federal de São Carlos, 13565-905 São Carlos - SP, Brazil; [2]Centre of Social insects study, Universidade Estadual Paulista, 13506-900 Rio Claro - SP, Brazil; [3]Physiologic Science Department - Universidade Federal de São Carlos, 13565-905 São Carlos - SP, Brazil. Presenting author: djbf@ufscar.br.

Plants produce high range of allelochemicals that regulate interactions of insects with plants, especially in plant defense against herbivory. These allelochemicals are important source of insecticides and fungicides molecules which can be applied in an integrated program of pest management (IPM).

Leaf cutting ants are known as serious pest for agriculture and forestry due to the high amounts of vegetal matter used as food and substrate for the symbiotic fungus development [1]. In Brazil, the insects effects to agricultural production are very significant and can reduce it in 30%, with loss of $ 4 billion/year. To control them are employed synthetic halogenated, sulfur and phosphorus compounds. However, the continued use of these compounds leads to emergence of resistance by the insects, soil and water contamination, may affect non-target species, and causing environmental imbalance. The concept of biorracional pest control, a way to control insects and diseases with the use of natural products and their derivatives, is proposed in order to minimize the environmental impacts. Thus, it is necessary to search for new natural compounds, they nano or microencapsulated and they as metallic complex and for methodologies that can be more selective and less dangerous to the environment.

Since, there is a symbiosis between the fungus and leaf cutting ants, the control of ant nests could be done by use of insecticide and or eliminating the fungus.

Nanocapsule or nanosphere could be obtained from organic materials, including biodegradables such as poly-ε-caprolactone (PCL), and from oxide of metal (for example titanium dioxide) and they have vast applications, including paint, toothpaste, UV protection, photocatalysis, photovoltaics, sensing, electrochromics, as well as photochromics. Nano and microencapsulation of natural compounds can lead to expansion of their activity, since encapsulation may increase the stability of the compounds and release them in the active center, allowing determining the mechanism of action and of interaction between insects and fungus.

The toxicity for the environment caused by the active compounds and by nanocapsule constituents should not exist or to be below the toxic concentration. Fishes are used to determine these toxicities, as well as the place of toxic action.

The presentation will discuss the control of leaf cutting ant nests with recent alternatives methods using natural products (flavonoids, coumarins, limonoids, alkaloids) as insecticide and or fungicide, they encapsulated in nanosphere or nanocapsules, their complex with metals and their toxicity to fish and *Vibrio fisheri*. As well as, it will be present new methods to discovery inhibitors of enzymes involved in the insecticide and fungicide activity (Acetylcholinesterase) and involved in metabolization of polysaccharides (polysaccharidases). (FAPESP, CNPq, CAPES, INCT-CBIP)

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ANT CONTROL IN A PEDIATRIC HOSPITAL OF BUENOS AIRES

R. JOSENS, F.J. SOLA, A. GIACOMETTI, M.A. DI RENZO & N. MARCHISIO

Grupo de Estudio de Insectos Sociales. Instituto de Fisiología, Biología Molecular y Neurociencias- CONICET. Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. Ciudad Universitaria, Pab. II (1428). Buenos Aires, Argentina. roxy@bg.fcen.uba.ar; fjsola@bg.fcen.uba.ar; agiacometti@bg.fcen.uba.ar; agos_direnzo@hotmail.com

Insects in hospitals

In urban settings a diversity of insects are fought in homes and buildings in general. Some insects damage structures (termites, carpenter ants, etc.), others are biological vectors of diseases (kissing bugs, mosquitoes, etc.), some can sting (wasps, bees, ants, etc.) and others cause nuisance invading food or places where people live or work (flies, cockroaches, ants, etc.). Those places where the presence of insects can bring serious consequences are the places commonly called "sensitive"; hospitals are a clear example.

The presence of microorganisms on the cuticle of different insects is well known. Cockroaches can have on their cuticle bacteria, viruses, parasites and fungi (Bracke *et al.*, 1979; Fotedar *et al.*, 1989; Graczyk *et al.*, 2005; Lemos *et al.*, 2006; Salehzadeh *et al.*, 2007). In hospitals, cockroaches can have human pathogenic bacteria on their body (Elgderi *et al.*, 2006; Xue *et al.*, 2008) and even strains of antibiotic multi-resistant bacteria (Burgess, 1984; Cloarec *et al.*, 1992; Fotedar *et al.*, 1991; Mpuchane *et al.*, 2006; Pai *et al.*, 2004). A study that compared the bacteria on cockroaches in different urban buildings showed that neither the total bacterial abundance per cockroach, nor the number of bacteria species per cockroach differed between a hospital, home, office, restaurant and market (Xue *et al.*, 2008). However, *pathogenic* microorganisms have been isolated from cockroaches captured in hospitals but not from those found in nearby residential areas (Fotedar *et al.*, 1989).

Flies have been considered as one of the most important insects as mechanical vectors of pathogens (rev. Graczyk *et al.*, 2001 and references included there). A study on *Klebsiella* spp -bacteria commonly involved in nosocomial infections- compared the bacteria present in the cuticles of houseflies from the field, from a hospital and from the wounds of patients post-operation. The study revealed that 82% of bacteria detected on flies from the hospital were resistant to four or more antibiotics commonly used and the 96% of bacteria detected in wounds of patients were also resistant. However, less than 10% of bacteria detected on outdoor flies had these resistance levels (Fotedar *et al.*, 1992). A higher percentage of *Klebsiella* isolated from the hospital houseflies and patients showed multiple drug resistance to four or more antimicrobials than in the controls. This suggests that the drug-resistant strains of *Klebsiella* spp. sampled in the patients were acquired by the flies (Fotedar *et al.*, 1992).

While there are some insects common in hospitals, ants have some characteristics that make them ideal agents for harboring and transmitting microorganisms:

1) Some ant species have very small sizes, allowing them to enter through very small crevices where cockroaches and flies cannot (e.g. in sterile equipment and medical supplies, places to store sterile material, small diameter cannulae or catheters, etc.).

2) They have great ability to explore, can travel long distances, also within the walls of constructions and structures.

3) As ants never live alone or isolated, such as non-social insects, any food source can generate massive ant recruitment and therefore the circulation of hundreds of individuals –

especially in the case of tramp ants-, which increases the potentiality of mechanical vectoring of pathogens.

Hospital ants have stirred interest after the first studies conducted in the early 70s by Beatson (1972) in England and by Eichler (rev. 1990) in Germany. From the 90s, their study has gained great impulse in Latin America, in Colombia (Olaya & Chacon, 2001; Olaya *et al*., 2005), and especially Brazil. Since the early work of Fowler (Fowler *et al*., 1993), Brazil has a rich career in the study of urban ants -particularly from the São Paulo State University (UNESP-Rio Claro) and the Biological Institute (São Paulo) (Campos-Farinha, 2005) – as well as many studies and surveys on hospital ants. Many of these studies found bacteria on ants sampled in hospitals (Bueno & Fowler, 1994; Fowler *et al*., 1993; Moreira *et al.*, 2005; Zarzuela *et al*., 2005; for historical rev. Cintra 2007 and cites therein). This adds evidence about the potentiality that these insects could have to transfer pathogens, even more if we consider that many pathogenic bacteria found on ants' cuticle showed resistance to antibiotics (Fontana *et al*., 2010; Moreira *et al.*, 2005; Rodovalho *et al*., 2007).

While it is essential to keep the hospital environment free of pests that can threaten people's health, it is also important that staff, patients and families are not exposed to pesticides. Patients who have compromised their immune or nervous systems, the elderly, neonates and infants, and those with allergies or chemical sensitivities are particularly vulnerable to the adverse effects of pesticides (Owens, 2003). Even some medicines may potentiate adverse reactions to pesticides. Therefore, hospitals require a different pest-control treatment compared to any other buildings.

Toxic baits

To control household ants and especially those found in hospitals, the use of *food baits* added with a toxicant is recommended. This method of administration has some advantages over others: first and foremost, it avoids toxic volatiles, minimizes the amount of toxic used, and reduces exposure to personnel handling it, as well as the people that inhabit the residence. In addition, localization or access to the nest is not necessary. The ants themselves carry the bait with the toxic to the nest, where it is distributed among the members of the colony. The toxicant should have a delayed action, allowing enough time for workers to carry as much toxic bait as possible to the nest.

In the case of hospitals, the use of toxic baits is indicated for cockroaches and ants (Owens, 2003; Pampiglione & Velo, 2010). The administration of sprays, aerosols, liquids or powders may pose a health risk to hospital staff and especially to patients. In contrast, the use of food baits has virtually no impact on the environment or contraindications for its use in sensitive sites. Moreover, unlike any other forms of toxicant application, which requires the room to be empty during its application and for many hours or days after this, food baits can be applied with the patients in the ward (Pampiglione & Velo, 2010). Regarding commercial baits, in different countries there are many brands of gel baits against ants and cockroaches that have different active compounds, a toxic substance that is lethal to the target insect.

Ants' bait feeding

Ant baits can be very efficient in some instances, but in other cases they may be completely useless, without affecting the presence or abundance of ants, i.e. the infestation level. Several reasons can be involved in the effectiveness or ineffectiveness of a bait.

There could be seasonal variations in the consumption of sucrose solutions along the year, due to differences in the number of workers and/or brood or changes in the availability of alternative sources (rev. Silverman & Brightwell, 2008). The balance between the incoming sugar flow to the nest and the colony requirements determines the foraging motivation. In turn, individual foraging motivation affects decision making during foraging activity, i.e. the amount of nectar ingested, the time spent in the source, the level of recruitment, etc. (Howard & Tschinkel, 1980; Josens & Roces, 2000; Mailleux *et al*., 2006; Falibene *et al*., 2009).

A very low toxicant concentration can be more easily accepted than a concentrated one, but it could be less effective for control, as sharing the bait by trophallaxis among a large population can readily dilute a toxicant to a sub-lethal dose (Rust *et al*., 2004; Greenberg *et al*., 2006). Conversely, high toxic concentrations can provoke bait rejection by making it detectable by the ants (Klotz & Williams, 1996; Hooper-Bui & Rust, 2000). However, when a colony has high requirements for carbohydrates, even high concentrated toxic baits can be accepted; whereas when these requirements are low, even baits with low toxic concentration can be rejected or less ingested (Sola *et al.*, 2013). The level of a colony's carbohydrate requirements depends on factors specific to the colony itself (population size, number of broods, reserves, etc.) and also on the availability of the resource in the environment. In addition, it is worth stressing that the bait with the toxicant we offer will always compete with other food sources that ants can find, and the presence of the toxic can be detrimental to bait acceptance.

Not only the toxic concentration is relevant, but also the choice of the toxicant in relation to the ant species to be controlled. Ants can reject sugar baits with a given toxic, but not with another one (Sola *et al.*, 2013). Moreover, the toxicant rejection can vary between species with similar feeding habits. For example, while the carpenter ant *Camponotus mus* rejects boric acid more than borax (Sodium tetraborate), the Argentine ant –*Linepithema humile*- rejects borax more than boric acid (Sola *et al*., 2013). Therefore, the potential effectiveness in toxic bait application for ant control bears a close relationship with the species and the current conditions.

In control conditions, the factors mentioned above may explain why sometimes commercial baits are not effective. Even more, the gel and other vehicles that are being used for ant baits are quite dense and viscous, which hinders ant ingestion (O'Brien & Hooper-Bui, 2005; Josens *et al.*, 1998). Viscous sugar solutions are ingested very slowly, so at the end of the intake, ants reach smaller loads than for more diluted solutions (Josens *et al.*, 1998; Medan & Josens, 2005). In addition, viscous solutions generate long feeding times (Josens *et al.*, 1998), which leads ants to stay longer at the source reducing the frequency of nest visits and therefore, diminishing the possibility of information exchange with nestmates and recruitment (Nuňez, 1982).

Case of pediatric hospital

Cases of acute poisoning by accidental exposure to high doses of insecticide are well documented (Shannon *et al.*, 2007), but little is known about the chronic health effects due to prolonged or repetitive exposure to low doses of pesticides. In this sense, the Environmental Protection Agency of USA (EPA) describes birth defects, cognitive difficulties, behavioral changes, organ damage, some forms of cancer and asthma, among others related to chronic exposure to low doses of pesticides (EPA 2012).

Several studies indicate that exposure to pesticides during pregnancy or after birth may increase the occurrence of certain illnesses. There is growing recognition that exposure to pesticides early in life can have a profound impact on the development and therefore could contribute to the onset of disease in later (Winans *et al*., 2011). For example, several reports suggest an increase in the incidence of acute lymphoblastic leukemia in children by previous exposure to pesticides (Pombo Oliveira & Koifman, 2006; Rudant *et al.*, 2007; etc.). A recent study made in Australia (Bailey *et al.,* 2011) showed a positive correlation between the pest control treatments in homes and the incidence of this pathology later, revealing the existence of a key period age in children (2 to 3 years). The authors argue that this window of greater sensitivity could be due to the typical behavior for that age, such as crawling on the floor and putting everything in their mouth, which would increase the exposure. Moreover, children have a higher respiratory and metabolic rate than adults and lower body mass, which makes the effects of pesticides at early ages even worse. Since 1989 in the United States, integrated pest management (IPM) has been implemented in public buildings in many states, minimizing the use of pesticides and avoiding sprays and dusts. Currently, one of the most rapidly expanding vanguards of public sector is the IPM implementation in buildings managed by states and municipalities, *particularly schools* (Greene & Breisch, 2002).

We were contacted by an important pediatric hospital from Buenos Aires, where its authorities impose restrictions on hazardous products and protocols that can be used for pest control therein. But, the cost of this decision brings about a difficulty in controlling pests. This system of "children's hospital" poses a great challenge: how to control ants without applying the "classic products and standard protocols" applied by pest control companies. To tackle this objective, our strategy was based on identifying the species present and analyzing their behavior. On the one hand, we evaluated outdoors, in the green areas of the hospital, the relative abundances of ant species, their food preferences and the behavioral dominances. On the other hand, control treatments were performed using two different toxicants in sugary baits inside the rooms with ants, identifying the species in each case.

Considering the whole hospital, rooms and green areas, we found 15 species belonging to 12 genera. For control indoors we operated on a service call system: hospital staff phoned us in requests for ant control within infested rooms. During 2012, thirteen rooms were notified to be ant infested, in which 7 different species were found, belonging to the following genera: *Nylanderia*, *Brachymyrmex*, *Pheidole*, *Monomorium* and *Acromyrmex*. The most frequent species indoors was *Nylanderia fulva*, followed by two species of *Brachymyrmex*.

Several studies have demonstrated a great variability of ant assemblage richness and species composition associated with human structures in Brazil including hospitals (Bueno & Fowler, 1994; Fowler *et al.*, 1993). This is unlike the findings of studies reported from Europe and North America, which have few associated species. It is natural to expect a small number of species in hospitals of temperate climates (Fowler et al. 1993); however, we have found in the hospital of Buenos Aires a similar number of species to several hospitals in Brazil. We will present the details of this work, which was the first survey and non-standard protocol to control hospital ants performed in Argentina.

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RESUMOS / *ABSTRACTS*

APRESENTAÇÕES ORAIS /
ORAL PRESENTATIONS

TAXONOMY, SYSTEMATICS, BIOGEOGRAPHY AND PALEONTOLOGY

A TAXONOMIC REVISION OF THE ANT GENUS *Gnamptogenys* (*striatula* GROUP) FOR BRAZIL (HYMENOPTERA, FORMICIDAE, ECTATOMMINAE)

G.P. CAMACHO[1], R.M. FEITOSA[2] & J.H. SCHOEREDER[1].

[1]Laboratório de Ecologia de Comunidades, Departamento de Biologia Geral, Universidade Federal de Viçosa (UFV), Av. Peter Henry Rolfs, s/n, Campus Universitário, CEP: 36570-000, Viçosa, MG, Brasil, e-mail: gabipcamacho@ymail.com; [2]Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, PR, Brasil.

INTRODUCTION

The genus *Gnamptogenys* was described by Roger (1863), with *Ponera tornata* as the type species, as subsequently assigned by Emery (1911). Mayr (1865) considered *Gnamptogenys* as a member of Ponerinae, and Emery (1895) positioned the genus in the tribe Ectatommini. This classification was followed by all subsequent authors until 2003, when Bolton raised the subfamily Ectatomminae with *Ectatomma*, *Gnamptogenys*, *Rhytidoponera*, and *Typhlomyrmex* as its members.

Lattke (1995) presented the first revision of the genus for the New World, based on the morphology of adult workers. In this work, he described 15 new species, made 16 synonymies and presented a morphological synopsis of the genus. Currently, 73 species of *Gnamptogenys* are accepted in the New World (Lattke 1995). Apparently, most of the known species of the genus lives in mesic forest habitats from the southern United States to central Argentina. Their nests are usually constructed of pieces of decomposing wood in the soil and tend to be small, rarely exceeding the number of 500 adults, with some species exhibiting polygyny (Lattke 1995).

In his work, Lattke (1995) recognized six species-groups of *Gnamptogenys* in the Neotropics: *striatula* group (22 species), *minuta* group (nine species), *rastrata* group (14 species), *sulcata* group (eight species), *mordax* group (17 species) and *concinna* group (three species). The *striatula* group, the more diverse, has five species occurring in Brazil: *G. striatula* Mayr, 1884; *G. pleurodon* Emery, 1896; *G. moelleri* Forel, 1912; *G. reichenspergeri* Santschi, 1929 and *G. relicta* Mann, 1916. In a more recent contribution, Lattke et al. (2007) presented an updated key for the Neotropical species known so far and described a new one, *G. wilsoni*.

However, recent collecting techniques of litter ants, applied mainly in quantitative surveys, have revealed many specimens of *Gnamptogenys* that do not fit the descriptions of the known species of the genus. The examination of this new material and of that deposited in different ant collections has enabled comparative studies of external morphology and revealed different undescribed taxa. Ants of this genus are rich in cutaneous sculpturing, which somehow facilitates morphological studies. In addition to the preparation of a proposal for the updated taxonomy of the *striatula* group of *Gnamptogenys* in Brazil, this paper presents new and/or neglected characters that proved to be of great importance in a more detailed and objective delimitation of the groups and species that compose them.

METHODS

We examined about 3,300 specimens of *Gnamptogenys* (gr. *striatula*), and some specimens of other groups for inferences about the differences and similarities between them. The material gathered in this study comes from six national institutions that harbor the largest Formicidae collections of the Neotropical region (Instituto Nacional de Pesquisar da Amazônia (INPA), Museu Paraense Emílio Goeldi (MPEG), Comissão Executiva do Plano da Lavoura Cacaueira (CPDC), Museu de Zoologia da Universidade de São Paulo (MZSP), Universidade Federal de Uberlândia (UFU) e Universidade Federal de Viçosa (UFV)), specimens from these collections were loaned to comparative examination in the Laboratório de Ecologia de Comunidades, UFV.

RESULTS

***Striatula* group** Lattke, 1995

Diagnosis: Anterior margin of clypeus always convex, ranging from a central denticle to a fully rounded edge. Head always wider posterad than anterad; mandibles triangular, often with rugulae or striae on dorsal surface; scapes often exceeding the vertexal margin; eyes positioned slightly after head midlenght; second segment of gaster ventrally arched; petiolar node high in lateral view; subpeciolar anteroventral process relatively broad.

Gnamptogenys moelleri (Forel 1912)

Diagnosis: Large size (5.03mm to 6.41mm TL). Cephalic vertex with one or more transverse costulae. Lateral margins of head strongly convex, giving the head a strongly rounded aspect. Maximum width of head about 1.5 times greater than the length of the vertexal margin. Scapes very long, longer than 1.1 mm, and always longer than the length of head. Dorsal profile of mesosoma flat.

Gnamptogenys pleurodon (Emery 1896)

Diagnosis: Medium size (4.03mm to 5.29mm TL). Whitish, long and erect hairs covering the body. Occipital corners pointed in lateral view. Anterior margin of mesopleura often forming a pronounced keel, which ends inferiorly in a tooth of variable size. Costulae in propodeal declivity transverse. Dorsal and anterior margins of petiole undifferentiated and posterior margin concave, giving the petiole a pointed aspect, in lateral view.

Gnamptogenys reichenspergeri (Santschi 1929a)

Diagnosis: Small size (2.19mm to 3.09mm TL). Mandibles striated dorsally. Eyes reduced, formed by a single facet. Dorsal profile of mesosoma flat, with metanotal suture poorly impressed. Propodeal spiracles wide and directed laterally, placed distant from the lateral margin of propodeal declivity by two or more times the width of its opening.

Gnamptogenys relicta (Mann 1916)

Diagnosis: Small size (2.43mm to 2.70mm TL). Mandibles smooth and shining dorsally. Compound eyes with approximately four ommatidia in its greatest diameter. Dorsal profile of mesosoma flat, with metanotal suture conspicuous, clearly visible. Propodeum without lobes or projections. Propodeal spiracles high, turned backwards and with very narrow openings; the spiracles are located directly on the lateral margin of propodeum declivity; propodeal declivity covered by conspicuous transverse costulae. Metacoxal spine present and conspicuous. Surface of segments I and II of gaster covered by deep longitudinal costulae; anterior face of gaster smooth and shiny.

Gnamptogenys striatula Mayr, 1884

Diagnosis: Medium to large size (4,08mm to 5,91mm TL). Head vertex with longitudinal costulae. Antennal scapes always smaller than 1,1 mm, variable in size. Mesonotum slightly higher than propodeal dorsum, in lateral view. Propodeal spiracles separated from de lateral margins of propodeal declivity by less than twice its width. Petiole variable in shape, but never projecting posteriorly. Body sculpture variable in diameter, but never too wide.

Gnamptogenys sp. n. A

Diagnosis: Small size (3,16mm to 3,44mm TL). Mandibles smooth and shining dorsally. Eyes reduced, formed by a single facet. Dorsal profile of mesosoma flat, without metanotal suture. Propodeum with blunt projections on the edge between dorsal and declivous face, in lateral view. Propodeal spiracles with wide openings, directed laterally and not elevated; spiracles separated from the lateral margin of propodeal declivity by tree times its opening; surface of propodeal declivity shining, with some inconspicuous rugulae. Metacoxal spine absent. Surface of segments I and II of gaster covered by small striae formed in the base of hairs, with smooth and shining areas between them; anterior face of gaster shining, with some inconspicuous rugulae.

Gnamptogenys sp. n. B

Diagnosis: Small size (3.61mm TL). Mandibles smooth and shining dorsally. Eyes reduced, formed by a single facet. Scapes, legs and gaster yellowish, much lighter than the rest of the body. Dorsal profile of mesosoma flat, with a slight metanotal impression. Propodeal spiracles with wide openings, turned slightly posterad and at the same level of the integument. Propodeum with blunt projections on the edge between dorsal and declivous face, in lateral view; Propodeal declivity shinning, with some poorly marked rugulae. Metacoxal spine absent. Dorsal surface of segments I and II of gaster completely smooth and shinning; anterior face of gaster smooth and hairless.

Gnamptogenys sp. n. C

Diagnosis: Medium size (3.75mm to 4.75mm TL). Antennal scapes short, with less than 0.85 mm in length. About five costulae on the dorsal surface of mesosoma. Costulae of pronotum very large, with more than 0,03 mm in width. Propodeal spiracles located directly on the lateral margins of the declivity.

Gnamptogenys sp. n. D

Diagnosis: Medium size (4.15mm to 4.71mm TL). Eyes placed in a depression on the sides of the head, their outer margin slightly beyond the lateral margins of the head in frontal view. Antennal scapes length less than 0.8 mm, much shorter than the head length. Mesosoma strongly convex in lateral view, without metanotal suture.

CONCLUSION

The examination of the material gathered here led to the recognition of the species boundaries defined by Lattke (1995). In addition, four new species have been recognized for Brazil. These results increase the knowledge about the Brazilian ant fauna. The recognition of these species sheds solid basis for studies on the phylogenetic relationships among *Gnamptogenys* species, as well as on its natural history.

Great effort is still required in order to establish the boundaries between species of *Gnamptogenys*, particularly in relation to the composition of the species complex, *G. striatula*. Furthermore, research focusing on the recognition of phylogenetic relationships among species of *striatula* group and other *Gnamptogenys* groups are essential, mainly due to its interesting biogeographic scenario, which certainly has great importance in an attempt to clarify how the diversification occurred in the apical clades of Formicidae. Nevertheless, improving the knowledge about the boundaries between existing species, their distribution and their morphological and biological characteristics is the first step towards all other approaches of natural sciences. (CNPq, CAPES, FAPEMIG)

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COMPARATIVE PHYLOGEOGRAPHY OF ANTS ALONG THE BRAZILIAN ATLANTIC RAINFOREST

P.R. STRÖHER[1,2], D.A. DE OLIVEIRA[1] & M.R. PIE[1,2]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná (UFPR), Rua Francisco H. dos Santos, 100, CEP 81531-980-Curitiba, PR, Brasil, e-mail: patricia.stroher@gmail.com. [2]Programa de Pós-graduação em Entomologia, Universidade Federal do Paraná, Curitiba, PR, Brasil.

Known for its natural beauty, rich biodiversity, and high levels of endemism, the Atlantic Rainforest is among the most devastated environments in the world. Despite this importance, comparatively little is known about the evolutionary mechanisms that led to current patterns of species endemism and intraspecific genetic variation. In this study we investigate the phylogeography of two ants of the Atlantic Rainforest – *Gnamptogenys striatula* (Ectatomminae) and *Hylomyrma reitteri* (Myrmicinae) – using both nuclear (ant.epic965) and mitochondrial (cytochrome b) loci. Samples were obtained from southern portion of the Atlantic Rainforest (states of São Paulo, Paraná and Santa Catarina). We did not find evidence for genetic differentiation among the studied populations for both species, possibly due to the absence of obvious barriers to gene flow between them. Moreover, Extended Bayesian Skyline Plots found evidence of population stability through the time for both species. These results are consistent with the hypothesis that southern Atlantic Forest remained stable, despite periods of climatic and vegetation instability in the last ice age. This study is one of the first comparative phylogeography studies on ants of the Atlantic Forest, and underscores the utility of ants in uncovering the evolutionary history of this biome. (CNPq)

PHYLOGENY, TAXONOMY, AND NEST ARCHITECTURE OF THE FUNGUS-GROWING ANT GENUS *Sericomyrmex* (HYMENOPTERA: FORMICIDAE)

A. JESOVNIK

National Museum of Natural History, Smithsonian Institution, 10th & Constitution Av. NW, Washington, DC 20560-0188 & University of Maryland, 4112 Plant Science Bldg., College Park, MD 20742, USA email: jesovnika@si.edu

The fungus-growing ants (Myrmicinae: Attini) comprise a diverse and intriguing clade of ants that obligately cultivate fungus gardens, a behavior that had a single origin in their most recent common ancestor approximately 50 million years ago (Schultz & Brady, 2008). All attine species grow fungus gardens inside their nests on organic material collected by foraging workers, effectively practicing agriculture in a way similar to humans (Schultz et al., 2005). The most conspicuous of the Attini, the leaf-cutting genera *Atta* and *Acromyrmex*, are dominant herbivores in Neotropical ecosystems (Wirth et al., 2003). Apart from their ecological importance, the enormous colonies of leaf-cutters are considered to be “superorganisms,” among the most complex of all known ant societies. For these reasons, the leaf-cutters have become model organisms for studies of symbiosis, behavior, caste development, ecology, and coevolution (Mehdiabadi & Schultz, 2010). However, with 15 attine genera and 253 species described to date, the leaf-cutters constitute only a small percent of total attine diversity (Bolton, 2013). Most attine genera are not so well studied, and much of their remarkable natural history remains to be described, impeding a better understanding of how the ant-fungus relationship evolved. The genus *Sericomyrmex* belongs to the clade of “higher Attini,” which also includes the genus *Trachymyrmex* and the leaf-cutting genera *Atta* and *Acromyrmex* (Schultz & Brady, 2008). Currently, 22 *Sericomyrmex* species and subspecies are recognized, distributed throughout most of South and Central America (Mehdiabadi & Schultz, 2010). *Sericomyrmex* is known for its problematic taxonomy, vague species descriptions, and lack of clearly defined morphological characters. The last key to *Sericomyrmex* species was published in 1916, at a time when only 10 species were known (Wheeler, 1916).

I describe my ongoing efforts to delimit *Sericomyrmex* species by integrating multiple sources of information. A molecular phylogeny based on one mitochondrial and two nuclear markers apparently recovers a lower number of species than currently recognized or, alternatively, may fail to recover the actual number of species due to a very recent rapid radiation and insufficient variation in the chosen markers. A similar lack of informative variation is found in morphological characters, which so far resolve only 5-8 operational "species." In an effort to increase the resolving power of molecular markers, I generated transcriptome data for three species of *Sericomyrmex* with the goal of finding genes evolving at rates appropriate for inferring species-level phylogeny. The specimens for the transcriptomic study were chosen to span the species-level diversity of *Sericomyrmex* as indicated both by morphology and by their positions in separate clades of the molecular phylogeny. I present preliminary results of this transcriptome study and future plans for reconstructing *Sericomyrmex* phylogeny. Finally, I describe my efforts to use ecological and behavioral data as sources of information about *Sericomyrmex* species boundaries. I summarize the results of studies of *Sericomyrmex* nest architecture based on field work in Guyana, Peru, Brazil, and Central America, where my excavations reveal variation in nest size and architecture. The subterranean architecture of ant nests has been shown to be species-specific (Tschinkel, 2003), and in fungus-growing ants nest architecture is important not just for the ants, but also for their fungal cultivars, which require particular environmental conditions (Bollazzi & Roces, 2002; Bollazzi et al., 2008).

Ants are often used in biodiversity and ecological studies in Central and South America, for which they are quantitatively collected, e.g., with pitfall traps or leaf-litter sifting (LaPolla et al, 2007; Armbrecht et al, 2005; Longino & Colwell, 2011). *Sericomyrmex* species are frequently present in such samples and are frequently incorrectly identified, even at the morphospecies level (pers. obs.). Therefore, apart from the obvious direct benefit to the field of ant taxonomy, knowledge of *Sericomyrmex* species boundaries will be of a great general value for ecological and biodiversity assessment studies. Understanding the biology of *Sericomyrmex* species is also important for reconstructing the origin and evolution of higher attine agriculture and for explaining the remarkable ecological success of the leaf-cutting genera *Atta* and *Acromyrmex*. (Explorers Club Washington; Cosmos Club Washington; ESA; NSF DEB 0949689)

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TAXONOMIC STUDY OF THE *rastrata* COMPLEX, GENUS *Gnamptogenys* ROGER, 1863 (HYMENOPTERA: FORMICIDAE: ECTATOMMINAE) IN BRAZIL

Key words**:** ants, Brazil, *Gnamptogenys*. Tropical forests, millipeds predators.

M.P. GUALBERTO[1]; J.L.P. SOUZA[1]; R.S.M. FEITOSA[2] & J.E. LATTKE[3].

[1]Instituto Nacional de Pesquisa na Amazônia (Av. André Araújo, 2936 – Aleixo, CEP: 69060001, Manaus – AM, Brasil. (**mariliaporfirio@gmail.com; souza.jorge@gmail.com**); [2]Departamento de Zoologia Universidade Federal do Paraná, Caixa Postal 19020, CEP 81531-980, Curitiba - PR, Brasil (rsmfeitosa@gmail.com); [3]Museo del Instituto de Zoología Agrícola, Universidad Central de Venezuela, Apartado 4579, Maracay 2101-A, Venezuela (john.lattke@miza-ucv.org.ve)

INTRODUCTION

Currently *Gnamptogenys* has 141 recent species and six fossil species (Bolton, 2013). It is characterized by the strongly sculpture tegument, it can be striate or foveolate; the promesonotal suture is fusionated; propodeal spiracle rounded; metacoxal dorsum usually with a spine or tubercle (absent in some species) and the absence of a seta on the fore tibia. The genus *Gnamptogenys* is widely distributed, occurring in the Neotropical, Australian, Nearctic and Indo-Malayan regions. It's gathers predatory ground-dwelling ants of tropical forests, nesting in booth the leaf litter and decomposing wood. The feeding habits of this ants can be classified in (1) specialist, (2) tendency to specialist (where there is a preference for a particular prey) and (3) generalist, most part of this species foraging on the soil surface (Lattke, 1990). There are records of specificity feed by Coleoptera, millipedes and even other ants (Lattke, 1990).

It is divided to four groups of species in the Old World and six in the New World, this groups share similarities in morphology, behavior and similar ecological niches occupancy (Lattke *et al.*, 2008). In Neotropical region, there are six groups: *minuta* (with nine species), *striatula* (with 24 species), *rastrata* (with 16 species), *mordax* (with 19 species), *sulcata* (with eight species) and *concinna* (with three species) (Arias-Penna, 2008; Lattke, 1995; Lattke *et al.*, 2007). A compilation of previous data for this study shows that there are records of about 34 species of *Gnamptogenys* to Brazil, distributed in these six species groups (Fernandéz & Sendoya, 2004; Lattke, 1995, 2004; Lattke *et al.*, 2007).

One of the groups in the New World is the *rastrata* group, defined by Lattke (1995). It contains species with similar morphology and habits. Species in the *rastrata* group are specific millipede predator. In this group, ants has the head sub-quadrate shaped; anterior margin of clypeus straight; mandibles usually striated; scapes beyond occipital margin, sometimes striates or smooth and shiny. Promesonotal suture slightly pronounced, never interrupting the sculptures; metanotal suture well impressed; propodeal denticles usually present. Petiole low, sub-petiolar process is subquadrate. Metacoxal tooth always present and second segment of gaster ventrally arcuate.

The group is divided in the subgroups rastrata and banksi, that can be differentiate by the shape of the mandibles. The *rastrata* subgroup has triangular mandibles and includes the *rastrata* complex, one of the largest complex of species of *Gnamptogenys* in the Neotropical Region. Six of the nine know species of the rastrata complex can be found in Brazil, *G. lanei* Kempf, 1960, *Gnamptogenys lucaris* (Kempf), 1968, *G. mecotyle* Brown, 1958, *G. menozzii* (Borgmeier, 1928), *G. rastrata* (Mayr, 1866), *G triangularis* (Mayr, 1887).

The taxonomic history indicates the last study of the genus (Lattke, 1995) has diagnoses not sufficiently representative, which difficult the observation and comparison of structures. As well, as differences between the identification key information and diagnoses of some species. Furthermore, illustrations are absence in some cases. This study considered external morphological characters of ants in the *rastrata* complex for redefine the complex and the included species.

MATERIALS AND METHODS

About 530 specimens were examined from the following collections: Centro de Pesquisa do Cacau (CPDC), Instituto Nacional de Pesquisa na Amazônia (INPA), Museu Paraense Emílio Goeldi (MPEG), Museu Nacional Quinta da Boa Vista (QBUM), Museus de Zoologia da Universidade de São Paulo (MZSP), Universidade Federal de Uberlândia (UFU) and Universidade Federal de Viçosa (UFV) (Brandão, 2000).

The specimens studied were identified using the available literature and by comparison with the type material, whenever possible.

For the external morphology was followed terminology in Hölldobler & Wilson (1990) and the surface sculpturing of the integument was employed the nomenclature proposed by Harris (1979).

RESULTS AND DISCUSSION

rastrata COMPLEX SPECIES

Gnamptogenys. cuneiforma Lattke,1995. Panamá.
Gnamptogenys. enodis Lattke, 2004. Colômbia.
Gnamptogenys. ingeborgae Brown, 1992. Colômbia.
Gnamptogenys. lanei Kempf, 1960. Brazil (Amapá- Bacia Amazônica).
Gnamptogenys. lineolata Brown, 1992. Hispaniola.
Gnamptogenys. mecotyle Brown, 1958. Brazil (Amazonas e Pará)
Gnamptogenys. menozzii (Borgmeier, 1928). Brazil (Sergipe, Bahia, Goiás, Espirito Santo, São Paulo, Santa Cataria and Rio Grande do Norte).
Gnamptogenys. rastrata (Mayr, 1866). Brazil (Sergipe, Bahia, Rio de Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul)
Gnamptogenys. triangularis (Mayr, 1887). Brazil (Amazonas, Acre, Rondônia, Bahia, Mato Grosso, Goiás, Mato grosso do Sul, São Paulo and Paraná)
***Gnamptogenys.* sp. n. 1.** Brazil (Pará and Mato Grosso). **New specie**.
***Gnamptogenys.* sp. n. 2.** Brazil (Alagoas, Bahia, Rio de Janeiro and São Paulo). **New specie**
G. lucaris, was considered member of *rastrata* complex by Lattke (1995), however this specie doesn't have promesonotal suture and propodeal spine, both structures presents in *rastrata* group, beyond that the mandibules in *G. lucaris* are smooth and shining, while in the Brazilian species of *rastrata* group are striated. These characters render *G. lucaris* a member of the *sulcata* complex.

GNAMPTOGENYS N. SP. 1 (FIGURE 1)

Caste known: worker (w).

Diagnosis: pronotum with circular or semicircular grooves; propodeal spines thin and sharp; grooves on the gaster are interrupted by constriction between the first and second segment.

Comments: Kempf (1968) considered theses specimens as variation of *G. lanei*, differentiating them by the large size, primarily by length and width of the head and thorax length. However when this specimens were compared to the holotype, was clear the difference in the form of the grooves, in *Gnamptogenys*. sp. n. 1, they vary to semicircular a circular, with eight transversal grooves in the pronoto, the grooves in the gaster were interrupted by the constriction. In *G. lanei* the grooves in the pronotum are longitudinal, the grooves in the gaster are continuous. In addition, the side of pronoto in *Gnamptogenys.* n. sp. 1 is slightly convex, the mesonotum of *Gnamptogenys.* n. sp. 1 is well defined because the shape of the grooves and the mesonotal suture is conspicuous. These characters made these specimens here considered a new specie of *Gnamptogenys*.

Occurrence: This specie were collected in Pará, and Mato Grosso, this states are represented by the Amazonian biome, which is character by the tropical rainforest. Elevate temperatures, humidity and frequent rains. This is the biggest Brazilian biome and location of the Amazon River basin (Brasil, 2010; MMA, 2013).

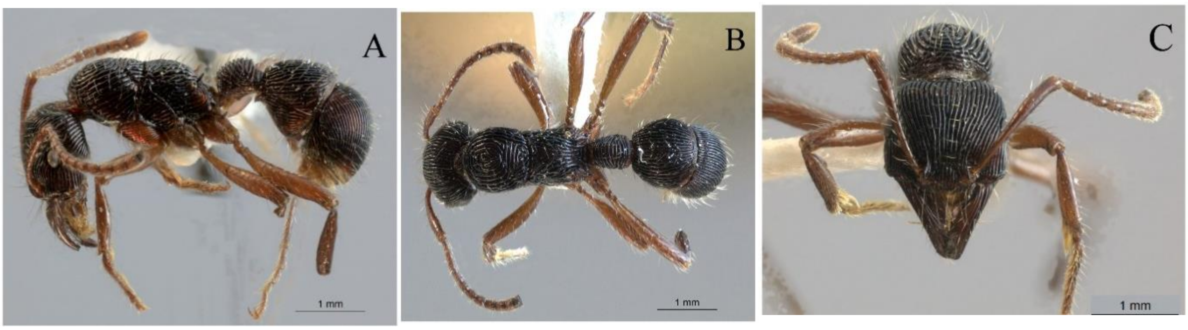

Figure 1 - *Gnamptogenys* n. sp. 1 A – lateral view; B – dorsal view; C - head, frontal view.

GNAMPTOGENYS N. SP. 2 (FIGURE 2)

Caste known: worker (w).

Diagnosis: Scapes smaller or as long as the occipital margin, not exceeding once its width; dorsum of pronotum with longitudinal grooves 13; transverse striations on the dorsum of the petiole (6-10), in lateral view resemble the letter "V" (figure 2).

Comments: Resembles *G. rastrata, G. triangularis* and *G. menozzii,* sculptures by rectilinear and longitudinal in mesossoma however, differ markedly by streaking the petiole, which are concentric *G. rastrata* tend to be a longitudinal *G. menozzii* and transversal in *G. triangularis* and *G.* n. sp. 2.

Occurrence: this specie were collected in Bahia, São Paulo, Rio de Janeiro and Alagoas; these states join the Atlantic forest as principal biome. This biome covers a big part of the Brazilian coast characterized by humid forest tropical (Brasil, 2010; MMA, 2013).

Figure 2 - *Gnamptogenys* n. sp. 2 A – lateral view; B – dorsal view; C - head, frontal view.

CONCLUSION

The number of known species for the *rastrata* complex in Brazil was increased from five to seven (*G. lanei* Kempf, 1960; *G. mecotyle* Brown, 1958; *G. menozzii* (Borgmeier, 1928); *G. rastrata* (Mayr, 1866); *G. triangularis* (Mayr, 1887); *G.* n. sp. 1 e *G.* n. sp. 2), with the recognition of two new species.

The distribution of the species was updated and expanded, with records in more than 70% of the Brazilian states.

The direction of sculpture in the mesosoma and petiolar, and the shape of the petiole are considered important traits for the separation of species in the complex.

(CAPES, CNPq CEMBAM, FAPEAM).

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THE TAXONOMIC REVISION OF *Stigmatomma* ROGER (HYMENOPTERA: FORMICIDAE) IN THE MALAGASY REGION

F.A. ESTEVES & B.L. FISHER

Department of Entomology, California Academy of Sciences, 55 Music Concourse Drive, 94118, San Francisco, California, U.S.A., email: flaviaesteves@gmail.com

*Stigmatomm*a Roger is an early branching lineage within Formicidae, and possesses an interesting behavior and morphology: in some species the larvae are incapable of the trophallaxis, and adults puncture vulnerable spots in the larval skin, feeding on the drops of hemolymph; the nests seem to spread diffusely through the substrate, perhaps because they move their larvae in order to feed on prey, rather than the reverse; some species developed intermediate castes between worker and queen (i.e. specimens morphologically similar to workers and able to lay fertilized eggs); they are predaceous cryptic foragers of soil, leaf litter and rotting logs. The genus is distributed worldwide, but until few years ago it was unknown to Madagascar, and was first collected there in 1993 by BLF, thanks to his leaf litter protocol and collection techniques, innovative at that time. Our project focuses on the taxonomic revision of *Stigmatomma* in the Malagasy region, and aims to (1) provide diagnoses and identification keys to species groups and species; (2) recognize species through male-specific characters; (3) evaluate biogeography patterns within the Malagasy region and discuss implications for the conservation of this group. The revision is based on traditional morphological characters obtained using optic microscope, SEM images and dissections, male morphology, and clusters based on analysis of mtDNA. The foundation for this study is the one of the largest and most comprehensive regional ant inventories in the world conducted from 1992 to 2013 by BLF and his Malagasy colleagues. The presentation will include discussion of the division of Malagasy *Stigmatomma* in tentatively monophyletic species-groups, species delimitation, and suggestions for further taxonomic revisions of the genus in other zoogeographical regions. (Field work supported by NSF DEB-0842395)

BIOLOGY/NATURAL HISTORY, BEHAVIOR

A NEW POPULATION OF *Blepharidatta* (FORMICIDAE: MYRMICINAE) FROM THE BRAZILIAN SEMI-ARID

J.C. PEREIRA[1,2] & Y. QUINET[1,2]

[1]Laboratório de Entomologia, Unidade de Mirmecologia, Instituto Superior de Ciências Biomédicas, Universidade Estadual do Ceará (UECE), Av. Paranjana, 1700, CEP 60714-903 - Fortaleza, CE, Brasil, e-mail: janainainfocross@gmail.com. [2]Programa de Pós-graduação em Ecologia e Recursos Naturais, Universidade Federal do Ceará, Fortaleza, CE, Brasil.

Blepharidatta (Myrmicinae, Blepharidattini) is a strictly Neotropical ant genus that is composed of predatory species whose small colonies nest in soil or leaf-litter. With widely scattered populations, but high nest density in places where they occur, these ants are also noticeable for their close phylogenetic relationship with basal groups of Attini (fungus-growing ants). At least three species are recognized, but only two are formally described: *Blepharidatta brasiliensis* Wheeler (Amazon Rainforest) and *Blepharidatta conops* Kempf (Cerrado). A new population (*Blepharidatta* sp.) was found in the Caatinga biome (a savanna-like formation of northeastern Brazil), at the “Reserva Particular do Patrimônio Natural Serra das Almas” (RPPNSA), in Crateús (State of Ceará, northeastern Brazil). The aim of the study was to obtain information about the biology of this new population and to compare it with that available for other species, particularly *B. conops*. The work was carried out in a wooded Caatinga area of RPPNSA, where *Blepharidatta* sp. nests were excavated in order to describe their architecture, as well as to obtain information about the size and composition of colonies. A detailed analysis of the carcasses ring found around nest opening was used to establish the diet of *Blepharidatta* sp. whose foraging activity pattern was also investigated by monitoring foragers’ activity during 24 hours periods. The distribution, density and foraging area size of nests were investigated by repeated mapping of nests found in an area of 144 m². The results show that *Blepharidatta* sp. and *B. conops* share some key features of their biology, such as the basic architecture of their nests built in soil, with wide tunnels and some chambers, the presence of a ring of carcasses around the unique nest opening, monogyny, the presence of phragmotic head in queens, a diet consisting mainly of ants and diurnal foraging habits. Accordingly, *Blepharidatta* sp. and *B. conops* clearly differ from the Amazon or Atlantic Rainforest species (e.g. *B. brasiliensis*) that nest in leaf-litter, are polygynous, and whose queens have no phragmotic head. However, significant differences were found between *Blepharidatta* sp. and *B. conops*, in particular in nest architecture (more complex and with different types of chambers in *Blepharidatta* sp.), colony and foraging area size (larger in *Blepharidatta* sp.) and nest density (lower in *Blepharidatta* sp.). Moreover, *Blepharidatta* sp. differs from *B. conops* with respect to queen and brood location in the nests, as well as to the size of the queen frontal disk and the sculpture of the disk cuticle. *Blepharidatta* sp. could therefore represent a new species, possibly endemic to the Caatinga biome. However, it could also represent one extreme in the phenotypic variations observed in all populations forming *B. conops* species. (CAPES)

DYNAMICS OF EXPLORATION OF NEW AREAS IN LEAF-CUTTING ANTS OF THE GENUS *Atta*

R.V. TRAVAGLINI[1], L.C. FORTI[1] & V. FOURCASSIE[2]

[1]Laboratório de Insetos Sociais Praga - LISP, Departamento de Proteção de Plantas, FCA – UNESP, Fazenda Lageado, CEP: 18.610-307-Botucatu, SP – Brasil, Telefone: (14) 3880-7100, email: raphaeltravaglini@fca.unesp.br [2]Centre de Recherches sur la Cognition Animale, UMR CNRS 6154, Université Paul Sabatier, 118 route de Narbonne, F-31062 Toulouse Cedex, France

INTRODUCTION

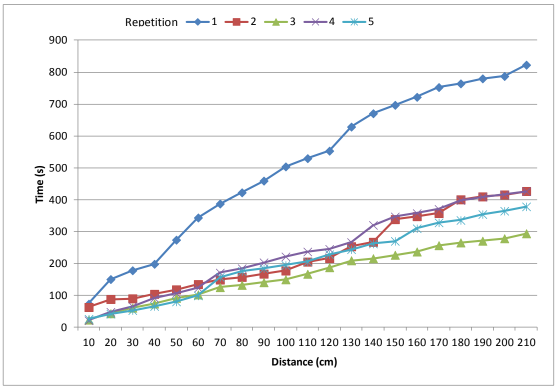
Ants of the genus *Atta* are considered dominant herbivores in Neotropical environments Hölldobler & Wilson (1990). These social insects exhibit division of labor Wilson (1980), in which the task of searching for new food sources is achieved by a specialized group of workers called scouts Silva (2011). These scouts play an essential role in the initiation of the recruitment process. In a lot of ant species, including leaf-cutting ants, they lay a chemical trail on their way back to their nest or to the closest active trunk-trail Farji-Brener & Sierra (1998) and this trail is then used by recruited workers to reach the resource that has been discovered. A foraging trail supporting a high traffic of workers soon appears and the geometry of this trail strongly depends on the route followed by the scouts during their first return trip to the nest. Ant scouts are also able to modulate their trail-laying behavior as a function of the characteristics of the resource they have discovered, so that the number of recruited ants reaching the resource can be adjusted according to the quality and/or quantity of this resource Detrain *et al.* (2008). Finally, in leaf-cutting ants, scout ants are able to convey information about the type or quality of the substrate they have discovered. For example, recruited *Acromyrmex* workers can the conditioned to the odor of the leaf fragments carried by the scouts and use it as a signal to make their choice between different types of substrate when reaching the end of the trail Roces (1990); Lopes *et al.* (2004). In leaf-cutting ants the competition for resource is strong Whitehouse & Jaffé (1996) and the fitness of a colony thus depends in part on the efficiency of the search behavior of its scouts. Theoretical models show that the most efficient way to search for an unknown target is to avoid as much as possible to scan repeatedly the same area. Ideally, this is achieved if one follows a straight line Bénichou *et al*. (2005). Therefore, the faster scout ants move away from their nest, the higher their chance of discovering new resources. Once a resource has been discovered however it is essential for them to return as fast as possible to their nest in order to initiate the recruitment and avoid the appropriation of the resource by another colony. Both performances are possible only if the scouts are able to orient in their environment. The purpose of our experiment was to investigate the movement of the scouts when exploring a new terrain and the type of orienting cues that could influence their movement.

MATERIAL AND METHODS

We used nine colonies of the species *Atta sexdens rubropilosa* Forel 1908. These colonies had been kept in the laboratory for one year inside recipients containing a volume of symbiotic fungus *Leucoagaricus gonglyophorus* of approximately one liter Forti *et al*. (1994). During the experiments the recipients containing the nests were connected to a rectangular glass box (2.15 x 0.95 x 0.15m) through a transparent plastic tube. There was no vegetation in the box during the experiments. Lines were drawn on the lower side of the box floor, across its width, every 10 cm. The unique source of light was provided by eight 32-Watt fluorescent lamps hanging from the ceiling of the experimental room. The visual environment was formed by the objects and furniture around the glass box. A black 0.5m² cardboard was placed behind the nest to provide an additional visual landmark for the ants. The dynamics of exploration was assessed by noting the time elapsed between the opening of the nest and the time the first ant crossed each line drawn on the box floor, starting with the line closest to the nest entrance and ending with the line further away from it. At the end of the experiment all ants remaining on the foraging area were captured and placed back in their nest. The experiment was repeated five times for each colony, yielding a total of 45 replicates. To eliminate the chemical cues left by ants during exploration, the area was cleaned with acetone between each repetition. A minimum interval of 30 minutes (range: 30min – 23h, median: 1h) was respected between repetitions to make sure that the environment was free of odors. To compare the performances of the ants during successive exploration we performed an Analysis of Variance with Repeated Measures (ANOVAR) with the software R3.0.1 (R Core Team 2013). Since the design was fully balanced we used the function *aov()* of the stats package. The response variable was the time (in seconds) at which ants crossed each line on the box floor. The two repeated independent variables were the distance from the nest entrance (10 – 210 cm) and the repetition number (1 to 5). The colony variable was used as an error term to take into account the dependency between the data collected with the same colonies.

RESULTS AND DISCUSSION

The slope of the curve describing the relationship between time and the distance to the nest for each repetition of the experiment (Fig. 1a) corresponds to the time required for an ant to travel a distance of 1cm across the foraging area. It can be used to evaluate the speed at which ants cross the area (Fig. 1b): the higher the value of the slope, the slower the speed. The result of the ANOVAR shows that the interaction between distance and repetition was highly significant ($F_{80,640}$= 3.295, p<0.001), i.e. that there was a significant difference between the slopes of the linear regression lines of each repetition of the experiment. One can identify two groups of repetitions significantly different from each other: repetition 1 and repetition 2, 3, 4, 5 (Fig. 1b*)*. The movement of scout ants across the length of the area was significantly slower during the first repetition of the experiment, when the area was unknown to the scouts. The exploration was twice as fast in the second repetition and did not vary significantly thereafter. Since the area was cleaned between repetitions this suggests an effect of familiarity of the ants with the visual environment surrounding the area. Moreover, there was no significant relationship between the difference in the speed at which ants explored the area between repetitions and the time elapsed between these repetitions ($F_{1,34}= 1.938, p=0.173$).



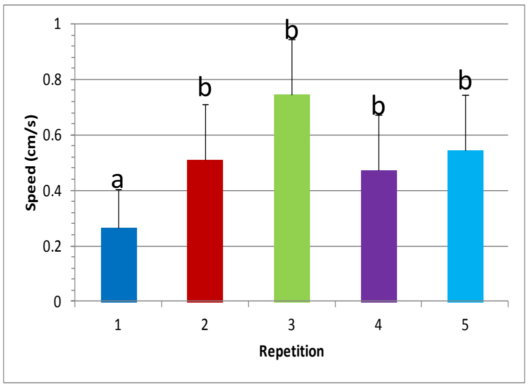


Figure 1 : a) exploration dynamics: relationship between time (averaged over 9 colonies) and the distance from the nest entrance for each repetition of the experiment. b) mean speed ± SE at which ants crossed the area in each repetition of each experiment. The bars bearing the same letter are not significantly different (ANOVAR, p>0.05).

CONCLUSION

Our results suggest that in each colony the same group of ants, probably scout ants, explore the area in successive repetitions of the experiment. These ants become familiarized very rapidly with the foraging area because the speed at which they crossed the area was doubled after just a single exploration. Since all chemical cues that could have been deposited during exploration were removed between repetitions, the familiarization process must be based on other type of cues, e.g. tactile or visual. Ants could sense with their tarsae the nature of the substrate on which they move (glass) and be more confident to walk on it in their second visit. Alternatively, they could keep in memory the visual characteristics of the environment surrounding the area (illumination intensity, zones of higher contrast, landmark locations) and recognize these cues in their second visit. Indeed, ants of the genus *Atta* have been shown to be able to use several types of cues to orient in their environment, e.g. gravitational, chemical or visual Vilela *et al*. (1987); Ribeiro *et al*. (2009). Remarkably, the effect of the familiarization process did not depend on the time elapsed since the last exploration of the area, which would be expected if a short-term memory process was involved in the familiarization. Further experiments in which tactile and/or the visual cues surrounding the area will be manipulated between repetitions will help to decipher the mechanisms underlying the familiarization process shown in the present experiment.

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INDIVIDUAL FORAGING BEHAVIOUR IS ASSOCIATED WITH DIFFERENTIAL TREATMENT OF NEIGHBOURS IN *Pachycondyla verenae*

F. SEGERS[1,2], R.S. FERREIRA[3], S. CHAMERON[1], F.S. NASCIMENTO[1] & N. CHALINE[1,2]

[1]Laboratório de Comportamento e Ecologia de Insetos Sociais, Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP), Universidade de São Paulo, Ribeirão Preto - SP, Brasil. Email: nchaline@hotmail.fr . [2]Laboratoire d'Ethologie, Expérimentale et Comparée, Université Paris 13, Sorbonne Paris Cité, Villetaneuse, France. [3]Universidade Federal de Lavras, Departamento de Biologia, Setor de Ecologia, Laboratório de Ecologia e Conservação de Invertebrados, Lavras, Minas Gerais, Brasil

Within the context of non-nestmate recognition, a differential treatment of neighbours is commonly observed among ant species. When workers from neighbouring conspecific colonies are encountered during foraging trips they can be tolerated, but conversely, strangers might be attacked, a phenomenon known as "dear enemy" (DEP). This strategy is thought to save the costs of frequent fights with regularly encountered conspecific colonies, while on the other hand, wandering individuals are repelled, to prevent their colonies from settling in the neighbourhood. Evidence suggests that habituation to non-nestmate cuticular odour profiles is the underlying mechanism for the DEP, however, field evidence for this is lacking. We investigated the DEP in the facultatively polygynous ant, *Pachycondyla verenae*. Colonies of this species largely overlap in foraging ranges because nests can be found as close as 0.5 m and workers make solitary foraging trips up to 20 m. We mapped a total of 26 colonies on two experimental fields and performed a total of 291 dyadic encounters between workers of colonies with a wide range of inter-nest distances (0.5 – 50 m). Individual workers from focal colonies were tested near their colony entrance and the direction in which they set off to forage was noted. Our results show that on the colony level, aggression significantly decreases with inter-nest distance in *P. verenae* and that individual foragers were less responisive to workers from colonies located in the direction of their foraging path than to workers from colonies in other directions. These findings suggest that learning of allocolonial odour profiles takes place in the field and possibly are responsible for the occurence of DEP in *P. verenae* (USP, Programa de catedras franceses no estado de São Paulo-Lévi-Strauss Program (2012.1.1762.59.5), Consulat général de France au Brésil, Pronex FAPESB/CNPq "Rede Multidisciplinar de Estudos sobre Formigas Poneromorfas do Brasil", ANR)

QUANTITY OR QUALITY? SOCIOMETRY OF THE INITIAL BROOD OF WORKERS IN *Acromyrmex* SPP.

N.G. ALMEIDA[1], T.A. SALES[1,2], I.N. HASTENREITER[1,2] & J.F.S. LOPES[1,2]

[1]Mirmecolab, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora (UFJF), Rua José Lourenço Kelmer, s/n, Campus Universitário - São Pedro, CEP 36036-330, Juiz de Fora, MG, Brasil, e-mail: nilhian@yahoo.com.br. [2]Programa de Pós-graduação em Ecologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, MG, Brasil, e-mail: tatiane.archanjo@gmail.com; belnetoh@gmail.com; julianeflopes@yahoo.com.br.

INTRODUCTION

The phase of foundation of ant colonies represents a critical period in which the queen is responsible for performing of all tasks, including from excavation to offspring care (Hölldobler & Wilson 1990). To increase the likelihood of successfull colony establishment, the queen must perform a balance between number and size within the first brood of workers. In social insects, this trade-off is because the amount of resource is limited during colony founding (Oster & Wilson 1978, Hasegawa & Imai 2012). Thus, this balance turns possible obtain a labor force of workers suitable, both in size and number of individuals, to execute all activities of the nest.

Such relation has already been recorded to *Camponotus japonicus* (Hasegawa & Imai 2012) and *Atta* (Araújo *et al.* 2011), an important leaf-cutting ant genus. These species display a claustral founding in which founding queens raise the first brood without leaving their nests. In other words, only the stored resources in the queen's body are available to produce the first brood (Wheeler 1994) at the same time their own metabolic needs.

Differently of *Atta*, *Acromyrmex* presents nonclaustral founding in which founding queens forage outside the nests (Liu *et al.* 2001). Thereby, despite having body reserves, they use the foraged substrate to cultivate the fungus garden and feed their brood. Therewith, we can examine if there is this trade-off between size and number of initial worker generations for nonclaustral ants. The present study compared head width and the number of individuals from different generations. We also investigate the longevity of workers from these initial generations.

MATERIALS AND METHODS

Founding queens of *Acromyrmex* were captured after the nuptial flight on December 2011, at Universidade Federal de Juiz de Fora, Juiz de Fora, Minas Gerais, Brazil. They were brought to the laboratory and kept individually in plastic pots with the bottom covered with a 1-cm plaster layer to maintain humidity for fungal growth. Twice a week, they were feed with fresh leaves of *Acalypha* sp. The leaves were offered in circumference shape with standardized measure 2.5cm. Unused leaf pieces were always removed. Once a week, the presence of workers was checked. A total of 19 founding queens were observed in this study.

Soon after the worker emergencies, they were counted and marked with a different color for each generation, computed by week. In total, 15 generations were followed. The head width measure was taken from dead individuals, which were collected weekly. For the analyses, the generations were pooled in three groups: G1 (first to fifth generation), G2 (six to tenth generation) and G3 (eleventh to fifteenth generation).

The head width, the number and longevity of workers were compared by Kruskal Wallis. Student Newman Keuls test was used to determine significant differences between G1, G2 and G3.

RESULTS

The results showed that the head width was different among the groups ($H= 7.9317$; $df=2$, $p= 0.0190$), being smaller the workers of the first group (Fig1).

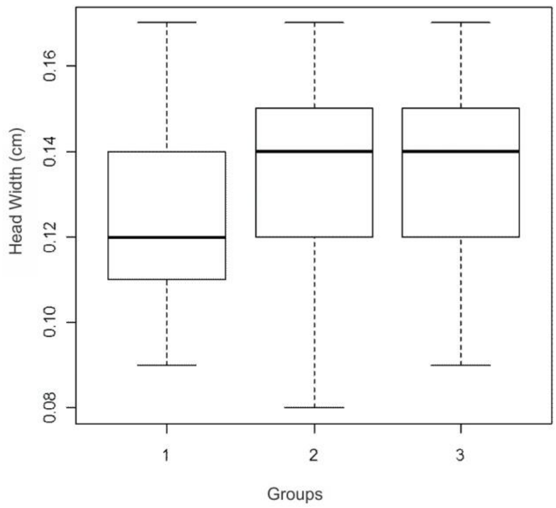

Figure 1. Comparison between the head width of workers from three groups. Student Newman Keuls test: head: G1 and G2: $p= 0.0352$; G1 and G3: $p= 0.0069$; G2 and G3: $p= 0.2306$.

The number of individuals in each generation was also significantly different ($H= 46.95$, $p= 0.000$), with G2 presenting a higher number of workers (Fig2). The number of workers in the groups G1 and G3 were smaller and not statistically different.

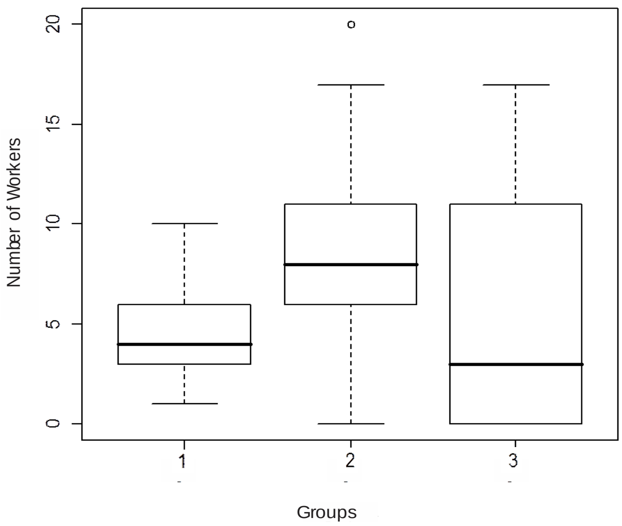

Figure 2. Number of workers in the three groups. Student Newman Keuls test: G1 and G2: $p< 0.0001$; G1 and G3: $p= 0.6007$; G2 and G3: $p< 0.0001$.

The longevity of workers also differed among the groups ($H= 66.6151$; $df= 2$; $p= 0.0000$). Individuals of G1 lived longer than those of G2 group (survival G1: $\bar{x} = 9.8$ G2: $\bar{x} = 8.1$ weeks), and G2 workers lived longer than the G3 ones (survival G3: $\bar{x} = 4.0$ weeks).

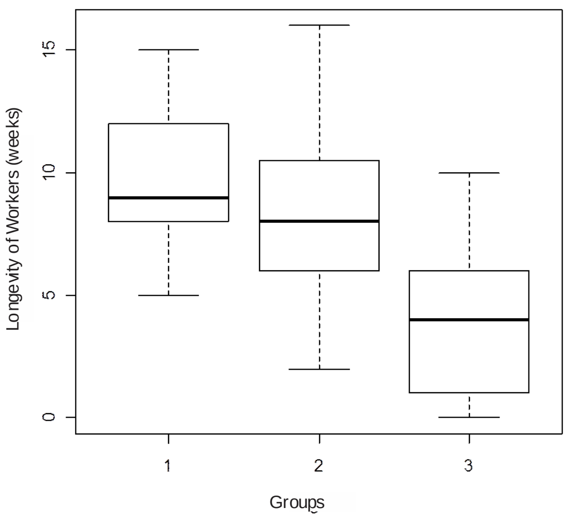

Figure 3. Longevity of workers of the three groups. The survival was computed by week. Student Newman Keuls test: G1 and G2: $p= 0.0020$; G1 and G3: $p< 0.0001$; G2 and G3: $p< 0.0001$.

DISCUSSION

The data showed that the five first generations are less numerous and the workers are in average smaller in size. This demonstrates that *Acromyrmex* queens, that display nonclaustral founding, perform a balance between number and size of workers in the initial generations.

In *Acromyrmex subterraneus brunneus*, workers from mature colonies are classified according with their head width in: large (1.7 to 2.0 mm), medium (1.2 to1.6 mm), small (0.9 to 1.1 mm) and very small workers (0.7 to 0.8 mm) (Forti *et al.* 2004). In this study, the smaller workers from G1 had head width of 0.9 mm, which fits in the small size class. In other words, the first generations of these incipient colonies of *Acromyrmex* were not as smaller in size as could be.

In a study about first-generation workers of claustral *Camponotus japonicus* was verified that the production of both larger numbers and larger sizes of first-generation workers is associated with a large amount of resources stored by the queen. The queens of *Acromyrmex* have nonclaustral founding that is, they use the foraged substrate to cultivate the fungus garden and feed their brood (Liu *et al.* 2001). Then we can suppose that they also have available enough resources to produce larger number and larger sizes of first workers. Moreover, although to ensure survival of the incipient colonies a minimum number of workers is required, larger workers are more efficient in task processing (Hasegawa & Imai 2012). Also founding colonies do not produced more smaller individuals because the costs associated with smaller size would outweigh the benefits of further increased numbers (Porter & Tschinkel 1986).

From six to tenth generation (G2), the number of workers was higher than G1 and G3. The reduced number of workers in the G3 group was a peculiar data, given that, after the foundation stage, successful colonies enter an ergonomic stage in which they rapidly grow by producing all worker brood for a number of years (Bourke & Franks 1995). In the tenth week of ergonomic stage, the number of larvae and workers can exceed 50 individual units (personal observation). Therewith, the fixed amount of resource offered for these colonies may not have been enough to well feed all individuals. Due to malnutrition of the larvae and workers, the colonies growth and longevity of the G2 group and of the following generations could have been hindered.

This study presents for the first time important sociometric data from *Acromyrmex* in the beginning of the ergonomic phase.

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SOCIAL POLYMORPHISM IN THE ARBOREAL ANT *Odontomachus hastatus* (FORMICIDAE: PONERINAE): GEOGRAPHIC VARIATION AND ECOLOGICAL ASPECTS

C. BOTTCHER[1], R. JEANSON[2], V. FOURCASSIÉ[2], J. ORIVEL[3] & P.S. OLIVEIRA[1]

[1]Laboratório de Ecologia e Comportamento de Formigas, Departamento de Biologia Animal, Instituto de Biologia, Universidade Estadual de Campinas (UNICAMP), Caixa Postal 6109, CEP: 13083-970, Campinas, SP, Brasil, email: caubottcher@gmail.com; [2]Centre de Recherches sur la Cognition Animale, Université Paul Sabatier, Toulouse, France; [3]Ecologie des Forêts de Guyane, ECOFOG, Kourou, French Guiana

Multiple-queen (polygyny) colonies are common in social insects, especially in ants. The number of queens in a colony is an important factor, influencing both worker production and longevity, and thus affecting ecological success. Although the existence of polygyny challenges evolutionary theory, little is known on the selection pressures that might cause its evolution and maintenance in a population. The aim of our study is to elucidate the ecological factors regulating polygyny in the ant *Odontomachus hastatus*, an arboreal species characterized by intraspecific plasticity in the number of queens, i.e. social polymorphism: whereas the populations found in the Brazilian *restinga* (Cardoso island, south of the state of São Paulo) are polygynous, those found in the rain forest of French Guiana are monogynous. Nest density in Brazil is much higher than in the French Guiana. In Brazil ants build their nests in the tangle of roots of bromeliads with a diameter exceeding 30 cm, a relatively rare feature of bromeliads in the restinga. In French Guiana the nests are usually found near rivers and are more common at the junction of palm leaves. However, they are also observed in epiphytes and we also found some nests built by ants in the vegetation with clay and plant material. In Brazil, the presence of more than one queen was found in approximately 37% of the nests collected. The largest colony collected contained 626 workers and 6 queens. In French Guiana, all colonies collected had only one queen and the largest colony had 436 workers. In dyadic encounter experiments there was a very high probability of observing aggression between workers of colonies belonging to separate geographic zones, i.e. Brazil and French Guiana. Furthermore, within the same geographic zone the colonies collected at different sites in French Guiana were more aggressive among themselves than the colonies collected at different sites in Brazil. For these latter, aggression was practically nil, including when dyadic encounters occurred between polygynous and monogynous colonies. Our results strongly suggest that the main ecological factor regulating the number of queens in *O. hastatus* is the limitation of nesting sites. Polygyny could be promoted when the habitat becomes saturated, leading fertilized queens to enter into already established nests. In addition, *O. hastatus* workers seem to be less aggressive in populations in which polygyny occurs, probably facilitating the acceptance of new queens in established nests and their subsequent alliance. (CNPq, FAPESP, CNRS-France)

MORPHOLOGY, PHYSIOLOGY & GENETICS

COMPARATIVE MORPHOLOGY OF SPECIES OF CERAPACHYINAE (HYMENOPTERA: FORMICIDAE) FROM THE ATLANTIC FOREST

T.S.R. SILVA[1,2], V. ALARCON[1,3] & C.R.F. BRANDÃO[1]

[1]Laboratório de Hymenoptera do Museu de Zoologia da Universidade de São Paulo, Av.Nazaré, nº 481 CEP 04263-000 - São Paulo, SP, Brasil, [2]Programa de Pós-Graduação em Sistemática, Taxonomia Animal e Biodiversidade, Museu de Zoologia da Universidade de São Paulo/MZSP, Av.: Nazaré, n° 481, Ipiranga, São Paulo/SP, Brasil, CEP 04263-000, [3]Graduação em Ciências Biológicas, Instituto de Biociências, Rua do Matão, trav. 14, nº 321, Cidade Universitária, São Paulo - SP, CEP: 05508-090, email: victor2alarcon@gmail.com.

INTRODUCTION

The study of morphology not only provides data that support the taxonomic study, but can also elucidate the functions of the morphological structures as well as clarify issues intrinsic to morphology (Beutel & Kristensen, 2012).

The subfamily Cerapachyinae is cosmopolitan, with most species occurring in tropical regions. It was originally described as a tribe of Ponerinae and in 1920 was elevated to subfamily, currently including three tribes, seven genera and a total of 259 species, plus a fossil genus with seven species (Bolton et al., 2007). Recent studies have suggested that the subfamily is paraphyletic (Brady & Ward 2005, Moreau et al., 2006, Brady et al., 2006).

Very little is known of the diversity and biology of these organisms. They are considered specialized predators (Briese & Macauley 1981), with records of cerapachyine ants attacking nests and preying on larvae and pupae of other species of ants (Wilson 1958a). Many species of Cerapachyinae exhibit group attack behavior and nomadism (Wilson 1958b).

The Atlantic Forest is considered a "hotspot" of biodiversity and over the years has suffered from habitat loss (Myers et al., 2000). Seeking to improve knowledge on the biome's biodiversity, the project "Richness and Diversity of Hymenoptera and Isoptera Along a Latitudinal Gradient in the Atlantic Forest- The Rain Forest of eastern Brazil" (1999-2005) integral Program BIOTA-FAPESP collected ants at various points along the Atlantic Forest, inside and outside the state of São Paulo. Among the material collected several specimens of cerapachyine ants were found.

OBJECTIVES

In the present study we plan to establish consistent specific limits for the specimens of Cerapachyinae collected in several localities of the Atlantic Rainforest, through analysis of morphological characteristics. Measurements will be taken from structures knowingly associated with their biology as well as those commonly used in taxonomic studies. The informations of localities will be assembled and then compared with the distribution data found in the literature to determine possible new records and possible expansion in the distribution of the genera and species for the subfamily. Finally, with these informations gathered, it is expected the redescription of known species, as well as the description of possible new ones, the assembling of literature that contains behavioral information and elaboration of high-resolution images, distribution maps and identification key to the genera.

METHODOLOGY

All specimens considered for this work are deposited in the Hymenoptera Collection of the Museu de Zoologia da Universidade de São Paulo (MZSP) sampled in several locations along the Atlantic Forest, under the BIOTA FAPESP project #98/05083-0 "Richness and diversity of Hymenoptera and Isoptera along a latitudinal gradient in the Atlantic forest - the rainforest of eastern Brazil.". The nomenclatural and taxonomic classification used follows Bolton et al. (2007). The assessment of the species distribution will be based on Kempf (1972), Brandão (1991), as well as electronic catalogs (AntWeb, 2013).

The measures of specimens will be made using a calibrated micrometer coupled to the ocular lens of a stereoscope and recorded to the nearest 0.01mm. Measures and indices will be adapted from those used by Silva & Brandão (2010), as well as other references that deal with morphological characterization in the subfamily. Terms for external morphology and sculptures follows, respectively, Bolton (1994) and Harris (1979).

PRELIMINARY RESULTS

At the beginning of the study, 74 individuals sampled from 10 localities were allocated into two genera, each with only one species. In the genus *Cerapachys*, 64 specimens were found in all locations, all of them identified as *C. splendens*. In the genus *Acanthosticus*, 10 specimens were sampled in two different localities, none of them identified to the specific level.

So far we could observe that specimens of *C. splendens* showed several differentiated morphological aspects that caught our attention: variation in the length of hairs (although these structures tend to be easily modified or lost through abrasion); clinal variation in sculpturing, ranging from densely foveolate to sparsely punctate; variation in body color, from dark brown to light yellow brownish. The variation in body size is not large, but it exists. The shape of the subpeciolar process is quite variable.We also observed that two individuals have 12 antennal segments, contrasting with the 11 suggested by the identification key developed by Brown (1975).

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COMPARATIVE MORPHOLOGY OF THE TRIBE DACETINI (HYMENOPTERA: FORMICIDAE) IN THE ATLANTIC RAINFOREST

T.S.R. SILVA & C.R.F BRANDÃO

Laboratório de Hymenoptera, Museu de Zoologia da Universidade de São Paulo, Av. Nazaré, 481 CEP 04263-000 - São Paulo, SP, Brasil, e-mail: tsrsilva@usp.br

INTRODUCTION

The ant tribe Dacetini comprises nine genera with worldwide distribution, with a total of 925 described species, extant and extinct. For the Neotropical region, three genera and 207 species were recorded, with diverse distributional gradients: species of *Acanthognathus* were recorded ranging from Honduras to Southern Brazil and Paraguay, the two of *Daceton* were found in some northern states of Brazil, Suriname, French Guyana, Guyana, Bolivia and Peru, while *Strumigenys* is widespread in the Neotropic (Kempf, 1972; Brandão, 1991).

The generic classification of the tribe, until recently, was product of numerous revisionary works made by Brown (1948, 1953, 1954a, 1954b, 1957a, 1957b, 1958, 1959a, 1959b, 1961 and 1962), Brown & Kempf (1969), Lattke and Goitia (1997) and Galvis & Fernández (2009). Although all of them provided valuable contributions to the knowledge of the group, the majority of these works are not recent, and those that are contemplate species that occur only in a single country.

Four recent publications dealt throughoutly with the tribal and generic classification, discussing character validity and inferring phylogenetical affinities, proposing, through this, drastic modifications within the group, as well with other tribes. These publications, organized by Baroni-Urbani & De Andrade (1994, 2007) and Bolton (1998, 2000), established different contexts for Dacetini, incorporating species to different genera and tribes in some cases, and segregating in others, molding the classification of the tribe as we currently know.

This works follows Baroni Urbani & De Andrade (1994, 2007) only regarding *Strumigenys* and its synonyms. Concerning the other genera and tribes, the classification follows Bolton *et al.* (2007).

Due to the great range of morphological variations that occur between genera, the characterization of the tribe is considered by many authors as a challenge. Simultaneously, these same characters confer uncommon habits to the group, but convergent with other tribes. Cryptobiotic predators on small arthropods of the litter is the prevalent biology of the Dacetini, although some species, like *Daceton armigerum*, have characteristic habits, occupying arboreal as well as epigaeic ecosystems. The Atlantic Rainforest is considered one of the world's "hotspots" of biodiversity and, through the years, had its original range drastically reduced due to suppression of its native vegetation (Myers *et al.*, 2000). Using this observation as a premise, the need for studies in this biome becomes prioritary, seeking an improve of knowledge on the organisms that integrate it. In the present work, 3619 specimens collected in 26 localities regularly spaced in the Atlantic Rainforest were analysed.

OBJECTIVES

The main scope of the presente work is analyse the morphological characteristics from the species during the realization of the BIOTA Project, measure strictures knowlingly associated with the biology of the group as weel as those commonly used on taxonomic works. With these informations at hand, we will compare the morphometric and structural data of each species in the way that we can establish specific boundaries of the studied group.

Simultaneously, we will compare locality data of the analysed specimens with the already available information of the group in the literature, in order to verify the existence of new distributional records.

With these data at hand, new species and described ones are to be determined.

METHODOLOGY

The examined specimens are deposited in the Hymenoptera Collection of the Museu de Zoologia da Universidade de São Paulo (MZSP), collected in different localities in the Atlantic Rainforest, under the BIOTA Fapesp project #98/05083-0, namely "Richness and diversity of Hymenoptera and Isoptera along a latitudinal gradient in the Atlantic Forest – the rainforest of eastern Brazil". The nomenclatural changes suggested by Baroni-Urbani & De Andrade (2007) are considered here only at the generic level. The concept of the tribe Dacetini follows Bolton et al. (2007). Species distribution will be taken from Kempf (1972) and Brandão (1991), as well as electronic catalogues (Antweb, 2013).

In the collection, there were seventy two species from BIOTA project, belonging to the tribe Dacetini. From *Acanthognathus* three species were recorded: *A. brevicornis* Smith, M.R., 1944, *A. ocellatus* Mayr, 1887 and *A. rudis* Brown & Kempf, 1969. From the genus *Strumigenys*, seventeen species were recorded: *S. appretiata* (Borgmeier, 1954), *S. comis* (Kempf, 1959), *S. crassicornis* Mayr, 1887, *S. cordovensis* Mayr, 1887, *S. denticulata* Mayr, 1887, *S. dentinasis* (Kempf, 1960), *S. elongata* Roger, 1863, *S. louisianae* Roger, 1863, *S. lygatryx* (Bolton, 2000), *S. precava* Brown, 1954, *S. prospiciens* Emery, 1906, *S. rugithorax* (Kempf, 1959), *S. saliens* Mayr, 1887, *S. schmalzi* Emery, 1906, *S. smithii* Forel, 1886, *S. splendens* (Borgmeier, 1954), *S. subedentata* Mayr, 1887 and fourty two morphospecies.

All specimens analysed were from twenty six localities, covered by primary Atlantic Rainforest.

Measurements are being made with a micrometer coupled to the ocular lens of a stereoscope and recorded to the nearest 0.01mm. Measures and indexes used will be the same as those proposed by Brown (1953) and Brown (1961), reviewed by Silva & Brandão (2010).

PRELIMINARY RESULTS

Only two of the Dacetini genera occur in this biome, *Acanthognathus* and *Strumigenys*, with four and 40 species, respectively. Until this moment, only six species of *Strumigenys* are considered new and 9 species are considered uncertain (comparison with the type or with another specimen is needed, or the specimen is considered close to an already described species). The *Acanthognathus* species determined in the analysis are: *A. brevicornis*, *A. lentus*, *A. ocellatus* and *A. rudis*. The species of *Strumigenys* already defined are: *S. appretiata, S. borgmeieri, S. carinithorax, S. cosmostela, S. crassicornis, S. cultrigera, S. denticulata, S. dentinasis, S. elongata, S. epelys, S. fridericimuelleri, S. gytha, S. louisianae, S. precava, S. reticeps, S. rugithorax, S. saliens, S. sanctipauli, S. schulzi, S. schmalzi, S. smithii, S. splendens, S. subedentata, S. substricta, S. tanymastax, S. trinidadensis.*

One of the defined species, namely *S. gytha*, deserves special attention. Bolton (2000) described it based only in one specimen collected in the state of São Paulo, southeastern Brazil. In the diagnosis Bolton mentions that this species lacks an apicoscrobal hair citing, however, that this character might had been lost due to its fragile constitution. In our samples we found four specimens with morphological characters matching those proposed by Bolton to delimit *S. gytha*, with the additional presence of a pair of flagellate hairs in the apicoscrobal position. In some specimens analysed the apicoscrobal hair showed signs of damage produced by abrasion, while in others this structrure was complete in one side of the head and damaged in the other side. Assuming that the specimen described by Bolton lost this character in some moment we propose the redescription of *S. gytha,* incorporating this important character.

Apart from the workers, gynes from different species were collected throughout the samples and, part of them, never had been cited in the literature. We found gynes of 19 different species, of which 7 are not yet described: *S. appretiata, S. borgmeieri, S. epelys, S. rugithorax, S. substricta, S. tanymastax* and *S.* sp. D.

The further study of the uncertain species may reveal more undescribed species or provide important information on extention of distribution ranges to several Dacetini species. Distribution maps as well as an identification key will be elaborated when more information is assembled.

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CONFOCAL MICROSCOPY IN *Atta sexdens rubropilosa* BRAINS: SUBLETHAL DOSES OF FIPRONIL INTENSIFIES SYNAPSIN IMMUNOSTAINING.

P. CINTRA-SOCOLOWSKI[1], T.C. ROAT[1], R.C. F. NOCELLI[2], A.M. PEREIRA[1], P.H. NUNES[1], O. MALASPINA[1] & O.C. BUENO[1]

[1]Centro de Insetos de Estudos Sociais, Depto. de Biologia, Instituto de Biociências, Universidade Estadual Paulista (UNESP), Av. 24-A, 1515, CEP13506-900, Rio Claro- SP, Brasil, e-mail: priscilacintra@yahoo.com.br. [2] Centro de Ciências Agrárias, Depto. Ciências da Natureza, Matemática e Educação, DCNME, CCA, UFSCar, Araras - SP, Brasil.

Ants are numerically abundant, relatively easy to sample and sensitive to environmental changes, being used as bioindicators. Although they are common in agricultural ecosystems, few studies have considered physiological and morphological alterations of xenobiotics about ants and their impact on the ecosystem. Fipronil is very effective against crop pests, acting as a blocker of chloride channels in receptor gamma-aminobutyric acid (GABA) in insects. Studies with organs of the digestive system of ants of the genus *Atta* revealed changes caused by the effect of insecticides and show the importance of analyzing histological changes of other affected organs. This study aimed to verify the neurotoxic action of sublethal doses of fipronil on the mushroom bodies from leaf-cutting ant *Atta sexdens rubropilosa* through immunocytochemistry analysis of protein synapsin observed under confocal microscopy. Synapsin is a protein involved in the traffic of vesicle filled with neurotransmitters. The previous procedures for determining the LD_{50} value resulted in 1.42 ng / ant and sublethal doses used were $LD_{50/10}$ and $LD_{50/100}$. Topical applications were made with the aid of a micropipette and 1µl was applied in the dorsal part of the mesosoma and the ants were transferred to Petri dishes. The control group received only the solvent acetone. All tests were conducted in BOD with temperature of 24.5 ° C ± 1 and 70 ± 5% relative humidity. The brains were extracted from the samples 24 hours after application and fixed in 4.0% paraformaldehyde for 2 hours. The material was incubated for 4 days at 4 ° C with mouse monoclonal antibody against the protein synapsin 1 (SYNORF1 1:50) diluted in PBS with 0.2% Triton X_{100} and 5% NGS. After washing in PBS, preparations were incubated with secondary antibodies, goat anti-mouse conjugated to CY5 (1:250 in PBS and 1% NGS) for 2 hours at room temperature. Finally, the brains were washed and mounted on slides for observation. The results showed labeling for protein synapsin more evident in the brains extracted from treatments with the insecticide, specifically in the regions of glia in mushroom bodies and antennal lobes of ants exposed to the insecticide, when compared to the control group. Using the softwareLAS-AF Confocal Laser Scanning Microscope Leica TCS SP5-II was possible to measure the intensity of emitted fluorescence in the areas of the mushroom bodies. The data were compared using the Kruskal-Wallis statistic test and resulted significant differences between the control group and the treatment ($p < 0.0001$). In Dunn test, performed retrospectively, there were differences between the control and treatment $LD_{50/10}$ and $LD_{50/100}$. Thus, it is concluded that the sublethal doses of the insecticide fipronil intensified synapsin immunostaining, evidencing increased release of neurotransmitters, which may be linked to neurotoxicity, and overexcitation. (CAPES, PNPD 00000.058869/2010)

CYTOGENETIC CHARACTERIZATION OF THE *Solenopsis invicta* BUREN, 1972 POPULATION FROM VIÇOSA, MINAS GERAIS, BRAZIL.

A.P. ALVES-SILVA[1], R.A.C. DÂNGELO[2] & S.G. POMPOLO[2]

[1]Programa de Pós-graduação em Genética e Melhoramento; Universidade Federal de Viçosa. Av. Peter Henry Rolfs, sem nº, CEP 36570-000 – Viçosa, Minas Gerais, Brasil, e-mail: anapaula-ssdd@hotmail.com. [2]Universidade Federal de Viçosa. Viçosa, Minas Gerais, Brasil.

There are approximately 185 species currently known of the genus *Solenopsis*, these being considered of difficult identification. Cytogenetic tools are becoming increasingly common to resolve evolutionary and taxonomic issues. This tool, unfortunately, has been seldom used within genus *Solenopsis*. Only eight species were already cytogenetically studied (*S. invicta*, *S. saevissima*, *S. xyloni*, *S. fugax*, *S. molesta*, *S. geminata* and *S. aurea*), and were separated into two cytogenetic groups. The subgenus *Diplorhoptrum*, consisting of species with n = 11 chromosomes, and the subgenus *Solenopsis*, with n = 16. Both groups lack any data about chromosome banding patterns. As expected, the species *S. invicta* has n = 16, characterized by the prevalence of metacentric chromosomes. The main objective of this study is to increase the cytogenetic information in the complex genus *Solenopsis* by describing the cytogenetic heterochromatin banding patterns of *S. invicta* population from Viçosa-MG, providing raw material for further phylogenetic discussions on *Solenopsis* genus. The metaphases was obtained from five mature colonies. Several worker larvae were collected and dissected. The brain ganglia obtained were submitted to colchicine and alcohol/acetic-acid solutions and air-dried. The chromosome arm ratio was used for their classification into karyotypes. *S. invicta* population from Viçosa showed the same diploid number of other populations studied, n = 16. However, differently than described in other studies the population from Viçosa did not show predominance of metacentric chromosomes, showing 7 meta/submetacentric and 9 subtelo/telocentric. This difference may indicate a karyotype differentiation among populations of *S. invicta* and it might have been caused by increase of repetitive DNA or small chromosomal rearrangements. However, the degree of chromosome compactation may have affected the data on the previous results, increasing the metacentric chromosome proportions. The regions of constitutive heterochromatin were found predominantly in centromeric and pericentromeric regions of chromosomes which may be a result of chromosome fusion as the most accepted chromosome theory in Hymenoptera suggests. Furthermore, we found that the amount of heterochromatin was considerably high relative to the size of the chromosomes. The cytogenetic data presented here, with the application of heterochromatin staining may be useful to solving some taxonomic constraints in genus *Solenopsis* and also enriching the discussion about the phylogeny of this complex group. (CAPES; FAPEMIG)

METRIC RELATIONS BETWEEN BODY PARTS IN *Atta sexdens rubropilosa*

P.L. RIBEIRO[1], P.M. LOPES[2] & A.F. HELENE[2].

[1]Laboratório de Ecofisologia do Instituto de Biociências da Universidade de São Paulo, (USP). Rua do matão Tv 14, CEP 05508-900 - São Paulo, SP, Brasil, e-mail pedrolribeiro@gmail.com; [2]Laboratório das Ciências da Cognição do Instituto de Biociências, Universidade de São Paulo, São Paulo, SP, Brasil.

INTRODUCTION

The relationship between form and function in different organisms is a central issue in understanding multiple aspects of their biology. Variation in size can lead to a persisting proportionality between body parts or not, namely, it can be isometric or allometric. In eusocial animals is a common condition the presence of a broad distribution of sizes in the same colony, as it occurs in *Atta*.

Considering that an allometric variation in size can be related to a variation in the way that organisms handle with environmental challenges, it is reasonable to expect that in eusocial animals morphometric variations are associated to labor division, morphologically defining castes (Wilson, 1980a). Indeed, allometry can optimize the realization of certain tasks. For instance, colonies of hunting ants may have soldiers with greater head width than workers, so that the hunting is more effective (Feener et al., 1988). It also seems to be important for leaf-cutting ants during foraging, since it is been observed that leg length plays a major role in determining leaf fragment size, due to the cutting mechanism: they lean on the leaf edge with their hind legs to cut a semicircular fragment and the reach depends on hind leg length (Wetterer, 1991).

The balance between costs and benefits in foraging can change in the presence of bigger or smaller ants: the expenses of travelling certain distances faster or slower and cutting or transporting leaf fragments of different sizes can dramatically change the general efficiency of foraging. All these factors are related to size in a general fashion, even when there is no allometry. When there is, we can speculate about its adaptive function and the efficiency gain it may bring to a colony in a more deterministic labor division.

A good example of how efficiency could be changed by organism size is offered by the size-grain hypothesis. It states that the bigger the anima, the longer the leg will be relatively to its body, as an adaptation to the terrain, which can be more rugose or plainer. To a small animal, with small legs, there is more rugosity than there is to a big animal in the same environment, since the last one walks over obstacles and can't penetrate holes, leaf litter, etc. The greatest benefit of long-leggedness is a speedy movement over a plain environment, whereas it prevents locomotion through narrow paths - that can serve as refuge or offer resources - and is an expensive tool. In a rugose environment long legs would be, therefore, a bad option (Kaspari and Weiser, 1999). This pattern was confirmed by Kaspari and Weiser (1999) in the *Formicidae* family as a whole, but was also encountered in groups of flying insects like Lepidoptera and Apidea, meaning that there could be another factor leading to this allometric relation rather than the rugosity of a terrestrial environment (Teuscher et al., 2009).

Once there are confirmations of allometry not only in hunting ants like *Eciton hamatum*, but also in leaf-cutting ants, like *Atta colombica* (Feener et al., 1988) and *Atta cephalotes* (Wetterer, 1991), it can be expected to be found in *Atta sexdens rubropilosa*. Nevertheless, an isometric relationship between total mass (including head) and head width has been observed on our lab in a first approach (non-published data).

OBJECTIVE

The present study pretends to verify if there are allometric relations between body parts of *Atta sexdens rubropilosa*.

MATERIALS AND METHODS

Twenty eight individuals were collected from a laboratory colony at the bioterium of the Department of Physiology of the Biosciences Institute, University of São Paulo. The ants were frozen and then had their legs and head removed. The body parts were then measured with a paquimeter to the nearest 0.05 mm, one ant at a time. They were then stored in a paper sheet with adhesive tape, grouped by individual. The measures taken were head width, mandible length, body length (without the head) and leg length (fore, middle and hind).

The measures were compared in graphics by pairs. In the x axis, was always head width, since it is been related to body mass, as said before.

The usual way to analyze allometric relations is by comparing variables in logarithmic graphics, then applying a linear regression whose equation is the power law y=ax^b, where y is the measure of a structure one wishes to compare with x, another structure's measure. 'a' is the proportionality coefficient, specific for each pair of measures and tells us where the regression line crosses the y axis. 'b' is the allometric exponent or the slope of the line, and is the one we want to observe, because it tells us in what way one measure changes in relation to the other. If it equals 1 or -1, we have isometry, i.e. proportionality, be it direct or inverse. If not, we have allometry of some kind. When the exponent doesn't change, we call it linear. When it does, it's called curvillinear allometry, which can be monophasic if it changes always in the same way or ratio and diphasic or triphasic, if it changes in variable ratios. A statistical analysis is applied to evaluate if the allometric exponent 'b' is different from 1, using Z test based on standard deviation estimation (SD) of the regression curve.

RESULTS

The ants ranged from 2.75 mm to 6.55 mm in body length (without head) and from 1 mm to 3.15 mm in head width. The majority of the exponents equaled 1, in other words, it was observed strong isometry between their body parts, as previously found between body mass and head width (non-published results). However, there was an exception: head width scaled allometrically with body length, with an exponent of 0.75. Since head width scales isometrically with body mass, we can say that, as mass increases, the relative length of the body decreases. So when we take body length as a reference, there is a general allometry of all the other parts measured in relation to it.

Figure 1

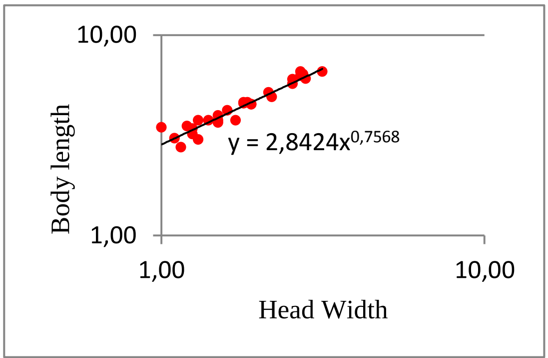


Figure 2

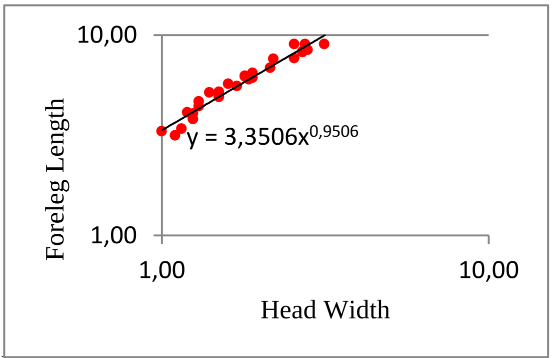


Figure 3

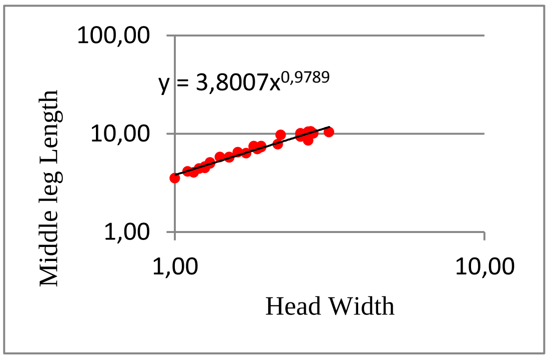


Figure 4

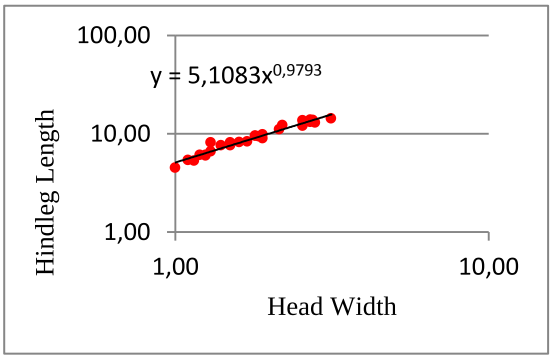
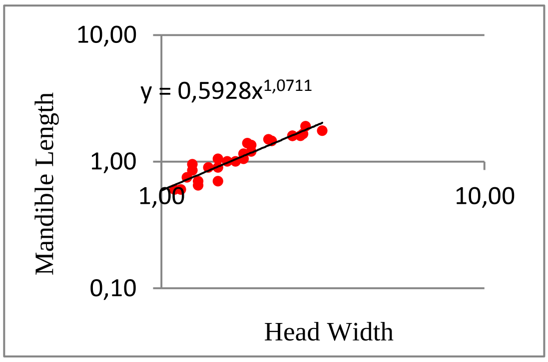


Figure 5



<u>Graphics with logarithmic axes:</u>

Figure 1: head width x body Length, b=0.7568 (SD=0.036, p<0.01). **Figure 2**: head width x foreleg length, b=0.9506 (SD=0.039 p=0.104). **Figure 3**: head width x middle leg length, b=0,9789 (SD=0.048, p=0.333). **Figure 4**: head width x hindleg length, b=0,9793 (SD=0.040, p=0.302). **Figure 5**: head width x mandible length, b=1,0711 (SD=0.068, p=0.148).

DISCUSSION AND CONCLUSION

We found an isometric relation between legs, head and mandible, but body length scales allometrically with all of the others. As said before, mass scales isometrically with head width, so the relations can also be applied to mass. In *Atta colombica*, it has been found that relative head width and leg length increases with mass (Feener et al., 1988). As for the legs, the same was observed in *Atta cephalotes* (Wetterer, 1991).

Usually, metric relations are obtained through comparison with body mass. What we see here, however, is that the general body pattern of ants in a colony must be inferred from comparisons between measures of body parts. In this case, one of them having a different pattern was enough to change the notion of proportionality of the body as a whole. The fact that the body is relatively shorter in more massive ants tells us that bigger ants have relatively longer legs and bigger heads.

The use of mass to analyze allometry aims at discussing efficiency and functionality. Indeed, it is a good approach, because different masses imply different strength, speed, energy expenditure and other important variables. Still, metric relations between body parts bring us a necessary complement to the discussion, since it includes the efficiency and functionality of form. In our case, the positive allometry for head size in relation to body length may result in loss of functionality in leaf transport and add to the observation that bigger ants operate below their optimum in terms of efficiency as observed by Burd (2000). It is possible that this allometry is beneficial up to a certain head / body ratio, enabling an individual to carry bigger or thicker fragments, but then it ceases to be, maybe due to disequilibrium for the ant having a very big head carrying a burden proportional to its size.

How to explain the persisting isometry in relation to total mass (including head) if body becomes relatively short? It may be suggested that the head compensates with an allometric gain in mass. It would be necessary to check if head gets larger in a proportional manner in relation to itself, in other words, if its shape is maintained or not. If it tends to get more spherical, for instance, mass / size relation will increase and we have an offset, with body contributing less to total mass while head is a greater portion of it. Moreover, shape can tell us something about the muscles associated to the mandibles and add to the understanding of mechanism and efficiency of leaf cutting and other functions, like defending the colony. As an alternative to head shape, we could say that body gets more robust, increasing in width or height, compensating decrease in length.

In a general fashion, larger ants perform tasks, like foraging, outside the nest and smaller ones stay inside, manipulating the fungus, taking care of brood and eggs, among others (Wilson, 1980). Looking at the results in this perspective, we have the basic case proposed in the size-grain hypothesis. So the larger ants would benefit from having relatively longer legs, being able to run faster and smaller ones from having shorter legs and being able to penetrate the fungus and the ground. It would be strong evidence, since all legs showed positive allometry. But here we are considering allometry in relation to body size. If we take mass as a reference, we have isometry and no support for this hypothesis. It would be important to have a more extensive evaluation in future to discuss the better way to consider these aspects.

One last possible approach is the issue of temperature. Termophilic ants have relatively longer legs than non-termophilic ones and there is a biogeographical gradient across the Earth, where long-legged ants are located in the tropical and subtropical zones (Sommer and Wehner, 2012). We can speculate about the relation between leg size and ant body size in a colony of *Atta sexdens rubropilosa* from this point of view. Maybe bigger ants benefit from longer legs because outside the nest the temperature would be higher and they locate themselves at a distance from the ground that prevents excessive heating. This would decrease energy expenditure and increase efficiency in leaf transport.

Finally, it would be interesting to check if there are missing size ranges in laboratory colonies, such as very big soldiers, for example, that may or not show different metric relations between body parts.

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SIZE AND SHAPE IN THE EVOLUTION OF ANT WORKER MORPHOLOGY

D.A. OLIVEIRA[1], M.K. TSCHÁ[1] & M.R. PIE[1]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná (UFPR), Rua Francisco H. dos Santos, 100, CEP 81531-980 Curitiba - PR – Brasil, e-mail: deborah.aoj@gmail.com.

Morphological evolution in ants has been traditionally thought as being strongly influenced by selection for colony ergonomic efficiency. Although many studies have focused on the evolution of social characteristics in ants, little is known about the evolution of worker morphology at macroevolutionary scales. In this study, we investigate the tempo and mode of the evolution of worker morphology, focusing on changes in size and shape. Datasets included a large sample of species from different ant genera and a set of *Pheidole* species, for a total of 1650 measurements. The rate of size evolution was at least five times faster than the rate of shape evolution. Modeling morphological evolution indicated statistically significant phylogenetic signal in both size and shape and in all datasets. Although shape evolution showed statistically significant deceleration over evolutionary time in the ant genera dataset, the opposite was found in *Pheidole*, with an accelerating rate of morphological evolution. (CNPq).

POPULATIONS AND COMMUNITIES ECOLOGY

ANT DIVERSITY IN TROPICAL DRY FORESTS: A MULTI-SCALE APPROACH AND EFFECTS OF FOREST SUCCESSION

L.F. SILVA[1,3], R.M. SOUZA[1], J.S. ALMEIDA-CORTEZ[2] & F.S. NEVES[1,3]

[1]Laboratório Ecologia de Insetos, Departamento de Biologia Geral, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Av. Antonio Carlos 6627, Pampulha, CEP 31270-901 - Belo Horizonte, MG, Brasil, email: lufigueiredobio@gmail.com. [2]Laboratório de Interação Planta-Animal, Universidade Federal de Pernambuco, Recife, PE, Brasil. [3]Programa de Pós-Graduação em Ciências Biológicas, Universidade Estadual de Montes Claros, Montes Claros, MG, Brasil.

Ants occur and dominate most ecosystems, playing important ecological roles. Moreover, these organisms are very sensitive to environmental changes, like verified along forest successional gradient. This is the case of Tropical Dry Forests (TDFs) that are distributed like forests patches in different secondary successional stages. TDFs are in contact with all Brazillian biomes, e.g. Cerrado and Caatinga. Therefore, the aims of this study were to evaluate the ant community structure in three ecoregions of TDFs along a successional gradient, and to identify the spatial scale that contributes most to the regional pool of ant species of TDFs. We tested the following hypotheses: (i) species richness (α) remains the same and species composition changes along forest successional gradient within and among ecoregion (ii) the degree of dissimilarity in ant species composition between plots (β_1) increase with the progress of succession and will be larger in transitional areas and smaller in Caatinga; and (iii) differences among ecoregions (β_3) are more important to TDFs total diversity than are differences among plots (β_1). The study was performed in Cerrado areas (Serra do Cipó), central region of Minas Gerais, in Cerrado-Caatinga transitional areas (North of Minas Gerais), and in Caatinga (Paraíba). In each region, ants were collected using pitfall traps installed in 9 plots of 0.1ha (50x20m) in early, intermediate and late forest stages of natural regeneration (three plots per stage). We installed pitfall traps in the epigaeic and arboreal microhabitats of five sampling points per plot (one in the center and four in the vertices). We collected 154 morphospecies distributed in 7 subfamilies and 35 genera. Species richness and composition did not differ between stages (p=n.s) besides species composition are different between ecoregions (R^2=0.17, F=28.362; p<0,001). β_1 did not differ between stages (p=n.s) but differ between ecoregions, being β_1 larger in the transitional areas, and smaller in Caatinga ($p < 0.05$). The ecoregion and stage scales contribute more for the gamma total diversity (40,2% and 27,6%). The maintenance of community structure between stages suggests that inhibition model of succession is operating in this study, showing that early stages are important to the conservation of TDFs as later. Since β_1 are larger in transitional area between Cerrado and Caatinga, species are more aggregated there. Moreover, historical processes are more important to diversity of ants in TDFs since the broad-scale (ecoregions) contributes more to regional pool of species. (CAPES, CNPq, FAPEMIG)

ANT DIVERSITY PARTITIONING ACROSS SPATIAL SCALES: ECOLOGICAL PROCESSES AND IMPLICATIONS FOR CONSERVING TROPICAL DRY FORESTS

T. MARQUES[1] & J.H. SCHOEREDER[2]

[1]Programa de Pós-Graduação em Entomologia, Departamento de Entomologia, Universidade Federal de Viçosa, Viçosa, MG, 36570-000, Brasil, e-mail: tatiants@gmail.com; [2]Departamento de Biologia Geral, Universidade Federal de Viçosa, Viçosa, MG, Brasil.

Several ecological and evolutionary processes can drive changes in diversity at different spatial scales. To determine the scale at which these processes are most influential, we hypothesized that (i) broad-scale differences between ecoregions had greater influence on ant species richness and species turnover than local differences among fragments within ecoregions and (ii) the degree of dissimilarity in ant species composition is larger between Tropical Dry Forest fragments and the surrounding vegetations than among Tropical Dry Forests located in different ecoregions, indicating that extant Tropical Dry Forests are relicts of a broader distribution of this vegetation. To examine ant diversity patterns, we built a nested hierarchical design on three spatial scales, ranging from 45 sampling units in each fragment (local scale), two fragments, one of Tropical Dry Forest + one of surrounding vegetation (landscape scale) and five Brazilian ecoregions (regional scale). A null model based on the sample was used to identify variations in the random distribution of ant species across spatial scales. We collected 163 ant species from 44 genera. Spatial partitioning of ant diversity showed that observed β_1 diversity (between fragments) and β_2 diversity (among ecoregions) were higher than expected by chance. In regional scale more than 65% of total species richness of ants was produced by the turnover of species among ecoregions, indicating that the ecoregional scale (β_2) plays a crucial role in structuring ant species composition in Brazil. Also, there is wide variation in species composition between fragments of the same ecoregion, around 75% of species are not shared between fragments. Then, the significative β-diversity among fragments (β_1) and the high dissimilarity in ant species composition between TDF fragment and surrounding vegetation in each ecoregion, indicates that evolutionary history is a major driver of the local and regional diversity of ants. We suggest that during historical events, populations of species of ants may have migrated among TDF fragments through the dispersal corridor and after these areas were isolated, the ant community may have suffered from external pressures of the biome in which they were embedded, leading to different evolutionary histories that consequently led to different diversity and species composition. We conclude that this analysis helps to identify possible non-random processes that govern the diversity, since it identifies the scales in which ecological processes contribute more to the regional diversity of ants, which becomes the primary target for conservation efforts. Based on species composition and diversity patterns, we stress the importance of creating more protected areas throughout the coverage area of Tropical Dry Forests, favoring a more efficient conservation process. (FAPEMIG, CAPES, CNPq)

ANTS AS MODIFIERS OF THE HERBIVOR GUILDS DISTRIBUTION IN MONTANE FORESTS UNDER DISTINCT DISTURBANCE LEVELS

R.B.F. CAMPOS, G.M. LOURENÇO & S.P. RIBEIRO

Laboratório de Ecologia Evolutiva de Insetos de Dossel e Sucessão Natural, Departamento de Biodiversidade, Evolução e Meio Ambiente/ICEB, Universidade Federal de Ouro Preto, MG, Brasil, e-mail: rbfcampos@gmail.com

INTRODUCTION

In the canopy, some species of ants are considered dominant by having strong territorial behavior, which can generate patterns of distribution with exclusive territories (Room 1971, Majer et al., 1994). This notable territorial behavior results in a three-dimensional mosaic pattern in forest canopies, which intercalates excluding territories with non-dominant species that occur within or between these territories (Majer et al., 1994) in what is so called permeable or mosaic free spaces (Ribeiro et al., 2013). In Neotropical forests, the formation of ant mosaics has been considered as the largest biotic organization able to affect the composition and diversity of other members of the arthropod community (Room, 1971; Blüthgen & Stork, 2007; Dejean et al. 2007).

However, one of the major debates about the distribution of canopy insects was the difficulty in defining the territories of dominant ants. Recent studies have shown that this difficulty is more related to the sampling methodology than to the absence of mosaics (Blüthgen & Stork, 2007; Ribeiro et al., 2013). Furthermore, to our knowledge, there is no research relating dominant ants and patterns of free-feeding herbivores distribution in the canopy. Also it is needed to consider that different guilds of herbivores may be affected in different ways by the ants, resulting in distinct patterns of herbivory and insect abundance in response to ants (Neves et al., 2011; Schoereder et al., 2010).

Furthermore, different answers to a same question may arise depending on the scale, as species distribution patterns may or may not be detected if studied at crowns or canopy scales, for instance (Neves et al. 2013). Thus, the detection of the effects of important factors for the biota, such as seasonality, historical areas of disturbance, heterogeneity and biological interactions may differ depending on the spatial scale studied.

Although there are studies on the distribution patterns of insect herbivores and their interactions with ants in the forest canopy, most studies focused on specific taxa, or community of herbivores in general (Oliveira et al., 2002; Neves et al. 2013; Schoereder et al. 2010). These studies did not investigate any specific interaction involving ants and all other insects present. In the present study, we tested the hypothesis that dominant ants in the canopy affect the distribution of herbivores species richness and abundance. We predict that the effect is positive for the richness and abundance of suckers and negative for the other guilds.

MATERIALS AND METHODS

The study was conducted at State Park Itacolomi (PEIT) , located in the southeastern state of Minas Gerais (20°22'30 "-20°30'00"S and 43°32'30"-43°22'30"W). We selected three areas with different levels of impact (intense, intermediate and light), suffered until 40 years ago, when the area was set as protected. The intense impact area had vegetation replaced by tea plantation, *Camellia sinensis* (L.) O. Kuntze , and currently also consists of successional forest with dominance of candeia, *Eremanthus erythropappus* (DC.) Mac Leish. This has a mean canopy height of 4.3m with slight or no distinction of understory. The intermediate impact area consists of secondary forest without predominance of candeia. This is nearby to an old tea plantation site, has a mean canopy height of 6.2m with an understory distinct and dense. The low impact area is composed of a deep forested valley, with canopy well structured, and mean height of 10.4m, with emergent trees up to 25m. The area has a mild impact, coming from occasional timbering.

In each area, a transect was defined and along it we demarcated eight sampling points, about 20m apart each other. Each spot consisted of a canopy segment comprising a central emergent tree and the nearest trees. The total segment tree canopy varied from four to seven trees, due to accessibility and crown continuity. In total 44 trees in intense impacted area, 42 trees in the area of intermediate impact and 46 in light impacted area were sampled, summing up 132 trees. We carried out four sampling campaigns using these same trees during two rainy seasons (December/2007 and April/2011) and two dry seasons (October/2011 and October/2012). Samples of insects were held in the treetops by beating the branches using an adapted entomological umbrella (Campos et al., 2006).

All insects were separated into morphospecies and compared with specimens of the reference collection of the Laboratory of Evolutionary Ecology of Canopy Insects DEBIO / UFOP where witnesses specimens were deposited. The insects from the orders Coleoptera and Hemiptera were identified to family or subfamily level. After the identification of insects of the orders Coleoptera and Hemiptera, individuals were separated by trophic guilds. Thus, individuals of the Order Coleoptera were separated in chewing, detritus, fungal feeders, predators and wood decay, as individuals of the Order Hemiptera were separated into sucking and predators. For some analyzes individuals detritus, fungal feeders, predators and wood decay of the two orders were combined into one group called prey.

The collected ants were identified to the best possible taxonomic level by specialists. After identification we established mosaic categories according to Ribeiro et al. (2013): Category 1 - for simple mosaic, ie, the presence of only one dominant ant species, category 2 - for mosaic permeable, ie, the presence of more than one dominant ant species, and Category 3 - no mosaic ie no dominant ant. Thus, each sampling point has received a category for further analysis. The classification of dominant ant was performed according Brandão et al. (2012).

The analyzis were performed taking into account two spatial scales: canopy segment scale (24 segments/sampling) and tree scale (132 trees/ sampling). For segments canopy scale, analyzes of covariance (ANCOVA) were made with bifatorial repeated measures where the richness and abundance of herbivores were considered response variables and mosaic categories were considered the explanatory variables. The ant mosaic categories (category 1 - simple mosaic, Category 2 - permeable mosaic and Category 3 - no mosaic) were considered as the dependent variable. For these analyzes we used the data from the second sampling (rain/2011) and fourth harvest (dry/2012). Due to the slight loss of homoscedasticity, data were log-transformed for analysis.

To test the possible variation in species richness and abundance of herbivores over space, time and influence the abundance of dominant ants in trees, we conducted analyzes using generalized linear models (GLM), where the richness and abundance of herbivores (specifically chewing, sucking and prey) were considered response variables and (i) the impact of different intensities (heavy, intermediate and light), (ii) the abundance of dominant ants and (iii) the interaction between these two factors were considered the explanatory variables.

RESULTS AND DISCUSSION

Sucking herbivores and prey showed greater richness in the site with light impact and similar in two other sites (ANOVA sucking $F_{2,\ 95}$=8.81, p <0.001; prey $F_{2,95}$=5.48, p=0.006). Similarly the average abundance of these two groups was greater in site with light impact and similar in other sites (ANOVA sucking $F_{2,\ 95}$=10.47, p<0.001; prey $F_{2,95}$=5.22, p=0.007). On the other hand, there was no difference between the seasons to the average richness or abundance of any of the groups.

The distribution of chewing, of the prey and richness of sucking did not respond to the mosaic categories. Nevertheless, the average abundance of sucking species changed due to the presence of the mosaic (ANOVA $F_{2,47}$=457.0, p=0.002), i.e., they responded positively to the dominant ant presence, independent of the season and the sampling area. The sucking species abundance was greater in the sites which presented mosaic (1, 2) and lower in places without mosaic (3). The light impacted site, which showed higher average richness and abundance of sucking species showed the largest number of crowns under simple mosaics.

The chewing species richness and abundance did not respond to the abundance of dominant ants and differences in impact areas, except in one dry season, when the interaction between the factors was significant ($\chi_{25,126}$=12.78, p=0.02), i.e., where there was a greater impact, there was also a greater abundance of ants and lower abundance of chewing species.

Sucking species richness and abundance presented greater values in the site under light impact than other sites, but inconsistently between sampling campaign (second sampling - rain $\chi_{25,126}$=16.68, p=0.005; $\chi_{25,126}$=57.59, p<0.001, third sampling - dry $\chi_{25,\ 126}$=33.08, p<0.00; $\chi_{21,\ 126}$=67.38, p<0.001). In the fourth sampling (dry) the sucking abundance was also positively influenced by the ant abundance ($\chi_{21,\ 131}$ =53.26, p<0.001). This pattern was possibly influenced by a trophobiotic relationship between sucking Membracidae Family (9 adults and 12 nymphs) and the ant *Myrmelachista catharinae*. Richness ($\chi_{25,\ 126}$=16.18, p=0.006) and abundance ($\chi_{25,\ 126}$=20.47, p=0.001) of preys were larger in light impact site and especially in trees where there was less dominant ants.

In conclusion, the presence of ant mosaic territories was clearly related to the abundance of sucking insect species so that those happen in greater numbers in locations with simple mosaic, reinforcing the idea that a given dominant ant species once present in a canopy monopolize the resource, thus reducing diversity of ant and other herbivore species. On the scale of the tree, the abundance of dominant ants resulted in different responses depending on the considered guild: sucking species were favored and the chewing and preys were negatively affected or not at all. Where the sucking species, especially trophobiont ones, were present, the dominant ants seem to protect the territory and other guilds may be actively removed. Thus, for the scale of the tree, herbivores were present and more abundant in the less disturbed site, but the determination of its presence in specific trees depends on the abundance of dominant ants and the guild in question.

Our study confirm the importance of the analysis on different scales for finding of insects distribution patterns on forest canopies, since the effects can be revealed or not according to the studied scale, i.e., crowns or canopy (Blüthgen et al., 2004; Neves et al., 2013; Schoereder et al., 2010). The present study also emphasizes the importance of analyzing concomitantly variables affecting the distribution of insects in tropical forest canopies. In addition, for the first time the existence of low herbivore/invertebrate diversity/abundance spots in the canopy was properly investigated, and shown to be, at least partially, related to the presence of ant mosaics.

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EFFECTS OF LONG-TERM FIRE REGIMES ON THE ANT COMMUNITY OF THE CERRADO

J. MARAVALHAS[1] & H.L. VASCONCELOS[1]

[1]Programa de Pós-Graduação em Ecologia e Conservação de Recursos Naturais, Universidade Federal de Uberlândia, Rua Ceará, s/n, Bairro Umuarama, CEP: 38400-902, Uberlândia, MG, Brasil. E-mail: jmaravalhas@gmail.com.

Ants are key organisms in tropical ecosystems, dominating resources and controlling plant and animal populations. They are sensitive to habitat changes, being ideal to study the impacts of disturbances and to be used as bioindicators. Fire is important in many ecosystems, maintaining habitat types and local populations. The Cerrado is the second largest Neotropical biome, a diverse fire-prone savanna and a conservation hotspot. Changes in the fire regime threaten this biome, so developing fire management strategies is crucial. We estimated species richness, composition, foraging activity and functional features of the ant community in savanic cerrado subjected to long-term experimental fire regimes. Besides, we partitioned total ant species richness (γ diversity) into its additive components of local diversity (α) and species turnover (β). Treatments varied in terms of fire frequency (unburned, mid-season fires every four and every two years) and burning season (fires every two years early, middle or late along the dry season), i.e. five regime treatments with four replicates each, in a total of 20 plots. Mid-season with biennial frequency treatment was included in both analyses. We sampled epigaeic and arboreal ants using 32 baited and unbaited pitfall traps per plot. We identified 165 ant species belonging to 41 genera. Fire-suppressed sites had less species than fire-treated ones, but there was no difference in richness irrespective of frequency or season of burning among burned plots. Fire frequency clearly affected community composition, as both ant strata differed amongst sites. Ant activity did not show clear patterns because of the between-treatment variance. Mean functional richness was high in all plots irrespective of fire treatment, but some groups differed among treatments: Fungus-Growing ants were common in intermediate frequency sites and decreased in unburned and frequently burned sites. Likewise, higher Attini were abundant in more open sites (late-season). Unburned plots had less General Myrmicinae, possibly explaining the low species richness found there, as this group encompasses many species-rich genera. Legionary ants were absent in late-season and infrequent in unburned plots, with similar levels in the remaining. Additive partitioning revealed a lower contribution of $\beta1$ (between-pitfalls) and a greater contribution of α and $\beta3$ (between treatments) to the γ diversity. Over 42% of all species collected were due to the turnover between fire treatments. The Cerrado ant community is very sensitive to changes in the fire regime and thus can be used as a proxy to other organisms in the development of fire management strategies. Fire-suppressed sites has low richness but harbors closed-habitat species, while frequently burned sites maintain the savanic structure and allow the persistence of open-habitat ants. Thus, we advocate the use of prescribed burning to control wildfires and maintain the Cerrado landscape while maximizing the conservation of habitats and species. (CNPq)

ENVIRONMENTAL EFFECTS ON ANT FUNCTIONAL DIVERSITY IN AN ATLANTIC FOREST FRAGMENT

R.S. PROBST[1,3] R.R. SILVA[2] & C.R.F. BRANDÃO[3]

[1]Programa de Pós-Graduação em Sistemática, Taxonomia Animal e Biodiversidade, Museu de Zoologia da Universidade de São Paulo/MZSP, Av. Nazaré, n° 481, Ipiranga, São Paulo/SP, Brasil, CEP 04263-000, probstrodolfo@gmail.com; [2]Museu Paraense Emílio Goeldi Coordenação de Ciências da Terra e Ecologia, Belém/PA, Brasil; [3]Laboratório de Hymenoptera, MZSP, São Paulo/SP, Brasil

This study was performed in the State Park of Xixová-Japuí (PEXJ), a conservation area located in the State of São Paulo. The objective was to evaluate the response of ant morphological diversity in three environments with distinctive vegetation types. At each environment we established 2 transects of 100m with 10 equidistant sampling points, each of them with a pitfall trap partially filled with a mixture of water, detergent and salt that remained in the field for seven days (at summer and winter seasons). In addition we registered abiotic variables and environmental resources at each collection point. Eighty-two species belonging to seven subfamilies (29 genera) were collected (65 in the summer season and 55 in the winter season). Morphological measures (N=11) were taken of ant workers (n=6, when possible) of all species to quantify the morphological diversity in each sample. We described morphological diversity by three indexes (FD: functional diversity (Petchey & Gaston), MPD: mean pairwise distance, MNTD: mean nearest taxon distance). We quantified the influence of the measured variables in the richness and composition of communities and the relationship between resource-environment. We used GLMs to test the relationship between local species richness, morphological diversity and the environmental variables using Gaussian and Poisson distributions, respectively. Litter density, temperature, DAP, number and size of twigs and soil slope were used as predictors of taxonomic and morphological ant diversity. Model selection was determined using the AIC criteria. We used the fourth-corner analysis to evaluate relationships between the environment and ant morphological traits, analyzing three matrices simultaneously (sites by environmental variables, sites by species presence/absence and species by morphological traits). In the summer, we found a weak relationship between species richness, twig size (estimated slope= 0.13, P=0.06) and soil slope (estimated slope=-0.10, P=0.10). Morphological diversity (FD) showed a negative relationship with litter density (estimated slope= -0.4, P=0.01); MPD was negatively associated with temperature (estimated slope=-0.44, P=0.01) and MNTD negatively associated with number of twig size (estimated slope=-0.002, P=0.04). In the winter, we found a weak and negative relationship between species richness and soil slope (estimated slope=-0.14, P=0.05). Morphological diversity (MPD) showed a weak relationship with temperature (estimated slope=-0.41, P=0.05) and MNTD showed a positive relationship with vegetation structure (DAP, estimated slope=0.31, P=0.01). Ant community assembly based on morphological traits in the summer season suggested significant negative relationships between the ant traits and temperature (range of Pearson r = -0.06 to -0.10) or litter density (range of Pearson r= -0.06 to -0.16) at pitfall scale; in the winter season we found no causal relationships between ant morphology and environmental variables. In overall, our results suggest different responses of species richness and ant morphology to habitat structure. Community assembly wide analysis and based on traits at summer was determined by temperature and litter density, suggesting a seasonal environmental filter influencing species composition in the PEXJ according to their ecological preferences. (FAPESP)

EXTRAFLORAL NECTARIES: A DRIVER OF ANT COMMUNITY IN A FRAGMENTED ATLANTIC FOREST LANDSCAPE

T. CÂMARA[1], W.R ALMEIDA[1], M. TABARELLI[2] & I.R LEAL[2]

[1]Programa de Pós-Graduação em Biologia Vegetal, Universidade Federal de Pernambuco, Rua Prof. Nelson Chaves, s/n, Cidade Universitária, CEP: 50.670-901, Recife, Pernambuco, Brasil, e-mail: camara.talita@yahoo.com.br. [2]Departamento de Botânica, Universidade Federal de Pernambuco, Recife, Pernambuco, Brasil.

Deforestation and forest fragmentation cause non-random extinction which compromise tree traits responsible to maintain biological interactions. Recently, our studies revealed an impoverishment of EFN-bearing plants in forest edge and forest fragments (ranging 10 ha to 300 ha) compared to forest interior (fragment of 3,500 ha). Here, we investigated whether EFN-bearing trees might be affecting ant community. We selected 18 fragments (ranging 10 ha to 3,500 ha in size) embedded in a severely fragmented 670-km² forest landscape of the Atlantic forest of north-eastern Brazil. EFNs-bearing trees (DBH $\geq$ 10 cm) were surveyed in 0.1-ha permanent plots established in the center of each fragment. Surveys of EFN-attended ants were conducted using 290-m transects running through the permanent plots parallel to the edge forest. Our results revealed an effect of EFN-bearing trees abundance on different functional groups of ant-tending EFN. As the abundance of EFN-bearing trees increase, the relative abundance of arboreal dominant and opportunists ants increases (Pearson: $r = 0.30$, $p = 0.02$; $r = 0.30$, $p = 0.03$, respectively). In contrast, arboreal subordinate ants were not affected by EFN-bearing trees (Pearson: $r = 0.04$, $p = 0.42$). Our results revealed the importance of nectar secreted by EFN-bearing trees as a driver of ant community structure in a fragmented forest landscape. This suggests a possible bottom-up cascade where in edge-dominated habitat might be impoverishing some ant functional groups. (CAPES, CNPq)

FLOWER-VISITING ANTS IN A FRAGMENTED LANDSCAPE IN SOUTH BRAZILIAN GRASSLANDS

B.O. AZAMBUJA[1]; L.R. PODGAISKI[1]; J.R. LIMA[1] & V.D. PILLAR[1]

[1]Laboratório de Ecologia Quantitativa, Departamento de Ecologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul (UFRGS), Av. Bento Gonçalves, 9500, CEP 91501-970 – Porto Alegre, RS, Brasil, e-mail: podgaiski@gmail.com

Ants are common flower visitors, foraging on high quality resources from several plant species in many ecosystems. Nevertheless, as ants usually fail to provide functional pollination services, they are considered nectar thieves, and may also displace legitimate floral visitors and damage floral structures. Here we studied environmental factors affecting flower-visiting ant diversity and composition in natural grasslands of the southernmost part of Brazil. These ecosystems support very high levels of biodiversity and ecosystem services, but are extremely neglected in terms of conservation, increasingly losing habitat to agricultural practices. For our research, we selected 27 grassland fragments (size ranging from 16 to 12,000 ha) surrounded mostly by soybean plantations in the region of Planalto Medio in Rio Grande do Sul State. During one day in summer and one day in spring we sampled ants in enthomophilous flowering plants in a 70 x 70 m plot within each fragment. Each flowering plant was monitored during 30 minutes, and flower-visiting ants were captured with an insect aspirator. As potential predictors of ant diversity we considered several variables related to vegetation structure, habitat and landscape (e.g. total and flowering plant richness, vegetation height, grassland management intensity, fragment area, percentage of grassland cover in 2 and 8 km radius). We recorded 108 flowering plant species visited by ants. The most visited ones were *Baccharis trimera* (Asteraceae) and *Borreria verticilata* (Rubiaceae). Ants were identified to 13 genera and 28 morphospecies. *Pheidole* was the richest genus (5 species). The most frequent ant genera visiting flowers were *Camponotus* (40% of all recorded visits) and *Brachymyrmex* (27%). By multiple regressions, we found that ant species richness was predicted by flowering plant richness (R^2=0.22; p=0.012), which in turn was negatively influenced by grassland management intensity (R^2=0.23; p=0.011). We performed Principal Coordinates Analysis with ant composition (species presence/absence) at all sites to find the main axis of compositional variation. This vector was highly correlated to vegetation height and percentage of grassland vegetation remaining in a 8 km radius (R^2=0.52; $p<0.001$). A Mantel Test using the complete ant species composition showed that more similar sampling units concerning surrounding grassland remnants (8 km radius) were also more similar based on ant composition (r_M=0.217; p=0.058). Our results show that flower-visiting ant richness is directly affected by available resources (flower richness), and indirectly by management intensity. Further, species composition seemed to be influenced both by local habitat characteristics (vegetation height) and habitat loss at the landscape scale. Our prospects include applying path analysis and ant-flower network analysis to better understand how animal-plant interactions are affected by local and landscape factors. (FAPERGS)

HOW DOES FIRE AFFECT ANT DIVERSITY AND SEED REMOVAL PROCESS? RESULTS FROM A REPLICATED BURNING EXPERIMENT IN SOUTH BRAZILIAN GRASSLANDS

L.R. PODGAISKI[1,2], C.P.R. FERRANDO[1], C.S. GOLDAS[1] M.S. MENDONÇA JR.[1] & V.D. PILLAR[2]

[1]Laboratório de Ecologia de Interações, Departamento de Ecologia, Universidade Federal do Rio Grande do Sul (UFRGS), Av. Bento Gonçalves, 9500, Porto Alegre, RS, Brasil, e-mail: podgaiski@gmail.com, [2]Laboratório de Ecologia Quantitativa, Departamento de Ecologia, Universidade Federal do Rio Grande do Sul (UFRGS), Av. Bento Gonçalves, 9500, Porto Alegre, RS, Brasil.

Fire and grazing are primary disturbances driving biodiversity patterns, ecosystem dynamics and ecological processes in grasslands all around the world. In Brazilian cattle grazing grasslands is a traditional economic activity, and fire is used by farmers to improve forage quality and reduce shrub encroachment. It is well known that fire leads to an increase in plant diversity by reducing competitive dominant species in these ecosystems. However, our understanding concerning the role that the post-burn habitat structure plays in animal assembly and ecosystem processes is limited. We conducted a replicated burning experiment in natural grassland of the southernmost part of Brazil (Eldorado do Sul, RS, 30º06'58"S, 51º41'05"W) to investigate fire effects on ant diversity and seed removal process. We established seven blocks with two 10 x 10m plots; one plot *per* block was randomly burned, and the other was considered control. We sampled ants with sweep net and five pitfall traps *per* plot. Seed removal by ants was accessed with five seed traps *per* plot. Each seed trap consisted in a closed plastic Petri dish with lateral holes containing a mix of seed species. During one year we gathered more than 4.000 ants, from 57 species and 27 genera. The most abundant species were *Camponotus crassus* (23%), *C. fastigatus* (8.8%), *Wasmannia* sp.1 (8.1%), *Ectatomma quadridens* (6.3%); *Pheidole* sp.5 (5.8%) and *Pheidole radoszkowskii* (5.6%). The richest genera were *Pheidole* (10 species), *Camponotus* and *Solenopsis* (6 species each one). Burned grassland sites presented an increase in ant abundance after one ($P=0.01$) and 12 months ($P=0.05$), which was positively correlated to the vegetation species richness ($r=0.51$; $P=0.06$). Ant richness also increased in burned grasslands after 12 months ($P=0.04$), and it was directly correlated to the grassland canopy openness ($r=0.60$; $P=0.02$). Principal Coordinates Analysis (PCoA) did not indicate fire effects on ant species composition (abundance, and presence/absence data). The seeds were more frequently removed from the traps contaning *Schinus molle* (Anacardiaceae, 64%) and *Solanum vireus* (Solanaceae, 45%) seeds. Total seed removal rates were enhanced in burned sites one month after fire ($P=0.04$). At this period, ant abundance was a good predictor of both *S. molle* ($r=0.64$, $P=0.01$) and *S. vireus* ($r=0.53$, $P=0.05$) seed removal rates. These findings suggest that fire disturbance in South Brazilian grasslands may constitute a filtering mechanism influencing ant diversity and their mediated ecosystem processes. Further, to complement our taxonomical results, we will apply a trait-based response-and-effect framework (CNPq, CAPES).

IMPORTANCE OF AGROFORESTRY FOR MAINTAINING INVERTEBRATE FAUNA, PARTICULARLY ANTS, ASSOCIATED WITH EPIPHYTIC BROMELIADS IN SOUTH-EASTERN BAHIA, BRAZIL

W.D. da ROCHA[1,3], J.H.C. DELABIE[2,3], S.P. RIBEIRO[4], G. SCHROTH[5], F.S. NEVES[6] & G.W. FERNANDES[1,6]

[1]Laboratório de Ecologia Evolutiva e Biodiversidade - LEEB, Instituto de Ciências Biológicas - ICB, Universidade Federal de Minas Gerais (UFMG), Av. Antônio Carlos, 6627, CEP 31270-901 - Belo Horizonte, MG, Brasil, e-mail: wd.darocha@gmail.com. Programa de Pós-graduação em Ecologia Conservação e Manejo da Vida Silvestre, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brasil. [2]Universidade Estadual de Santa Cruz (UESC), Ilhéus-Bahia, Brazil. [3]Laboratório de Mirmecologia, Convênio UESC/CEPEC, Centro de Pesquisa do Cacau, Itabuna-Bahia, Brasil. [4]Universidade Federal de Ouro Preto (UFOP), Ouro Preto-MG, Brasil. [5]C.P. 513, 68109-971 Santarém, Pará, Brasil. [6]Universidade Federal de Minas Gerais (UFMG), Belo Horizonte-MG, Brasil.

The contribution of the cocoa agroforest matrix to biodiversity conservation depends on its structure, floristic composition and landscape quality. This study intended to analyze the interactions between host trees/epiphytes/ants in the several agroforest systems associated with the cocoa tree, with the aim of verifying how these interactions may favor biodiversity conservation. We investigated if (i) the ant diversity associated with epiphytic bromeliads depends on the phorophyte architecture; (ii) the architectural heterogeneity (volume) and location (distance from the canopy epicenter) of epiphyte bromeliads determine the ant diversity and abundance of associated organisms. The study was carried out in five cocoa agroforests and one remnant of mature forest in the cocoa region of southern Bahia, Brazil. Data collection of the explanatory variables about the architecture of the phorophytes (CAP, stem, tree height, crown size and canopy shading area) and epiphytic bromeliads (bromeliads size = volume and distribution of bromeliads in the canopy), as well as of the dependent variables (ants and fauna in general), was conducted on 30 trees and 180 epiphytic bromeliads (six bromeliads per tree), occurring in the tree canopy. A total of 103 ant species and 5.808 invertebrates and vertebrates of the fauna associated with epiphyte bromeliads were collected. The architectural variable size of host tree canopy is positively correlated to the ant richness found associated to the bromeliads present in the canopy ($p<0.03$), while the remaining variables were not significant in explaining the diversity of ants ($p>0.05$). No relationship between bromeliad volume and richness of ants ($p=0.6$) was observed. However, we observed a positive and significant relationship between bromeliad size (volume) and the abundance of fauna associated ($p<0.0005$). Ant species richness and abundance of associated fauna was positively correlated with distance variable of epiphyte bromeliads in the tree crowns ($p<0.04$, $p=0.0003$; respectively).The tree canopy may contribute to maintaining determined spatial and physical conditions in the structure of the branches and leaves, which confers different microclimatic and microhabitat conditions. These will favor, in turn, the diversity and abundance of animals living in the canopy, as well as the occurrence and distribution of the epiphytes. The architectural information of the host trees is sometimes considered a determinant factor for the arboreal fauna. The function of this environment in regions where there are mosaics of forest remnants appears to be more a compromise that a solution. Agroforest initiatives can contribute to the planning of ecological corridors that contribute to the genic flow of a range of species and reducing the diversity loss in the tropical forest regions. Our results show too the importance of shade tree canopies in agroforests for

maintaining the native fauna associated with epiphytes. (CNPq, PRONEX SECTI-FAPESB/CNPq, projeto PNX 0011/2009, PPG-Zoologia UESC/BA)

LEAF LITTER ANT ASSEMBLAGES ON TWO FOREST TYPES IN THE UPPER AND MIDDLE BASIN OF A RIVER SYSTEM

A.C. LEITE[1,2], R.B.F. CAMPOS[1], C.B. COSTA-MILANEZ[1], R.F. SOUZA[1], F.S. CASTRO[1] & S.P. RIBEIRO[1]

[1]Laboratório de Ecologia Evolutiva de Insetos de Dossel e Sucessão Natural, Departamento de Biodiversidade, Evolução e Meio-Ambiente, ICEB, Universidade Federal de Ouro Preto (UFOP), Campus Universitário Morro do Cruzeiro, CEP 35400-000 - Ouro Preto, MG, Brasil, e-mail: acarvalholeite@gmail.com. [2]Programa de Pós-Graduação em Ecologia, Conservação e Manejo da Vida Silvestre, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brasil.

The patterns of ant species distribution and richness are related to several habitat variables and abiotic factors. Some of these factors may be a stronger determinant of species occurrence, which may be understood as its habitat template. It is known that the altitudinal gradient is a variable that severely restricts the richness and composition of litter ant assemblages. On the other hand, litterfall is a substantial habitat beneficial to provide extensive fauna continuity between forests due to the ability to standardize conditions for maintenance of wildlife. Thus, we know that leaf litter ant genus composition is usually most dissimilar between very different forest types or among biogeographically large-scales. However, the significance of relative differences in mesoscale is often neglected. In this way, it is necessary to verify the relative importance of litterfall conditions and mesoscale biogeographical variations to explain ant diversity patterns In this context, we study how different two forests types within a river system can be in terms of ant richness and composition. We investigate the leaf litter ant fauna in a montane and submontane semideciduous forests, respectively located in the upper (about 1.300m altitude) and middle (about 350m) "Rio Doce" basin, southeastern Brazil. Our hypothesis is that altitudinal restrictions will affect ant richness and composition despite the forests being part of the same river basin. It was expected that altitudinal variation should restrict some ant species occurrence in the montane forest. Moreover, genus composition should highlight the altitudinal contrast given the inability of some species colonize higher altitudes, associated with the possibility of specialist species in montane forests. We selected five independent areas, three belonging to Itacolomi State Park (upper Rio Doce), and two belonging to Rio Doce State Park (middle Rio Doce). Ant sampling was conducted between August and November 2006, using mini-winkler method. We collected a total of 41 genera (10 subfamilies), six of them exclusive to the montane forest and 12 exclusive to submontane. Unlike than expected, genus richness was not significantly different in any scale, although, genus composition was really dissimilar between forests (NMDS, Stress=0,3075; ANOSIM, R=0,3642, p<0,001). *Wasmannia* and *Nylanderia* are the two main contributors to the dissimilarity, being much more representative on the montane forest. Our results suggest that although genus richness shows an excellent response in large-scale studies, some variations between the forests may be diluted in taxonomic resolution. Furthermore, mesoscale has significant importance in structuring ant assemblages once leaf litter is not able to maintain favorable conditions through extensive distances and altitudes. Yet, the most conspicuous genera accounting for the dissimilarity indicates that the studied montane forest is extremely favorable to generalist species, in opposite to the specialist species that were expected. FAPEMIG and CNPq)

PROCESSES DRIVING ADDITIVE PARTITIONING OF ANT DIVERSITY ACROSS PLANT DEVELOPMENT STAGES

F.V. COSTA[1]; A.C.M. QUEIROZ[2] & F.S. NEVES[1]

[1]Laboratório de Ecologia de Insetos, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Av. Antônio Carlos 6627 – E3-257, Pampulha, CEP 31270-901 - Belo Horizonte, MG, Brasil, email: fecostabio@gmail.com. [2]Universidade Federal de Lavras, Departamento de Biologia, Setor de Ecologia e Conservação, Laboratório de Ecologia de Formigas, Lavras, MG, Brasil

Ontogenetic succession is the temporal process of colonization and replacement of species associated with a specific host, due to changes in the characteristics of individuals along their development. Plant development is one of the main factors that determine the insect-ontogeny interaction, since it leads to variations in resource quality and availability. Such variations, which are associated with ecological and physiological processes, lead the insects towards hosts which can provide better conditions for survival and reproduction. The additive partitioning of species diversity is a useful approach to analyze patterns of diversity in studies with multiscale sampling once it identifies the most significant sources of diversity in a sampling design with nested spatial scales. We evaluated whether: (i) ant richness increases towards higher host plant development stages due to species turnover from saplings to adults; and (ii) beta diversity between plants of the same stage (β_1) increase with plant development, being greater at highest stages. The study was conducted in a cerrado (savanna) fragment located at Montes Claros, Northern Minas Gerais, Brazil. To assess the effect of plant ontogeny on diversity partitioning we selected 60 individuals of *Copaifera langsdorffii* Desf. (Fabaceae: Caesalpinoideae) belonging to four different development stages: 15 saplings, 15 juveniles, 15 intermediate and 15 adults. In each plant we choose three different points of the crown to sample the ants by beating technique followed by capture with entomological umbrella. We observed a total of 35 ant species and the increasing of alpha diversity (α medium) towards higher development stages, ranging from 1.69 (saplings) to 2.64 (adults). The observed and expected α and β_1 diversity were similar for saplings ($p > 0.05$) and juveniles ($p > 0.05$), indicating that both stages were sufficiently sampled. For intermediate and adults we found that α observed was higher than expected ($p < 0.05$), suggesting that these stages are the scales that better contributes for total diversity. As expected, the β_1 was higher in adult plants and increases with plant development. According to our prevision, turnover was the mechanism responsible for the increment in ant diversity demonstrating that each stage has particular advantages and conditions for ants' colonization. These results suggest that all plants were sufficiently sampled and that *C. langsdorffii* support a huge ant diversity. Higher plant stages better contributes to the ant diversity probably due to the larger number of sites for egg laying, housing, feeding and better environmental conditions. These results are useful for understanding the processes behind the spatial patterns of ants' biodiversity and for helping to target conservation efforts to higher plants. (FAPEMIG, CNPQ)

SEED REMOVAL BY ANTS: EFFECTS OF SEED SIZE, HABITAT AND SPECIES RICHNESS

M.A. PADILHA[1], T.G. SOBRINHO[1], T.G. CORNELISSEN[2], C.D.C. GUIMARÃES[2], J.P. R. VIANA[2], A.S.M. BARBOSA[3] & J.H. SCHOEREDER[1]

[1]Laboratório de Ecologia de Comunidades, Departamento de Biologia Geral, Universidade Federal de Viçosa (UFV), Av. P. H. Rolfs s/n, CEP 36570-000, Centro – Viçosa, MG, Brasil. [2]Universidade Federal de São João Del Rei (UFSJ), Departamento de Ciências Naturais, Campus Dom Bosco, Praça Dom Helvécio, 74, CEP 36301-160, Fábricas - São João Del Rei, MG, Brasil. [3]Instituto Nacional de Pesquisas da Amazônia (INPA), Av. André Araújo, 2.936, CEP 69067-375, Petrópolis - Manaus, AM, Brasil. E-mail: padilha.mam@gmail.com.

INTRODUCTION

Dispersal refers to the displacement of propagules from the parental plant and not only enables the movement of individuals, enhancing therefore their spatial distribution, but also avoids the competition among parents and seedlings (Cordeiro & Howe, 2003), and high predation and parasitism rates (Janzen, 1970), resulting in higher fitness. Amongst the many seed disperser agents, ants are one of the most important groups (Hölldobler & Wilson, 1990).

Myrmecochory was firstly studied and described in arid regions of Australia and Africa, where it is especially common (Davidson & Morton, 1981), since myrmecochorous plants are typically adapted to the poor and dry soil of these regions (Lengyel *et al*., 2009) and should therefore, be more represented in environments with these features, like savannas, instead forests, that have opposite features.

An important characteristic that influences the removal of diaspores by ants is their size. If other characteristics among the diaspores of different species are held constant, ants carry larger amounts diaspores of smaller sizes (Leal & Oliveira, 1998). Ant species richness is another relevant variable in studies of myrmecochory, because there is a direct relationship between ant diversity and seed removal (Pizo & Oliveira, 2000). Another substantial factor that may influence seed dispersal by ants is the presence of keystone species. Keystone species are defined as those species that have important ecological functions that are independent of their biomass and/or abundance, whose eventual local extinction would cause significant loss in rates of ecological functions (Naeem *et al*., 2009). In the case of seed dispersal by ants, keystone species have been mainly documented for the Australian savanna (Majer *et al*., 2011) and for temperate forests of North America (Heithaus *et al*., 2005), but no study on their importance has been conducted in tropical areas.

In this work we tested the following hypotheses: 1) seed removal rate is higher in savanna than in forest habitats; 2) there is higher removal rates of small compared to large seeds in both forest and savanna; 3) frequency of seed removal is positively correlated to ant species richness in both habitats; 4) in savanna, seed removal is enhanced by the presence of keystone ant species, contrary to the forest, where these not occur.

METHODS

We carried out the study in areas located in two private patches in Minas Gerais state, Southeastern Brazil. The first is localized in the town of Ritápolis (21°00’S, 44°20’W), a savanna area of 19.88 ha, and the second is near the town of São Tiago (20°57’S, 44°20’W), a 106.2 ha fragment of semi-deciduous seasonal rain forest (a subdivision of the Atlantic rain forest biome). The patches are13 Km apart, and according to Scolforo & Carvalho (2006), this region is characterized as a patch of savanna phytophysiognomy, intermingled with fragments of semi-deciduous seasonal rain forest, located in the middle of the Atlantic rain forest domain.

We conducted the field work between March and April of 2012. We used artificial seeds for the experiments described hereafter and these were made of a 100 g of sunflower ground seeds, mixed with 10 g of wheat flour, and the mixture was homogenized with 100 mL of distilled water, resulting in a paste. From this paste, artificial round-shaped seeds were made into two size categories (small: 4mm and large: 12 mm) that were dried at 50°C for 2 h.

We conducted the experiments in ten areas of forest and ten of savanna and established nine seed depots on each, being these depots 5 m apart. Each seed depot consisted of a paper sheet on which we placed 20 artificial seeds (10 large and 10 small). We put seed depots for experiments at 0700 h and observed during 8 h aiming the register of ant species transporting large and/or small seeds. We considered seed transports effective when ants moved seeds at a distance equal to or greater than 30 cm from the origin point. For each removal event, we collected the individual ant and stored for identification.

In order to test the first three hypotheses, we performed Generalized Linear Models (GLM) among the following variables: average percentage of seed removal per plot, average species richness recorded in experiments per plot, size of seeds and type of habitat (savanna and forest).

To test the fourth hypothesis, to both savanna and forest habitats, we calculated averages of small and large seeds effectively removed during the observation for each habitat. Afterwards, we calculated the same averages excluding removal events of each remover species. We compared averages of general removal by the paired Wilcoxon's test to each of the averages obtained after exclusions of the remover species. In this analysis, those species whose exclusions were significant, were considered as keystone species.

We performed all analyses in software R (R Development Core Team, 2010), including residue analysis.

RESULTS

We recorded 13 ant species effectively removing seeds during the experiments in savanna and eight in forest, whereas many others behaved exploiting small and large seeds on site, removing particles of the artificial seeds, in both habitats.

Comparing the effect of seed size on seed removal in the two habitats, small seeds were more removed in savanna than in forest ($F_{1,18}$ = 5.56; P = 0.030) and there was no significant difference for large seeds between habitats ($F_{1, 18}$ = 0.64; P = 0.433). In savanna, the removal of small seeds was significantly higher than that of large seeds ($F_{1,18}$ = 11.53; P = 0.003), whereas in forest this difference was not observed ($F_{1, 18}$ = 1.74; P = 0.204) (Fig. 1).

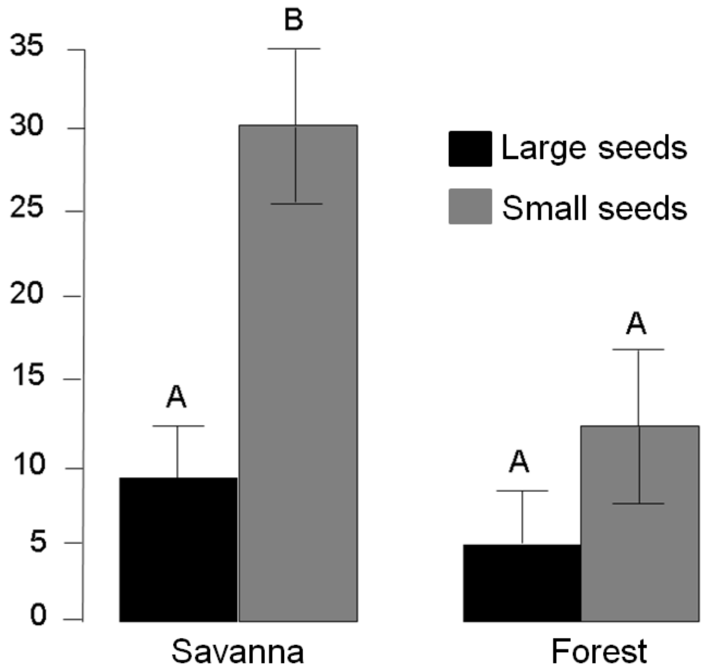

FIGURE 1. Average percentages of small and large seeds removal in savanna and forest. Different letters indicate significant differences.

Our results do not indicate a significant correlation between seed removal and species richness ($F_{1,36} = 0.82$; $P = 0.371$), as well as in any of the interactions: species richness and seed size ($F_{1,35} = 0.006$; $P = 0.936$) and species richness and type of habitat ($F_{1,34} = 0.064$; $P = 0.802$).

The Wilcoxon's test indicated that in savanna *Pheidole oxyops* is probably a keystone species, especially for the small seeds ($V = 45$; $P = 0.0091$). This species was responsible for the removal of 49.5% of small seeds, and amongst all interactions with seeds performed by those ants, 83.9% resulted in effective removal. In forest habitats, the results indicated *Pheidole* sp. as a possible keystone species, again only for small seeds ($V = 21$; $P = 0.033$), being responsible by the removal of 27.53% of those seeds.

In forest, *Atta sexdens* was responsible for 93.09% of removal of large seeds, and in savanna, *Atta laevigata* performed the removal of 92.22% of large seeds. However, their overall effect was relatively low, because they have a large local effect, patchily distributed. Therefore, there was a high removal in a few plots and none in others, resulting in non-significant results in the keystone analysis ($V = 3$, $P = 0.3711$ for *Atta laevigata* and $V = 10$, $P = 0.1003$ for *Atta sexdens*).

DISCUSSION

Higher seed removal in savanna compared to forests was corroborated only for small seeds. Such result can be explained by the removal of large seeds by *Atta laevigata* and *A. sexdens* in savanna and in forest, respectively. Both ant species had similar participation in such events, although the removal of large seeds by these species in both environments has been influenced by high removal rates in few experimental plots.

The significantly higher removal of small seeds in savanna compared to the forest is consistent with the ecological literature, confirming the pattern of higher frequency of myrmecochory in dryer ecosystems with poor soil and open vegetation, such as deserts and savannas (Milewski & Bond, 1982). In tropical forests, on the other hand, myrmecochory is rare, and for the most part, is an opportunistic and unspecialized relationship (Lengyel *et al*., 2010).

Seed size influenced dispersal rates by ants only in savanna habitats. The majority of interactions between ants and small seeds observed in the forest habitat were that of local exploitation, without removal. In fact, the number of species that effectively removed small seeds was higher in savanna (13 species) compared to forest (8 species).

The hypothesis of a positive relationship between seed removal and ant species richness was not corroborated by our data. This hypothesis was grounded on the majority of studies regarding the link between biodiversity and ecosystem functioning, that suggest an increase of certain ecological function rate with respect to the increase of species richness (Naeem *et al*., 2009). Gove *et al*. (2007) suggest that if myrmecochory is a mutualistic relationship in which all the mutualists have equal importance in the interaction, one could expect an increase in seed removal rates with the increase of species richness. However, according to the same authors, we can also expect constancy, because the relationship tends to be positive in first moment, but reach a *plateau,* from which redundant ant species arise. Notwithstanding, empirical data have not always found a positive correlation between seed removal rates and ant species richness, and this absence of pattern might be explained by the presence of keystone species of disperser ants (Ness & Morin, 2008). This fact is consistent with results found here in both habitats, savanna and forest.

The foraging strategy of keystone ants also influences the dispersal rates. Arnan *et al*. (2010) demonstrated that ants that forage in groups are better dispersers than those who forage individually. In the keystone species found in this study - *Pheidole* sp. and *Pheidole oxyops* - the foraging strategy was in fact one of the relevant factors influencing dispersal rates, as they are both group foragers.

Pheidole sp. - the keystone species found in forest - had the absolute majority of its interactions with seeds represented by local exploitation of seeds instead effective removal, as in the case of *P. oxyops*. Even so, we can assert its role as keystone species of seed removal in forest, because in all effective removal events in this habitat, those performed by *Pheidole* sp. were the majority and their exclusion would cause significant loss in seed removal rates. In fact, although *Pheidole* sp. exhibit a foraging behavior that would enable its classification as an inefficient remover, its role as keystone species in the forest studied here seems to be influenced by the absence of other efficient species. That is, the forest seems to be a less prone environment to myrmecochory and where ant species poorly adapted to the myrmecochory can excel as opportunistic dispersers, as in fact the literature has shown.

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TEMPORAL PATTERNS OF DIVERSITY: DYNAMIC OF GROUND-DWELLING ANT ASSEMBLAGES (HYMENOPTERA: FORMICIDAE) IN 25 KM^2 OF AMAZON FOREST

A.H.C. OLIVEIRA[1], J.L.P. SOUZA[1] & F.B. BACCARO[3]

[1]Laboratório de Sistemática e Ecologia de Invertebrados do Solo, Coordenação de Pesquisas em Biodiversidade/Programa de Pós-graduação em Entomologia, Instituto Nacional de Pesquisas da Amazônia (INPA), Avenida André Araújo, 2936, 69080-971 – Manaus, AM, Brasil, e-mail: ahcoliveira@gmail.com. [2]Programa de Pós-graduação em Entomologia (PPG-ENT), INPA, Manaus, AM, Brasil, e-mail: souza.jorge@gmail.com [3]Universidade Federal do Amazonas (UFAM), Avenida Rodrigo Otávio, Japiim, 69077-000 – Manaus, AM, Brasil, e-mail: fabricera@gmail.com

INTRODUCTION

The major challenge in ecology is to understand the temporal dynamics of species in natural systems. One factor that limits the understanding of the dynamics in tropical forests is the lack of studies with experimental protocols and standardized data collection on large scales (Magnusson *et al*., 2005). In the Amazon, the number of studies on mesoscale (25 km^2) with diverse groups of invertebrates such as pseudoscorpions (Aguiar *et al.,* 2006), ants (Oliveira *et al.,* 2009) and oribatid mites (Moraes *et al.,* 2011) is growing. However, most studies with soil invertebrates evaluate the correlation of composition and richness with environmental conditions in space, and not through time.

Among the invertebrates, the ants are dominant in most terrestrial ecosystems Stork (1991), both in number of species and in biomass. Ants are able to modify the physical and chemical characteristics of the soil, taking part in nutrient cycling (Lobry de Bruyn, 1999; Sousa-Souto *et al*., 2007) and interact with other groups of invertebrates, fungi and plants Schultz & McGlynn (2000). In addition to their ecological importance, have a sensitivity to environmental changes Dyer & Letourneau (1999) and live in colonies relatively sessile. With that, ants are often used to answer ecological questions (Kaspari & Weiser, 1999) or as model organisms in conservation assessments, monitoring, reforestation programs, and ecosystem management (Folgarait, 1998; Andersen & Majer, 2004; and Andersen *et al.,* 2004).

The establishment and persistence of ant species at a site is a complex function of the availability of food, nesting sites, the presence of competing species and predators (Perfecto & Vandermeer 1996; Kaspari, 1996), as well as environmental and climatic variables (e.g., topography, humidity, temperature) that regulate access to these resources (Levings, 1983; Kaspari & Weiser 2000; Vasconcelos *et al*., 2003).

In this research, we assessed the congruence between ant species composition sampled in 2006 and 2012, during dry season. The correlations between richness and composition with some environmental variables are stable between six years were also investigated.

MATERIALS AND METHODS

The study was conducted in Amazonian forest (Ducke Reserve) that is situated 25 km in the north of Manaus, Amazonas State (extreme north of Brazil). We used the RAPELD sampling design (Magnusson *et al*., 2005) to survey ground-dwelling ant assemblages. We collected ants in 25 km^2 of a tropical rainforest in 2006 and 2012, during dry season in 30 permanent plots of 250 m-long that follow terrain contours. The minimum distance between plots was 1 km. The pitfall traps (95 mm diameter; 8 cm depth; 500 ml volume) were partially filled with alcohol, buried with the rim at ground level, and left for 48 hours. Every 25 m-long, one pitfall was installed, totaling 600 subsamples in both years.

We identified ants to species or morphospecies, using specialized papers and reference material in the Entomological Collection of the National Institute for Amazonia Research (INPA). For the study, we accessed the selected environmental variables (clay and slope) in the database of Brazilian program for Biodiversity Research (PPBio), available at www.ppbio.inpa.gov.br, where the collection protocol for each variable are described in detail. Besides checking answers the assembly forward ant environmental variables stable on the time scale investigated (six years), was included in the model a dynamic variable, the volume of litter collected in 2012 in the same way that was sampled in 2006.

We analyzed the distributions of ant species recorded in both periods in the Ducke Reserve using presence and absence, and occurrence per plot. Occurrence data corresponds to the number of sub-samples in each species occurred, and can vary from zero to 10, for species in each plot.

To compare the number of ant species, we made rarefaction analyzes, based of species occurrences Gotelli & Colwell (2001), using the Mao Tao method. With the values obtained, we constructed species accumulation curves.

We reduced the dimensionality of the assembly collected in each year by principal coordinate analysis (PCoA) using occurrence data. With the composition of the assemblies sampled in both years, we conducted nonparametric multivariate analyzes of variance (npMANOVA) Anderson (2001).

To investigate the role of environmental variables in maintaining the number of species from one location, we used multiple regressions for each year of collection (2006 and 2012). The redundancy analysis (RDA) was used to detect how much of the change in the response variable (species composition matrix) can be explained by environmental variables and determine if the variables correlated with the assembly 2006 are the same as in 2012.

To investigate the role environmental variables in the dynamics of ant assemblies, we calculated the Euclidean distances of the scores generated by the PCoA axes for each plot between years. We used the values obtained as the dependent variable in a multiple regression using only the stable variables (clay and slope) as independent.

The rarefaction analyzes were performed using the program EstimateS (version 9) Colwell (2013). Multivariate ordinations and other analyzes were performed using the statistical program R (version 3.0) R Core Team (2013).

RESULTS AND DISCUSSION

In 2006 and 2012, 13.801 ants were collected, distributed in 54 genera and 301 species and morphospecies. The number of ant species identified in 2006 and 2012 was similar, 209 and 207 respectively. A small variation in the number of species between years in this study may be related to the relative stability of the environment and the niche that ants occupy. Much of ants sampled in the area can be classified as generalists Silva & Brandão (2010). Consequently, changes in the number of species between collection events in relatively stable environments such as upland forests are not expected. However, the species composition changed between years, with only 115 species recorded in the two sample events. Despite the change in the composition of ant species, the rates of increase of species were similar (Fig. 1), reaching match the confidence interval of each other. Vasconcelos *et al*. (2003) found rates of increase of similar species in a four-year interval between sampling events. Together, these results suggest that in these locations, the absence of some species is compensated by the occurrence of other, keeping some components of the assembly and stable number of species in the area.

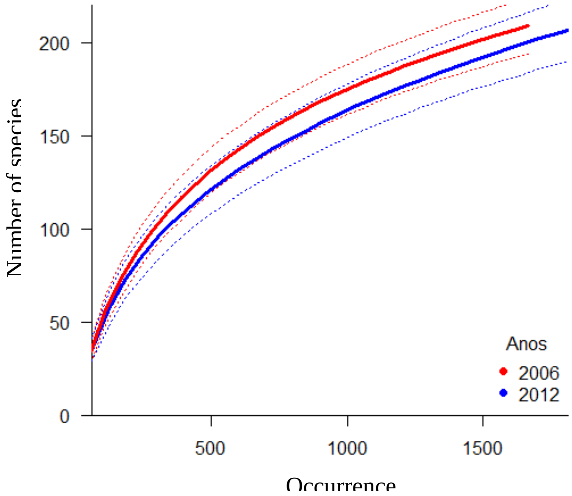

Fig. 1. Ground-dwelling-ant species accumulation curves for Pitfall trapping in 2006 and 2012, in Brazilian Amazon (Ducke Reserve). Dotted lines mark the 95% confidence intervals.

Apart from relatively stable over time, the number of ants species was not influenced by any environmental variables selected (clay, slope and litter). Unlike ant species richness, the composition of ant assemblages sampled in 2006 and 2012 was different and correlated with topographic gradient (RDA 2006 = 0.2096; p = 0.005 / RDA 2012 = 0.1658 p = 0.005). The results suggest that regardless of the species identity (more than 60% of the species composition between the changed years), the gradient is a predictor stable of ants assemblages structure.

The composition of ant assemblages collected in 2006 was different from the composition of species collected in 2012 (npMANOVA $r^2 = 0.12$, f = 8.07, p = 0.001) (Fig. 2). The two axes of the PCoA captures 21% of the variance of the data composition. The dissimilarity measures for the same plots in different years ranged from 0.20 to 0.52 (mean = 0.38) using Euclidean distance.

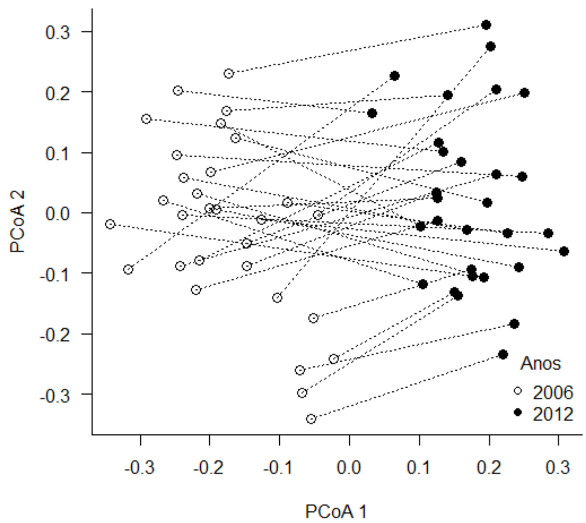

Fig. 2. PCoA ordination using occurrence data for ant species recorded in 2006 and 2012, in 30 plots of Ducke Reserve. The dotted lines represent the respective distances in a straight line (Euclidean distance) between the same plots in different years.

The multiple regression model explained 52% of the data variance in species composition between the two years ($r^2 = 0.52$, $p \leq 0.04$). Clay content explained only 5% of the variation in the composition of ants assemblages between years ($r^2 = 0.05$, $p \leq 0.01$). The portions with smaller distances (with more similar composition) grouped at the beginning and end of the clay gradient, but with variations around the central tendency (Fig. 3). The slope explained most of the variation in the composition of ants assemblages between the periods studied ($r^2 = 0.50$, $p \leq 0.01$). Plots with more different species composition grouped at the beginning of the gradient, which is flat places, while most similar plots are distributed throughout the gradient (Fig. 3).

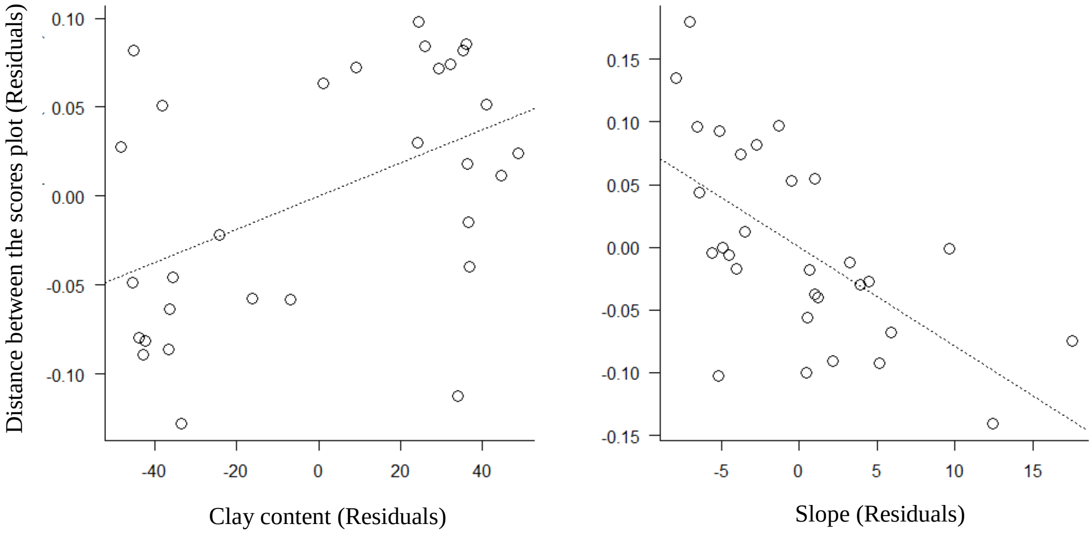

Fig. 3. Partial graphs of relationship between the difference in ants species composition between 2006 and 2012 as a function of clay (r2 = 0.08, F1, 112 = 10.75, $p \leq 0.01$) and slope (r2 = 0, 50, F1, 112 = 112.9, $p \leq 0.01$) in 30 plots of Ducke Reserve. Dotted line indicates the central tendency of the distribution of the residuals.

The plots with lower replacement of species were those located in places more inclined, with low accumulation litter, larger spacing between trees due to tree mortality rate and greater gap formation (Toledo *et al*., 2011), consequently the plant species composition is different from the flatter areas (Oliveira *et al*., 2008). These changes in environmental conditions can select or limit the establishment of certain ant colonies, favoring some species over others. In the most inclined areas, the replacement of species was lower, suggesting that the number of species capable of establishing and persists in this range of conditions is reduced. Higher areas and flat are more environmentally stable, and the observed changes in the composition of ant species in these sites may be influenced by biotic factors, such as species interactions.

The heterogeneity in the Ducke Reserve, here represented by a topographic gradient may regulate the temporal dynamics of ant species composition. In locations where environmental conditions are not a limiting factor, such as upland forests, biotic factors may be determinants to explain changes in species composition. The stability of the relationships between ant assemblages composition and environmental variables, suggests that historical series may be able to generate temporal and spatial models to predict ant species distribution, which should be taken into account in studies of environmental disturbances, invasive species and on delimitation of priority areas for conservation.

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THE STUDY OF TROPHIC STRUCTURE IN ANT ASSEMBLAGES TO CREATE A ZOOLOGICAL CHARACTERIZATION FOR TROPICAL BIOMES

A.B. GONTIJO[1], S.P. RIBEIRO[1], T.G.S. CARNEIRO[2], F.S. CASTRO[1], A.Y. HARADA[3] & J.T. LONGINO[4]

[1]Laboratório de Ecologia Evolutiva de Insetos de Dossel e Sucessão Natural, Departamento de Biodiversidade, Evolução e Meio Ambiente, Universidade Federal de Ouro Preto, Campus Morro do Cruzeiro, CEP 35400-000 – Ouro Preto, MG, Brasil, e-mail: gontijo.ab@gmail.com; [2]Terra Lab, Departamento de Computação,Universidade Federal de Ouro Preto, Ouro Preto, MG, Brasil; [3]Museu de História Natural Emilio Goeld, Belém, PA, Brazil; [4]Department of Biology, The University of Utah, Salt Lake City, USA.

In this study we analysed five year data sets from tropical forest litter ant species assemblages collected in two independent forest ecosystems on the Neotropical region: Ferreira Pena Scientific Station in Caxiuanã, Brazil and La Selva Biological Station, Costa Rica. Our goal was to seek structural patterns in ant assemblages that can be used as tools for characterization of different tropical regions. Similar sampling protocols were used in each location, as part of TEAM (Tropical Ecology Monitoring and Assessment) project, held by Conservation International. The TEAM protocol sites are organized in four to six independent sampling squares of 1 ha, called IMA (IMA – Integrated Monitoring Array), of fixed sizes and with orthogonally-opened trails. In this study were used three IMA, two in Costa Rica and one in Brazil. For ants, the squares are divided into four quadrants, each with imaginary lines running from the centre of the horizontal and vertical axes. Each quadrant was divided in 25 sub-quadrants with 10000 m^2 and a 100-meter transect, with sampling points spaced at 10-meter intervals, was selected randomly from the sub-quadrants in each quadrant. Data were taken using mini-Winkler four times per year, from 2003 to 2007. This characterization then generated tables of the relative frequency for the genus and guilds in each sampling site. Simple linear regressions and model residual exploratory analyses were performed to verify the similarities between the IMAs at the same region and between different regions. The relative frequency was obtained from the number of occurrences of each genus/guilds found in the samples within transects, in order to generate distribution and density data variance at local (transects) and site (IMAs) scales. To compare the dominance-rarity genus/guild distribution pattern between the studied regions, a hierarchical ranking was obtained according to the frequency of each genus/guild and rated from least-dominant to most-dominant. Then, comparative analyses were performed for the averages between IMAs in the same region and between IMAs in different regions. Relative dominance among genera varied strongly over time, but without any consistent pattern. In the other hand, the densities of guilds also varied over time, but the ratios of numeric dominance among guilds was more stable, allowing comparison of the trophic structure between different biogeographic regions. The results obtained from the comparison between the trophic guilds structures in the two regions showed considerable differences among themselves (0,2% of similarity), and similarities (80%) between the guild structures in different plots in the same region. Thus we can interpret the structure of trophic guilds of ants as zoological groups capable of generating useful patterns to characterize different biotropical regions, and having the potential to become a zoological biome character. (TEAM project: Conservation International/Biodiversitas)

USING TAXONOMIC AND ECOLOGICAL APPROACHES TO VALIDATE SURROGATE TAXA OF ANT SPECIES FOR MONITORING ACTIVITIES IN AMAZON FORESTS

J.L.P. SOUZA[1], F.B. BACCARO[2], V.L. LANDEIRO[3], E. FRANKLIN[4], W.E. MAGNUSSON[4], P.A.C.L. PEQUENO[4], I.O. FERNANDES[1], C.R. SANTOS NETO[1], M.T. TORRES[5], C.A. NOGUEIRA[1], C.B. GOMES[1] & M.P. CIDADE[6]

[1]Programa de Pós-Graduação em Entomologia, Instituto Nacional de Pesquisas da Amazônia (INPA), Caixa Postal 2223, CEP 69080–971, Manaus, AM, Brasil. e-mail: souza.jorge@gmail.com. [2]Departamento de Biologia, Universidade Federal do Amazonas (UFAM), Manaus, AM, Brasil. [3]Departamento de Botânica e Ecologia, Instituto de Biociências, Universidade Federal de Mato Grosso (UFMT), Cuiabá, MT, Brasil. [4]INPA, Coordenação de Biodiversidade, Manaus, AM, Brasil. [5]Coordenação de Dengue e Febre Amarela (DDVRCZ), Palmas, TO, Brasil. [6]Programa de Pós-Graduação em Recursos Naturais, Universidade Federal de Roraima (UFRR), Boa Vista, RR, Brasil.

With increasing human influence on the Earth's natural ecosystems, the rates of biodiversity loss are growing rapidly. Despite methods on conservation planning are increasing the availability of monitoring information, the spatial distribution of biodiversity remains scarce for several organisms. One way to overcome this problem is focusing on fewer taxonomic groups or surrogate taxa that are able to provide satisfactory answers in shorter period of time. Our aim was to identify a taxonomic resolution for ant monitoring and biodiversity assessment that was as cost-effective as possible. We measured the congruence between species-level data with the potential surrogate resolutions (genus, tribe, subfamily, guilds, indicator-taxa, and mixed-level approach). To evaluate the ecological response of each surrogate group, we also tested whether the same ecological patterns observed with species-level dataset can be retrieved using the surrogate resolution. Then, we evaluated the monetary and time costs to obtain each kind of dataset in order to improve the cost-effectiveness of monitoring programs. The study was conducted in 7 study sites of the Brazilian Biodiversity Research Program (PPBio). The sites cover a latitudinal gradient of 1,800 km in the Amazon Basin encompassing a wide environmental heterogeneity. Ants were sampled with Winkler (1,330 m^2 of litter), 1,510 pitfall traps and 1,020 sardine baits. All surrogate taxa richness's were able to predict overall species richness, recovering 84 to 96% of species matrix information. RDA analyses indicated that the ant assemblage composition was significantly related to topographic variables (soil characteristics and terrain slope). The percentage of maintenance of the ecological pattern by surrogate taxa ranged from 64 to 86%. Genus and tribe retrieved 86% of ecological pattern captured at species level. The mixed-level, indicator-taxa, genus and tribe had the highest average congruence with species in all sites, being the most conservative and cost-effective surrogates. This relationship occurred regardless of geographic location of the study site, type of vegetation, sampling effort or sampling technique used. The indicator taxa and the genera resolutions had the same capacity to maintain the ecological patterns. The total cost varies between the two identification resolutions, with genera showing the lowest cost while the indicator-taxa cost was very similar to species identification. Our results showed that the same answers we had with all species we also had with genus resolution. Because we standardized sampling techniques, our findings indicate a real ecological pattern that is robust to region-wide environmental variability. This allows for a reduction in time and costs associated. We propose that the association of a standardized protocol to the use of genus as a surrogate for species is a reliable and cost-effective solution for biodiversity monitoring and suggest that this might be

multiplied over other areas, principally in megadiverse regions, such as Brazilian Atlantic forests. (PNPD/CAPES, PPBIO, CENBAM, FAPEAM)

VARIATION OF ANT COMMUNITIES ALONG ENVIRONMENTAL GRADIENTS IN COASTAL SAND DUNES AT PÂNTANO DO SUL BEACH, SOUTH BRAZIL

F.B. ROSUMEK[1], C.E. CERETO[1,2], B.C. LOPES[1], T. BEDUSCHI[1,3], T.T. CASTELLANI[1], K.Z. SCHERER[1], G.O. SCHMIDT[1], C.H. VOLTOLINI[2] & M.I.M. HERNÁNDEZ[1].

[1]Departamento de Ecologia e Zoologia, Universidade Federal de Santa Catarina, Campus Universitário, Trindade, CEP 88080-900, Florianópolis, SC, Brazil, e-mail: rosumek@ccb.ufsc.br. [2]Universidade Federal da Fronteira Sul, Realeza, PR, Brazil. [3]Agroecology, University of Göttingen, Germany.

Coastal sand dunes are fragile environments, especially in its frontal sector, which is the most affected by marine and eolic activity. The responses of ants to the environment in the foredunes are still poorly understood. Therefore, the objective of this study is to assess the changes in ant community along a gradient of habitat structure complexity and anthropogenic disturbance in a frontal sand dunes ecosystem. Ants were sampled in ten areas following the coastline, 200m apart of each other. In each area, five pitfall traps were placed and remained open for one week. Additionally, ants were active sampled in the vegetation by two collectors for one hour. Two samplings were performed (summer and winter) with total effort of ten pitfalls and four hours/collector per area. Habitat structure was measured in local scale by the mean of ten quadrats per area for the following variables: litter cover, percentage of exposed soil, and, for vegetation, mean height, accumulated covering and species richness. In a larger scale, (three parallel transects 200m long) the anthropogenic disturbance was measured (amount of scarps, trails, buildings, streets, rubble and trash), together with other vegetation variables (total richness and number of ruderal and exotic species). Similarity between areas was assessed by clustering analyses, and the BIOENV test was used to correlate similarity matrixes of ant communities and environmental variables. A total of 77 ants species was sampled, 65 in pitfalls and 44 in the vegetation (with 32 shared species). In the pitfall traps, three species occurred in all areas (*Camponotus fastigatus*, *Pheidole* sp. 01 and *Solenopsis* sp. 01), and ten other species presented frequencies higher than 50%. In the active sampling, only *C. fastigatus* was ubiquitous, and other six species were found in more than half of the areas. There were three new records for the region (*P.* aff. *guilelmimuelleri*, *P. lucretii* and *P. spininodis*). Clustering analyses showed that ground-dwelling and vegetation ant communities are different from each other, and that vegetation communities varied more among themselves. For ground-dwelling ants, similarity between communities was correlated with habitat structure (Rho=0.628, p=0.01), but not with anthropogenic disturbance (Rho=0.405, p=0.09). The strongest correlation was given by the combination of two variables, local richness of plants and number of exotic species. For plant ants, there was correlation with anthropogenic disturbance (Rho=0,451, p=0.05), but not with habitat structure (Rho=0.11, p=0.42). The strongest correlation was given by the combination of the variables buildings and trash. These results suggest that the two communities have distinct behaviors, the ground-dwelling ants responding strongly to habitat structure, particularly to the local richness of plants, and plant ants responding strongly to habitat disturbance, which was measured in a larger scale. (FAPESC)

INTERACTIONS BETWEEN ANTS AND PLANTS, AND BETWEEN ANTS AND OTHER ARTHROPODS

ANT-PLANT MUTUALISM: DO ANTS PROMOTE A DECREASE OF HERBIVORES IN *Qualea gradiflora* IN CERRADO?

A.C. MARADINI[1], T.G. SOBRINHO[2] & J.H. SCHOEREDER[2]

[1]Programa de Pós- Graduação em Entomologia, Departamento de Entomologia, Universidade Federal de Viçosa, Avenida Peter Henry Rolfs, s/n, Campus Universitário, CEP 36570-000- Viçosa, MG, Brasil, email: anamaradini@gmail.com. [2]Laboratório de Ecologia de Comunidades, Departamento de Biologia Geral, Universidade Federal de Viçosa, Viçosa, MG, Brasil.

Ants may have a functional role in the ecosystems, because they can act as seed dispersers, pollinators, and can promote protection against herbivores in plants that offer resources, like food or habitat. In this study we tested the hypothesis that the increase of ant abundance and richness in plants bearing extrafloral nectaries causes a decrease in abundance and richness of herbivores. We carried out the sampling in the Panga's Ecological Station at Uberlândia, MG inserted in Cerrado vegetation. In this area we marked 90 *Qualea grandiflora* plants in three phytophysiognomies: cerradão, cerrado strictu senso and campo cerrado. We sampled herbivores and ants using an entomological umbrella, beating each plants 30 times and collecting the fallen insects. We analyzed the data through model selection, to evaluate which is the best model to explain the variation in the number, the species richness and the number of guilds of herbivores. The models included as explanatory variables ant species richness and abundance as well as phytophysiognomies. There were more richness, abundance and guilds of herbivores in cerrado strictu senso, then in cerradão and then in campo cerrado. As expected, the increase in the abundance of ants, disregarding their species richness, resulted in a decrease in the abundance, species richness and number of guilds of herbivores. Ants that visit plants bearing EFNs are generalist, and because of this they should act in a similar way in the attack of the herbivores. This way, an increase in the species richness of ants may not cause decrease of the herbivores. However, some keystone species may present more aggressive behavior towards herbivores, so more abundance of these ants promotes a decrease of herbivores in the plants. This facultative mutualism between ants and plants bring benefits to the plants, due to a possible decrease in injuries caused by herbivores, allowing more growing, flowering, seed production and, hence, higher fitness. (FAPEMIG, CNPq, UFV)

COMMUNITY STRUCTURE OF FOLIAGE-DWELING ANTS IN CERRADO SAVANNA: CONSEQUENCES FOR HERBIVORE INFESTATION

S.F. SENDOYA[1], J.Y. TAMASHIRO[2], F. FERNANDEZ[3], N. BLÜTHGEN[4] & P.S. OLIVEIRA[1]

[1]Departamento de Biologia Animal, Universidade Estadual de Campinas, C.P. 6109, 13083-862, Campinas, SP, Brazil, sebasendo@gmail.com. [2]Departamento de Biologia Vegetal, Universidade Estadual de Campinas, Campinas, SP, Brazil. [3]Universidad Nacional de Colombia, Facultad de Ciencias, Instituto de Ciencias Naturales. Bogotá DC, Colombia. [4]Technische Universität Darmstadt, Fachbereich Biologie, Darmstadt, Germany.

Ants are main components of the arthropod fauna in tropical ecosystems, including the Cerrado savanna. Their dominance can be explained by their capability to use liquid food sources on plants such as extrafloral nectar and secretions from honeydew-producing insects. The extensive use of these resources characterizes most arboreal ants as herbivores. Considering this, we may expect that the presence of liquid sources may determine the distribution of ants in cerrado vegetation, and shape the patterns of specialization in plant visitation/use. Furthermore, we expect that the structure of ant assemblages determine how they affect herbivore infestation levels on pants. Herbivore-infested plants may differ with respect to the species composition and richness of visiting ants. Here, we studied the differences in the structure of ant assemblages between plants with and without liquid food sources, and between plants infested or not by caterpillars (Lepidoptera). We sampled ants visiting plants in four localities of Cerrado savanna in southeastern Brazil by using arboreal pitfall traps. On each plant we registered the presence of caterpillars in order to determine how visitation by different ant groups might affect the presence of these herbivores. We found no difference in ant species composition or richness between plants with or without liquid food sources. However, in some localities there were differences in the intensity of ant visitation to plants with vs. without liquid food sources. This difference was conditioned by the sampling locality. In localities where ants visited more intensively plants with sugary exudates, such plants were more specialized in their interaction with ants. Furthermore, the structure of the ant assemblage at such localities was slightly different on plants with caterpillars compared to uninfested plants. This difference was driven mostly by visitation levels of *Camponotus* and *Pseudomyrmex* workers. Therefore the response of ants to liquid sources on foliage may depend on local conditions, and on the species composition of visiting ant assemblages. Variations in the presence and behavior of certain ant groups may also mediate a spatial variation in the outcome of ant-plant interactions, rendering ant-derived benefits to plants only under certain conditions. (FAPESP, CNPq)

EFFECTS OF NATIVE PLANTS EXTRACTS FROM CÓRDOBA-ARGENTINA OVER FORAGING ACTIVITY OF THE "CUTTING ANT" *Acromyrmex lundi* (GUÉRIN)

L.C. NOLLI[1], L.M. BUFFA[1], M.T. DEFAGÓ[1], G. DIAZ NAPAL[2] & S.M. PALACIOS[2]

[1]Cátedra de Entomología, Centro de Investigaciones Entomológicas de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Av. Vélez Sarsfield 299, CP 5000, Córdoba, Argentina, e-mail: lbuffa@efn.uncor.edu. [2]Laboratorio de Química Fina y Productos Naturales, Facultad de Ciencias Químicas, Universidad Católica de Córdoba, Argentina

In the search for new alternatives for insect pest management, natural products from plants are an option currently studied for being substances of low toxicity and biodegradable. The leaf-cutting ant *Acromyrmex lundi* is a very important herbivorous species in the Argentine Chaco phytogeographic region as it can cut various parts of plants and attack almost all cultivated species. The objectives of this study were: 1. determine the effect of plant extracts native of Córdoba-Argentina on the foraging activity of *A. lundi* in an artificial nest. 2. evaluate the crude extract with highest activity in foraging activity field tests. Extracts were prepared with aerial parts of plants belonging to 28 botanical families. In the laboratory, an artificial nest was installed, which consisted of a main chamber where the queen, the immature and the fungus remained, and smaller chambers that operated as dump and foraging areas. The work was carried out under controlled conditions (27°C, 12:12 hs light/darkness and Hº 25± 3). In free-choice tests, 8 discs of rose leaves of 1 cm of diameter were impregnated with 10µl per cm^2 of a 1% solution (10 ug / ul) of each extract or solvent (control). The Inhibitory Dose 50 (ID_{50}) was determined for all the extracts that showed 100% repellency. *Aristolochia argentina* Griseb. showed the lowest DI_{50} values, for what it was chosen for field trials. So far there was not evidence on the repellent activity of extracts of this plant against ants. Rose leaves treated with *A. argentina* extract (1% and 5%) and others with acetone (control) were placed on either side of an actively foraging path of six active nests of *A. lundi*, 50cm from the nest opening. The percentage of removed material was registered for two hours of observation on two consecutive days, ending the trial when removed 50% of the total substrate provided. Also, foraging activity was determined by counting at a fixed point and for three minutes, the number of workers carrying *A. argentina* towards the mound. The data were analyzed by *t*-test for paired samples. In field tests, it was observed that the foraging activity was not affected when used the extract of *A. argentina* to 1% ($P > 0.05$; n= 6), while significant differences were found at 5% ($P < 0.05$; n= 5). From these preliminary results, we propose to increase knowledge of the effects of *A. argentina* on cutting ants.

INFLUENCE OF PHYSICAL, CHEMICAL AND BIOTIC DEFENSES ON LEAF HERBIVORY OF *Tococa guianensis* IN THE CERRADO

A. BARTIMACHI[1,2], J. NEVES[1,2] & H.L. VASCONCELOS[1,2]

[1]Laboratório de Ecologia de Insetos Sociais, Universidade Federal de Uberlândia (UFU), Rua Ceará s/n, CEP 38405-000 – Uberlândia, MG, Brasil, e-mail: bartimarchi@yahoo.com.br. [2]Programa de Pós-graduação em Ecologia e Conservação dos Recursos Naturais, Universidade Federal de Uberlândia, Uberlândia, MG, Brasil.

Physical and chemical defenses as well as biotic interactions are different strategies used by plants against herbivores. While chemical defenses act by reducing herbivores feeding capacity, physical defenses (trichomes) act as a physical barrier for herbivore insects. Obligate ant-plant mutualistic interactions also play an important role in indirect defenses against herbivores, since ants often provide protection to their host plants in exchange for shelter (domatia). *Tococa guianensis* is a Neotropical ant-plant obligatorily associated with ants of the genera *Allomerus* or *Azteca*. However, on the limit of its southern distribution, *T. guianensis* populations were found to persist despite the local absence of *Allomerus* and *Azteca*. Several hypotheses were proposed to explain this long-term persistence: (i) opportunistic ants fulfill –at least partially– the role played by obligate species; (ii) herbivory is avoided because of leaf trichomes or chemical defense; (iii) herbivore pressure is too low where obligate ants do not occur. We performed a factorial experiment in two populations with obligate ants -*Allomerus octoarticulatus*- in Aragarças/GO (ARA) and Cachoeira da Fumaça/MT (CACHO) and one without obligate ants in Uberlândia/MG (UDI). The populations were in the same type of habitat (gallery forest, i.e. plants from different populations were growing in similar conditions).We manipulated the presence of ants (with ants or ants removed) and of trichomes (intact or shaved leaves). Herbivory rates were measured during four months on leaves produced after the beginning of the experiment. Furthermore, we measured trichomes density, the concentration of leaf tannins and domatia area (a surrogate of investment in biotic defenses, since the larger the size of the domatia, the greater the number of ants nesting in the plant). Trichomes affected herbivory in all three plant populations, but differences in herbivory between plants with or without trichomes were relatively small. Opportunistic ants did not affect herbivory rates in UDI. Obligate ants had a strong effect on herbivory rates in ARA, but surprisingly not in CACHO. Overall, herbivory rates were higher in ARA than in both CACHO and UDI. Trichome density was also higher in ARA than in CACHO and UDI. The concentration of tannins was higher in plants of UDI which also presented smaller domatia than those of CACHO and ARA. These results suggest that the importance of obligate ants as plant defenders is conditioned by the herbivory rate experimented by the plants. In ARA, where herbivory rate was high, the ant defense was extremely efficient for the plants, whereas in CACHO obligate ants did not affect plant herbivory. In places where *T. guianensis* occurs without obligate ants, plants appear to invest more in chemical defenses, while reducing the investment in ant-related traits (domatia size). The plasticity of defensive strategies against herbivores on *T. guianensis* helps to explain the existence of populations without obligate ants. (CAPES, CNPq)

INFLUENCE OF SOIL AND VEGETATION FEATURES ON THE NESTED PATTERN OF ANT-PLANT NETWORKS IN BRAZILIAN AMAZON

W. DÁTTILO[1], V. RICO-GRAY[1], D.J. RODRIGUES[2] & T.J. IZZO[3]

[1]Instituto de Neuroetología, Universidad Veracruzana, Xalapa, VZ, Mexico, email: wdattilo@hotmail.com [2]Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo, São Paulo, SP, Brazil. [3]Departamento de Ecologia e Botânica, Universidade Federal de Mato Grosso, Cuiabá, MT, Brazil.

Most interspecific interactions involve multiple species, and generate complex networks of interactions. Focused on the structure of these ecological networks, some studies have recently shown that mutualistic networks between ants and plants bearing extrafloral nectaries (EFN) are highly nested. This shows that species with few links interact with a subset of interactive species with several interactions. However, little is known about the role of abiotic factors on these networks. In this study, we hypothesized that soil pH and canopy cover may directly influence the amount and quality of nectar, and both factors could therefore affect the pattern of interactions (nestedness) in ant–plant networks. Specifically, we tested whether soil pH and canopy cover contribute to the variation in nestedness of mutualistic (plants with EFN) and neutral (plants without EFN) ant–plant networks. For this, we examined 24 ant–plant networks (12 mutualistic and 12 neutral) in the southern Brazilian Amazon. For each network we analyzed their nestedness (as NODF index. a nestedness metric based on overlap and decreasing fill). We recorded 238 plant species (72 with EFNs) and 149 ant species. We show that nestedness was not affected by canopy cover in both mutualistic and neutral ant-plant networks. Several studies have been shown that canopy cover (light availability) is directly related to the amount of nectar secreted. However, our results show no influence of canopy cover on the network structure. On the other hand, we show that only mutualistic networks were affected by soil pH. This possibly occurs because plants growing on soils with a higher neutral pH and nutrient availability tend to have nectar with higher concentrations of sugars and amino acids. Thus, due to preferences for nectar composition by ants, this could change the patterns of interaction in mutualistic networks. As prey availability is possibly the main factor influencing ants' presence on plants without EFN, soil pH should have little or no influence on the patterns of interaction in neutral networks. In short, our results show that abiotic factors that primarily affect the quality, but not amount of food resources, may have important effects on the structure of trophic interactions in non-symbiotic ant–plant networks. (CONACYT, CNPq, PPBio)

SEED MANIPULATION BY *Acromyrmex subterraneus* AND ITS EFFECT ON SEEDS GERMINATION OF *Mabea fistulifera*

T.V. FERNANDES[1], M.L.B. MAIA[1],T.B. OLIVEIRA DOS ANJOS[2] & R.I. CAMPOS[1]

[1]Laboratório de Ecologia de Formigas (LEF), Departamento de Biologia Geral, Universidade Federal de Viçosa, Ed. Shotaro Chimoya, s/n, Campus Universitário, CEP: 36570-000 - Viçosa, MG, Brasil, e-mail: tiagovf@yahoo.com.br. [2]aboratório de Anatomia Vegetal, Universidade Federal de Viçosa, Viçosa, MG, Brasil.

INTRODUCTION

Popularly known as "leaf-cutting", the ants of Atinni tribe are characterized by the cultivation of symbiotic fungi. Atinni ants have an exclusive behavior of using vegetal parts (including fruits, flowers and seeds) to cultivate basidiomycete fungi which is used as food for the colony (Della Lucia 2011; Hölldobler & Wilson 1990; Leal & Oliveira 1998; Teixeira 2007). More specifically, the seed transport and consumption performed by ants appears to be a very important interaction called myrmecochory (Christianini *et al.* 2007; Handel & Beattie 1990; Pizo & Oliveira 1998).

The attraction that the seeds cause on ants is directly influenced by a special appendixes denominated elaiosome (Beattie 1985), which are rich in lipids. This special structure is present on seeds of *Mabea fistulifera* (euphorbiaceae), a pioneer tree species very common in the Brazilian Cerrado and Atlantic Forest (Lorenzi 2000). The elaiosome of this species, in addition to the fat content, has an extremely attractive volatile to leaf-cutting ants (Peternelli *et al*. 2008).

A preview study has demonstrated higher germination rate of *M. fistulifera* seeds manipulated by *Acromyrmex subterraneus* when compared to non-manipulated (Peternelli *et al.* 2003). However the mechanisms behind this pattern are unknown. Preliminary observations have shown that after collecting the seeds, the ants remove the elaiosome and sometimes they also performed what we called seed scarification. In this way the present study aims to test whether seeds of *M. fistulifera* handled by *A. subterraneus* have an increase in their germination and simultaneously to test possible mechanisms causing this pattern. For that we tested four hypotheses: i) manipulation of *M. fistulifera* seeds by *A. subterraneus* has a positive effect on seed germination ii) this possible increase in seed germination was solely due to extraction of the elaiosome; iii) or the increase in seed germination is caused by a joint effect of elaiosome removal and seed scarification; iv) the seed storage time influences the patterns and mechanisms above cited.

MATERIALS AND METHODS

We used 20 mature nests of *Acromyrmex subterraneus* previously kept under controlled laboratory conditions (12:12 photoperiod and 25ºC temperature) for more than one year being fed only with leaves of *Acalypha* sp.. During 10 days, each nest received 40 seeds of *M. fistulifera* every 48h. The nests continued to be fed with leaves of *Acalypha sp*. during all experiment. Subsequently, seeds that were manipulated by ants and then discarded into the trash were collected and separated into two groups: seeds that had its elaiosome removed but were not scarified by the ants (FNE) and seeds without elaiosome and scarified (FES).

For control we used seeds that have never been offered to ants (CON). We selected 200 seeds from each of these three groups to be germinated. Each experimental group of 200 seeds was divided into 50 Petri dishes (four seeds per plate) covered with dampened filter paper. The dishes were placed randomly in a germination chamber with a constant temperature of 25ºC and a photoperiod of 12:12. The number of germinated seeds was evaluated daily until remained constant for five consecutive days, totaling 36 days. All the experimental procedure described above was performed twice using the same seed lot: the first occurred one month after the seed collection and the second after six months.

RESULTS AND DISCUSSION

Contrasting previous literature results, the mean percentage of germination was greater for no manipulated seeds (CON) than for seeds manipulated by the ants (FNE and FES) (effect of treatment: $F_{2,147} = 19.8$; $P << 0,001$). However, the seed groups manipulated by ants (FNE and FES) showed no statistical differences in seed germination (Tuckey for "one month": D = 0.09 ; P = 0.51 and Tuckey for "six month": D = - 0.02 ; P = 1.00). The same result was observed for the experiment performed with seeds stored for one and six months (interaction between time and treatment: $F_{2,147} = 0.36$; P = 0.70) ; (Figure 1).

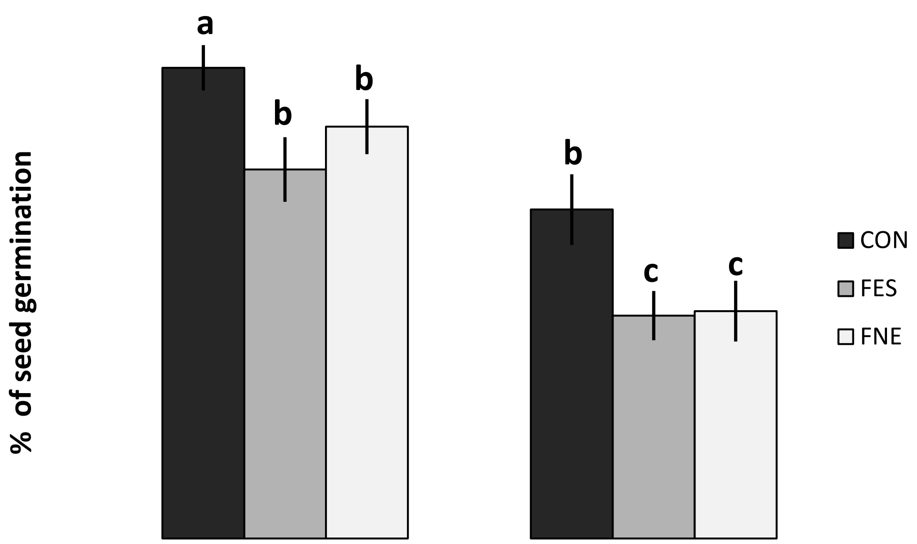

Figure 1. Mean (+ E.P.) percentage of seed germination per plate belonging to the tree studied groups after one and six month from seed collection. **CON: s**eeds that have never been offered to ants; **FNE:** seeds that had its elaiosome removed but were not scarified by the ants; **FES:** seeds without elaiosome and scarified. Means followed by the same letters did not differ significantly among themselves. The germination percentage of control was higher and there was no significant difference between the other two groups of seeds, regardless of storage time.

We conclude that unlike the previous results in literature seed manipulation by *A. subterraneus* causes a decrease in seed germination rate of *M. fistulifera*. At the same time, the removal of elaiosome appears to be the major mechanism associated with this decrease, while the scarification seems to have no effect on seed germination. Finally, this pattern is not changed by seed storage time.

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SPATIAL STRUCTURE OF ECOLOGICAL NETWORKS INVOLVING ANTS AND PLANTS WITH EXTRAFLORAL NECTARIES IN BRAZILIAN AMAZON

W. DÁTTILO[1], P.R. GUIMARÃES JR.[2] & T.J. IZZO[3]

[1]Instituto de Neuroetología, Universidad Veracruzana, Xalapa, VZ, Mexico, email: wdattilo@hotmail.com [2]Departamento de Ecologia, Instituto de Biociências, Universidade de São Paulo, São Paulo, SP, Brazil. [3]Departamento de Ecologia e Botânica, Universidade Federal de Mato Grosso, Cuiabá, MT, Brazil.

Within a natural environment, different species can interact with each other in different ways and generate complex ecological interaction networks. Recently, the study of ecological networks has provided important insights into the mechanisms that contribute to the structural organization of plant-animal interactions. However, the spatial effect has only recently been incorporated as a factor structuring these networks. In this study, we used the mutualistic interaction between ants and plants with extrafloral nectaries (EFNs) to evaluate how the topological structure and species turnover of ant–plant mutualistic networks vary over space in a regional scale. For this, we examined 12 ant–plant networks in the southern Brazilian Amazon, and analyzed their network topology (metrics: connectance, network specialization, nestedness-NODF, Z-score-NODF). Specifically, we calculated the dissimilarity of network topology over the geographic distance among sampling plots, in order to examine whether: 1) species turnover affects the topological structure of ant–plant networks, and 2) the core of generalist species remains stable at the geographic scale studied. We recorded 70 plant species (or morphospecies) with EFNs, belonging to 24 genera and 16 families. For ants, we recorded 121 species in 19 genera and eight subfamilies. We showed that although the ant and plant composition of networks changed over space, the central core of generalist species and the structure of networks remained unaltered on a geographic distance of up to 5099 m. This finding indicates that independently of variation in local and landscape environmental factors, the nonrandom pattern organization of these interacting assemblages do not change. We suggest that a stable generalist core over space can increase the potential for coevolutionary convergence of traits among species from both sides of the interaction within the community. We expect this, because the generalist core can drive the evolution of the whole community because these species interact symmetrically among them. In summary, all these findings contribute to our understanding of the maintenance of biodiversity and coevolutionary processes. (CNPq, PPBio)

THE EVOLUTION OF SOCIAL PARASITISM IN THE FUNGUS-GROWING ANT GENUS *Mycocepurus*

C. RABELING[1,2], T.R. SCHULTZ[2] & M. BACCI JR.[3]

[1]Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, U.S.A., email address: crabeling@gmail.com; [2]Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20013-7012, U.S.A.; [3]Center for the Study of Social Insects, São Paulo State University, Rio Claro, SP 13506-900, Brazil

Inquiline ants are obligate social parasites of other ant species that mostly lack a worker caste and exploit the host colony's resources to maximize their fitness. Despite their highly specialized life histories social parasite species evolved at least 80 times independently within the family Formicidae, and more species are being discovered at an increasing rate. Interestingly, most inquiline species have converged on the so-called social parasite syndrome, a complex suite of morphological and behavioral traits, which includes, but is not limited to, reduced mouthparts and body size, a smooth and shiny integument, and a swollen abdomen containing an increased number of ovaries. Recently, we discovered and described a new inquiline species in the fungus-growing ant genus *Mycocepurus*, *M. castrator*, from southeast Brazil. *M. castrator* is a workerless inquiline that is obligately dependent on the geographically widespread and locally abundant fungus-growing ant species *Mycocepurus goeldii*. In eusocial insects hosts and parasites are often closely related, an observation that became well known as Emery's rule. To explain how social parasite species originate two main hypotheses prevail: (i) the interspecific hypothesis states that a non-parasitic species evolves parasitic behavior allopatrically and starts exploiting a second free-living species, whereas (ii) the intraspecific hypothesis states that the parasitic species evolves directly from its host species in sympatry. To distinguish between the two hypotheses, it is useful to interpret Emery's rule in a phylogenetic framework, and test whether host and parasite are each other's closest relatives (strict interpretation of Emery's rule), or whether host and parasite are closely related but not necessarily sister taxa (loose interpretation of Emery's rule). To test whether *M. castrator* could have speciated in sympatry, we analyzed a comprehensive dataset consisting of a complete species sample of the genus *Mycocepurus* and five nuclear and mitochondrial markers. Our phylogenetic analyses demonstrate that the parasite is the closest relative of the host. Importantly, the genealogical relationships of single-copy nuclear and mitochondrial genes are incongruent. The nuclear phylogenies invariably show that the parasite renders the host clade paraphyletic, whereas the mitochondrial phylogeny infers host and parasite as reciprocally monophyletic. This is the first study to employ complete taxon sampling (i.e., of every known species in the genus) and comprehensive gene sampling, providing a thorough test of possible sister group relationships. Our data are consistent with the hypothesis that *M. castrator* arose via sympatric speciation. (Harvard Society of Fellows, Smithsonian Institution, NSF, FAPSP, CNPq)

BIOINDICATION, BIOINVASION AND PEST CONTROL

ADAPTABILITY OF THE INVASIVE ARGENTINE ANT THROUGH HABITAT SUITABILITY MODELING

F.M. RIBEIRO[1,2], J.W. RIBEIRO[1] & M.C. RIBEIRO[1]

[1]Laboratório de Ecologia Espacial e Conservação, Departamento de Ecologia, Instituto de Biociências, Universidade Paulista "Júlio de Mesquita Filho" (UNESP), Av, 24A, 1515, CEP 13506-700 – Rio Claro, SP, Brasil, email: felipemartello@gmail.com. Programa de Pós-Graduação em Zoologia, Universidade Paulista "Júlio de Mesquita Filho" (UNESP), Rio Claro, SP, Brasil.

INTRODUCTION

Biological invasions are recognized as one of the main causes of loss of diversity as well as the reduction and fragmentation of habitats (Suarez et al. 2001). Invasive species establish in new environments and reduce native biodiversity through predation, competition, hybridization and disease transmission. (Richardson 2011). Ants are considered as potencial invaders since 1950 (Richardoson 2011). Nowadays there are at least 150 species of ants introduced in new environments (McGlynn 1999) and five of them are among the 100 worst invasive alien species of the world (Lowe et al. 2000).

The, the Argentine ant (*Linepithema humile*) is native from and South of Brazil and nowadays is found invading environments in all Europe, Africa, North America, Oceania, Asia and several Oceanic Islands, particularly in temperate and subtemperate regions (Wild, 2004). This cosmopolitan distribution is related to its association with human activities, which accidentally transport them to new areas and provide perennial sources of food, shelters and suitable climatic conditions for successfull establishment of the colony (Suarez et al., 2001).

The unicoloniality, which is the absence of intraspecific aggressiveness among individuals of different colonies, also plays a key role in the success of this species to establish in new environments, since allows colonies to reach high densities, the supercolonies (Girauld et al. 2002). This behavior is very common in introduced range and is referred as a consequence of a loss of genetic diversity that introduced populations of this species experienced (Tsutsui et 2000), which allow to this species to reach an invasive status. However, the fact that Heller (2004) found this behavior in native population in Argentine added to records of this species as invasive as well as native element of ant community in Brazil, indicate that the adaptive processes that led the Argentine ant to achieve the status of invasive species are not yet fully known. In this study, we evaluate if the adaptability *L. humile* would be predict throughout habitat suitability modelling. A subsequent objective was designed a map of potential areas of distribution of the Argentine ant in South America.

MATERIAL AND METHODS

The modeling of *L. humile* was done in two ways: (1) for South America with records for the native distribution (n=67) and (2) with a large records dataset based on its invasive distribution of *L. humile* (n=940).Those models were generated from presence only records obtained from Roura-Pascual et al (2004).

We used 11 layers as variables to create both models trough Maxent software: landscape variable (distance from urban areas), environmental variable (altitude) and bioclimatics variables (land cover, precipitation of wettest month, precipitation of driest month, minimun temperature of coldest month, maxim temperature of warmest month, mean diurnal range, temperature annual range, annual precipitation and percentage of vegetation cover).

For both models, there were generated ten replics. The procedure used to select subsets variables was Jackknife. To validate the models, we used the bootstrap method from 30% of the sample points previously separated by software (random test percentage).

The strength of each model to predict the distribution of *L. humile* was evaluated using two dataset of occurrence: (1) the distribution of the other models (native or invasive) and (2) the distribution of the *L. humile* in Brazil, collect through a literature review (n=24).

The suitability index of each occurrence data was extract for each model and the mean and the standard deviation were calculated for each dataset.

RESULTS AND DISCUSSION

The model based on native distribution was the less efficient to predict the Brazilian and the invasive distribution (0.010±0.038 and 0.066±0.205, respectively). Although the model based on invasive distribution showed low efficiency to predict the distribution of the Argentine ant in Brazil (0.137±0.103), it was more effective to predict the native distribution of the species (0.374±0.251).

This results, associated with the difficulty of identifying species of this genus (Wild 2004), suggest that evaluation of the model based on invasive distribution in Brazil would have been underestimates because of taxonomic misidentification. This suggest us that the habitat suitability modeling is efficient to predict the adaptability of Argentine ant in South America.

Model which used invasive records was effective to predict the native distribution and, somehow the Brazilian distribution (Figure 1b). By other side the model that used the native dataset was not efficient in predict the two distributions (Figure 1a), which suggests us that exotic population suffer some adaptation that difficult its modelling trough native dataset. Our results also point the care that it may be taken in using Species Distribution Models with invasive species: the use of native dataset would underestimated the real distribution since invasive populations could have adaptations that are not present in native populations. (CAPES)

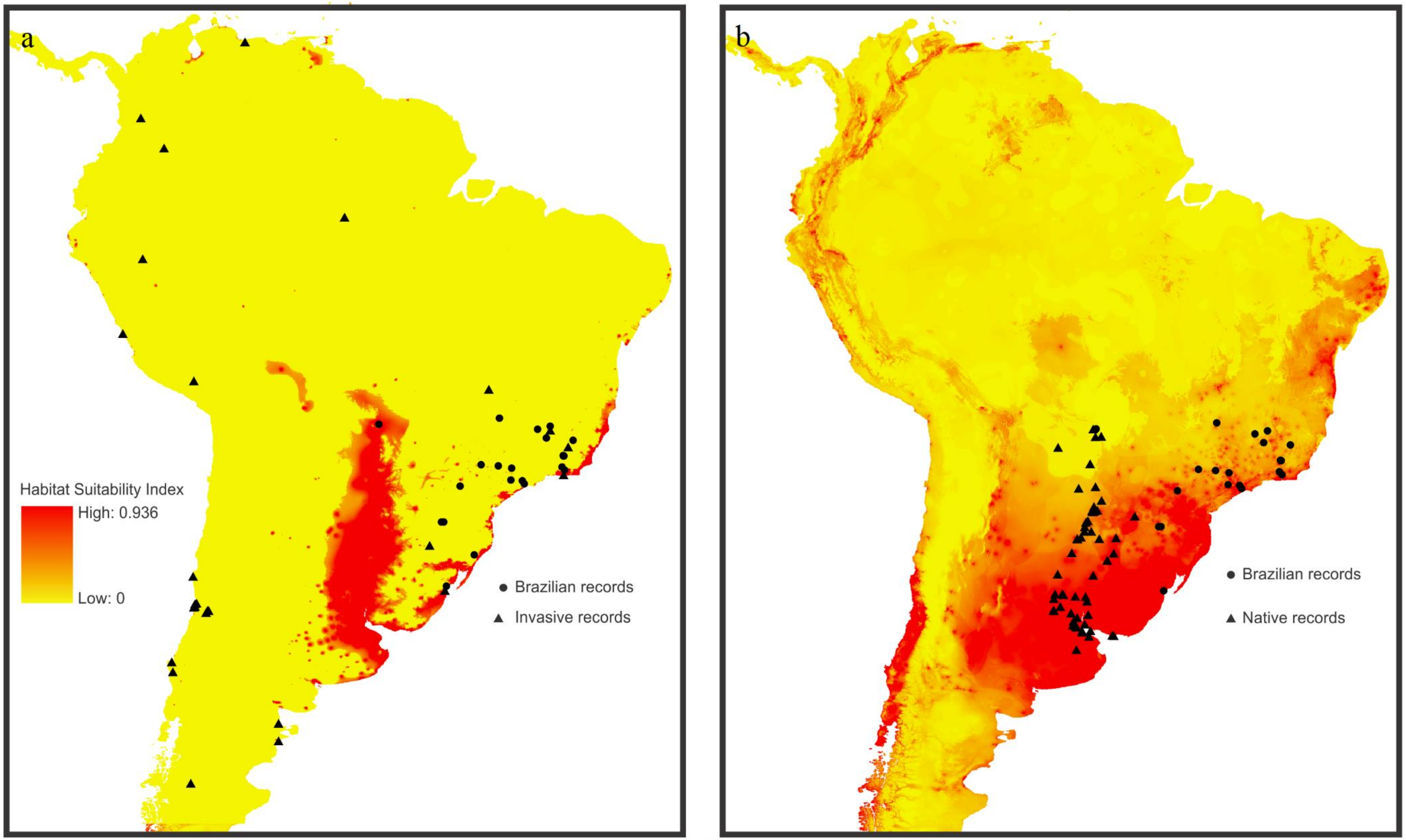

Figure 1. Habitat suitability models of the Argentine ant (*Linepithema humile*) in South America generated through records of (a) native distribution and (b) invasive distribution.

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EFFECT OF LOW-INTENSITY FOREST MANAGEMENT ON GROUND-DWELLING AND VEGETATION ANT ASSEMBLAGES IN THE STATE OF ACRE

P.N. MIRANDA[1], F.B. BACCARO[2], E.F. MORATO[3], M.A. OLIVEIRA[4] & J.H.C. DELABIE[5,6]

[1]Coordenação de Ciências Biológicas, Instituto Federal de Educação, Ciência e Tecnologia do Acre (IFAC), Av. Brasil, n° 920, Bairro Xavier Maia, CEP 69.903-068, Rio Branco, AC, Brazil, e-mail: patricia.miranda@ifac.edu.br; [2]Departamento de Biologia, Universidade Federal do Amazonas (UFAM), Manaus, AM, Brazil; [3]Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre (UFAC), Rio Branco, AC, Brazil; [4]Universidade Federal de Viçosa (UFV), Campus Florestal, Florestal, MG, Brazil; [5]Comissão Executiva do Plano da Lavoura Cacaueira, Centro de Pesquisas do Cacau, Laboratório de Mirmecologia (CEPEC/CEPLAC), Itabuna, BA, Brazil; [6]Universidade Estadual de Santa Cruz, Ilhéus, BA, Brazil.

Reduced-impact logging techniques are being used to reconcile forest conservation and economic development. Most studies involving animal indicators in forest management have prioritized areas with cutting intensity from 10 to 30 m^3/ha. This study aimed to evaluate the effects of low-intensity forest management on ant assemblages and environmental variables in a managed area in the southeast of Acre State, Brazil. The sample design was composed of nine paired samples located in managed and control areas of 10 ha in the Projeto de Assentamento Agorextrativista (PAE) Chico Mendes. We considered three years of logging (2005, 2007 e 2009), with three paired replicates in each. Two parallel 200 m-long transects, 50 m distant from each other were established in the center of each managed and control areas. These transects were used for sampling ground-dwelling and arboreal ants (20 sampling points for each technique) and environmental variables. Overall, 360 pitfall traps (opened for 4 consecutive days) and 4500 m^2 of understory vegetation were sampled. There were no differences in environmental predictors among control and managed areas, and no significant temporal trend was detected. At site scale, environmental characteristics and heterogeneity were also similar among control and managed areas. A total of 263 ant species in 48 genera were collected. The number of ant species was similar between treatments in both, pitfall and vegetation samples. We detected no correlations between the paired differences in species richness between managed and control areas, and the time since logging were found. However, the species composition differed between the managed and control areas for pitfall samples. When rare species (< 5 occurrences) were excluded, the species composition of ants sampled in vegetation also differed between managed and control areas. Of the 263 species collected, 111 were significantly associated with one treatment and one sampling methods. Despite changes in species composition, the proportions of species placed in functional groups remained stable. The exception was for fungus-growing species, which were four times more abundant in control areas. The absence of significant differences in environmental variables and ant richness between treatments suggests that the reduced-impact logging techniques, combined with low intensity extraction, promote subtle changes in forest structure. However, the deep change in ant composition indicates that maintain areas without logging a good alternative to keep this management category effectively sustainable to traditional communities. (CNPq, FUNTAC)

HOW CAN MINING ACTIVITY AFFECT SEED REMOVAL BY ANTS?

A.M. RABELLO[1,2], R.G. CUISSI[1], C.J. LASMAR[1], A.C.M. QUEIROZ[1,2], E.O. CANEDO-JÚNIOR[1,2] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras (UFLA), CEP: 37200-000 - Lavras, MG, Brasil, e-mail: ananzamr@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

Seed removal by ants is a major factor increasing plant recruitment, but there is little understanding of how mining activities may influence this interaction. Our study compared the effect of mining activity on the richness, composition and seed removal rates of seed-removing ant species, and if there is influence of the vegetation structure complexity on these parameters. We carried out this study in Nova Lima, in Minas Gerais, southeast Brazil. The samplings were conducted in February and March (rainy season), and July (dry season) 2012, in mining impacted areas (I) and others with natural vegetation (NV). Inside each area, we established one 200 m transect with five sampling points, 40 m distant from each other, using artificial fruits for attracting ant species. We recorded 19 seed-removing ant species, and richness differed statistically between I and NV areas ($p < 0.0001$), but not between seasons ($p = 0.1$). *Nylanderia* sp1 was the only species found in impacted areas. We also observed differences in seed removal rates between areas I and NV ($p < 0.0001$), and between seasons ($p < 0.01$). There was no significant change in seed-removing ant species composition between seasons (ANOSIM: R = 0.26; $p = 0.7$) and NV areas. Environmental variables that exhibited a positive effect on seed removal rate were understory structure ($p < 0.05$) during the rainy season and tree diameter ($p < 0.05$) during the dry season. Seed-removing ant species composition was affected by litter diversity ($p < 0.05$) during the rainy season, and canopy cover, weight, and litter diversity ($p < 0.05$) during the dry season. Mining activities negatively affected the ant activities, which avoided the impacted areas. The influence of environmental variables showed that ants only play a greater role as seed removing ants in more physically structured habitats. Certain ant species are sensitive to drastic changes and require specific habitat conditions for settlement. Therefore mining impacts threaten communities disrupting interactions like those between ants and plants. Moreover, seed removal by ants could be used as a tool in order to monitor degraded habitats, associated to the physical structure of environments (through environmental variables, such as those used in this study) for providing more reliable information about the ecosystem´s health. (CAPES, FAPEMIG, VALE S/A)

HOW DIVERSE IS THE *Wolbachia* ENDOSYMBIONT IN *Solenopsis* ANTS? INFERENCES OF THEIR VARIETY IN SOME *Solenopsis* SPECIES FROM BRAZIL

C. MARTINS[1,2] & O.C. BUENO[2].

[1]UFPI - Universidade Federal do Piauí, Campus Parnaíba, Av. São Sebastião, 2819, CEP 64202-020, Parnaíba, Piauí, Brasil, email: martins.c@ufpi.edu.br. [2] CEIS (Centro de Estudos de Insetos Sociais), Instituto de Biociências, Universidade Estadual Paulista Julio de Mesquita Filho (UNESP), Campus Rio Claro, Rio Claro, São Paulo, Brasil.

Intracellular bacteria of the genus *Wolbachia* (Class Alphaproteobacteria, Order Rickettsiales) are widely distributed on insects with estimates of 10 million species that can be infected making this bacteria one of the major parasites of insects. Due to the fact that these bacteria causes reproductive effects in their hosts, they are subject of interest in its possible use in insects' biological control strategies. One group of insects that may be target of these studies are the ants of the genus *Solenopsis*, native from South America, known to cause major problems in many regions of the world where they were introduced. Despite the economic importance of the ant and the fact that *Wolbachia* can be characterized as a biological control tool, studies of the diversity of *Wolbachia* in *Solenopsis* populations of Brazil, as well as strain genotyping were poorly explored and are relatively unknown. Therefore, we aimed to identify through a molecular tool to study the diversity of bacteria called Multilocus Sequence Typing (MLST) the diversity of the genus *Wolbachia* in *Solenopsis* species from Brazil and infer their evolutionary history. By sequencing five genes comprising the MLST the diversity of *Wolbachia* was analyzed and compared with existing records for Formicidae in *Wolbachia* database (*Wolbachia MLST website*) using Bayesian analysis. We found 15 new strains (which were deposited in the *Wolbachia MLST website* as ST-314 to ST-328) and one strain previously found in *Solenopsis* by other authors and also the most frequent in the samples analyzed (ST-29). Comparative analysis of the found *Wolbachia* strains indicates an unexpected diversity illustrated both by the number of strains as in phylogenetic analysis. Furthermore, phylogenetic analysis agrees with the division of *Wolbachia* strains of ants from New and Old World, already proposed by other authors. Moreover, phylogenetic analysis indicated the division of *Wolbachia* strains found in this study in five groups, grouping with the *Wolbachia* found in several species of ants. The results show the importance of detailed analysis of the *Wolbachia* strains for a better understanding of their evolutionary history and distribution in Brazil, as well as to provide information on future studies using *Wolbachia* as a potential biological control agent of ants. (FAPEPI/Capes, CNPq)

HOW DOES THE EPIGAEIC ANT COMMUNITY RESPOND TO DIFFERENT TYPES OF FORESTS IN NORTH-EAST AMAZON?

R.G. CUISSI[1], L.F. ZURLO[1], C.J. LASMAR[1], T.S. MORETTI[1], F.T. TANURE[1], E.O. CANEDO-JÚNIOR[2], C.R. RIBAS[1], R.M. FEITOSA[3] & C.J. MARSH[4]

[1]Universidade Federal de Lavras, Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Minas Gerais, Brasil, CEP: 37200-000, email: rafaelcuissi@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil. [3]Universidade Federal do Paraná, Departamento de Zoologia, Caixa Postal 19020, 81531-980, Centro Politécnico, Curitiba, Paraná, Brasil. [4]Imperial College London, Silwood Park Campus, Buckhurst Road, Ascot, Berkshire, SL5 7PY, United Kingdom.

ABSTRACT: The Amazon is considered the region with the most biodiversity on the planet. In this sense, knowledge about the various aspects of the biological diversity of the region is necessary. The replacement of primary forests with planted forests or secondary forests may cause species loss. Therefore, the use of bioindicators is needed to evaluate the effect of these changes. The use of ants as bioindicators has been an important tool to assess the quality of the environment. The objective of this study was to evaluate the response of ant communities to different types of forests in the north-east Amazon. We selected three forest types (primary, secondary and *Eucalyptus*) and sampled at 45 points per site. Ants were collected using pitfall traps with sardine and honey bait, buried to ground height, which remained in the field for 48 hours. We carried out an analysis of variance in order to check for differences in species richness between the different types of forests. For testing whether there is variation in species composition between the different types of forests, we performed similarity analysis. We collected 124 morphospecies, 61 belonging to primary forest, 69 in the secondary forest and 47 in the *Eucalyptus* forest (γ-diversity).There were differences in mean species richness per trap (α-diversity) among the three forest types ($p < 0.001$); the *Eucalyptus* forest had the greatest richness (7), followed by the secondary forest (5.6) and the primary forest (4.6). We also found differences in species composition among the three types of forest ($R = 0.564$, $p = 0.0001$), and the *Eucalyptus* forest community was the most dissimilar to the primary forest community ($R = 0.734$, $p = 0.001$), followed by the secondary forest ($R = 0.27$, $p = 0.001$).The replacement of natural environments by the anthropogenic (planted or secondary forests) causes an increase in α-diversity, but a decrease in overall γ-diversity. The higher α-diversity in the *Eucalyptus* forest can be explained by this environment having a higher abundance of a specific resource (favoring some species groups, such as generalists), the colonization of generalist species and a reduction of negative interactions (competition for resources). However, γ-diversity, and consequently β-diversity, of primary and secondary forests is higher than that found in the *Eucalyptus*, showing that these forest environments are probably more heterogeneous for ants. Together with this, we find that there is a higher dissimilarity in species composition between the primary forest and the *Eucalyptus* when compared to the secondary forest. Therefore, in the replacement of primary forests, secondary forests are a better management technique for the conservation of biodiversity in Amazonian environments than *Eucalyptus* forests.

KEYWORDS: Secondary forest; Eucalyptus forest; Bioindicators; Formicidae.

INTRODUCTION

The Amazon forest is known as one of the regions with most biodiversity on the planet, but the organisms in this environment are on direct and indirect influence of the impacts caused by man. Among these impacts, deforestation, fires (Aragão *et al.* 2008; Carmenta *et al.* 2013) and land use for agriculture (Martinelli *et al.* 2010) are the main responsible by biodiversity loss in this environment.

The edaphic fauna is important for maintaining several ecosystem functions, but is strongly influenced by human action that can significantly change the abundance and diversity of the community of these organisms, mainly by disruption of the physical environment and by modifying the quantity and quality of organic matter (Lavelle *et al.* 1993). In this sense, the use of ants can be an ideal tool to detect the presence of certain environmental impacts and to monitor the recovery from these impacts (Agosti *et al.* 2000).

One of the faster and effective ways to evaluate the effects of human activities is through the use of bioindicators. Among them, ants are successfully used in various types of ecological studies (Lach *et al.* 2010), responding to different environmental impacts caused by removal of vegetation (Zelikova & Breed 2008) and agricultural practices (Bos *et al.* 2007; Philpott & Armbrecht 2006). In the case of *Eucalyptus* plantations, many impacts on biodiversity have been detected (Andersen 2002).

In this context, the objective of this study was to evaluate the response of ant communities to different forest types in the north-east Amazon, testing the hypotheses that there is a change in ant species richness and composition when we replace the primary forest by planted forests or by forests in regeneration (secondary forests).

METHODOLOGY

From February to January 2010, we selected three forest types (primary, secondary and *Eucalyptus*) in Monte Dourado, Pará, Brazil. In each forest we sampled at 45 points, arranged in a triangle fractal pattern (Marsh & Ewers 2013). Epigaeic ants were collected using pitfall traps with sardine and honey baits, buried to ground height, which remained in the field for 48 hours. After this period, the ants were taken to the Laboratório de Ecologia de Formigas of Universidade Federal de Lavras to be selected and mounted with subsequent identification by the specialist Rodrigo Feitosa (UFPR).

We performed an analysis of variance (ANOVA) through generalized linear models (GLM), with Poisson distribution, to determine if there are differences in the ant species richness between different forests types. This analysis was performed in the R 2.14 statistical software (R development Core Team 2011). To verify whether the composition of ant species changes among different forest types we carried out a non-metric multidimensional scaling (NMDS) based on Jaccard index, which uses species presence/absence data. The statistical significance of NMDS was verified by similarity analysis (ANOSIM), performed with 999 permutations, which also uses Jaccard index to indicate the dissimilarity among groups. The program used was Primer v6 (Clark & Gorley 2006).

RESULTS AND DISCUSSION

We collected 124 morphospecies, 61 belonging to primary forest, 69 in the secondary forest and 47 in the *Eucalyptus* forest (γ-diversity).There were differences in mean species richness per trap (α-diversity) among the three forest types ($p < 0.001$; Fig. 1), the *Eucalyptus* forest had the greatest richness, followed by the secondary forest and the primary forest .

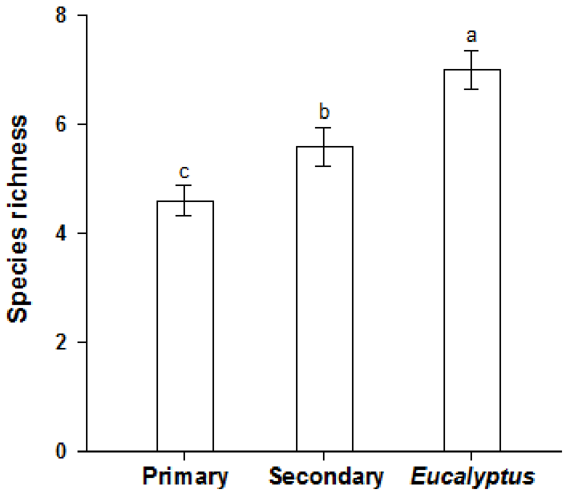

Figure 1 – Ant species richness in different forest types (df = 2; $p < 0.001$). Bars are standard errors. All ant species were collected in forests of north-east Amazon. Different letters indicate means differed significantly in pairwise comparisons.

The replacement of natural environments by the anthropogenic ones (planted or secondary forests) causes an increase in α-diversity, but a decrease in overall γ-diversity. The higher α-diversity in the *Eucalyptus* forest can be explained by this environment having a higher abundance of a specific resource favoring some species groups, such as generalist ants and/or by a reduction of negative interactions (competition for resources). However, γ-diversity, and consequently β-diversity, of primary and secondary forests is higher than that found in the *Eucalyptus*, showing that these forest environments are more heterogeneous in conditions and resources for ants (Andersen 1986; Leal *et al.* 1993).

We also found differences in species composition among the three types of forest ($R = 0.564$, $p = 0.0001$; Fig. 2), and the *Eucalyptus* forest community was the most dissimilar to the primary forest community ($R = 0.734$, $p = 0.001$; Fig. 2), followed by the secondary forest ($R = 0.27$, $p = 0.001$, Fig. 2).

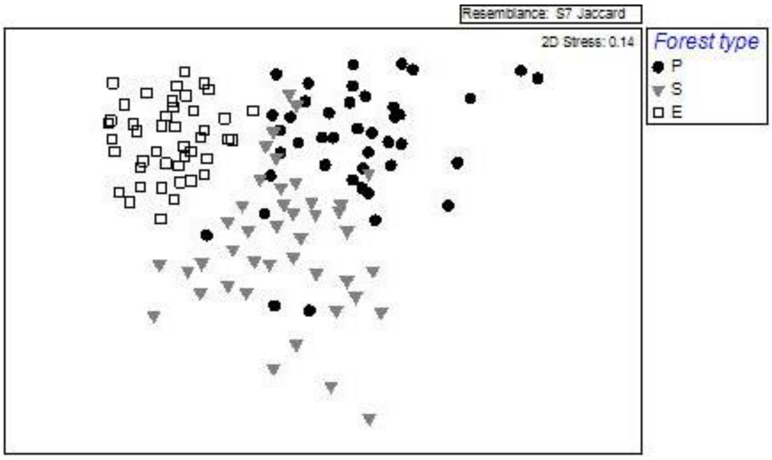

Figure 2 – Non-metric multidimensional scaling (NMDS) performed on ant species composition among different forest types (R = 0.564; p = 0.001). All ant species were collected in forests of north-east Amazon. P = Primary forest; S = Secondary forest; E = *Eucalyptus* forest.

Therefore we find that there is a higher dissimilarity in species composition between the primary forest and the Eucalyptus when compared to the secondary forest. In *Eucalyptus* forests the canopy cover exposes the soil litter to an intense sunlight, rain and winds, modifying the microclimate and affecting the decomposition of litter and general faunal composition (Louzada *et al.* 1997).

Finally, we believe that the replacement of primary forests by secondary forests are a better management technique for the conservation of biodiversity in Amazonian environments than *Eucalyptus* forests. In this scenario, the secondary forest is crucial for maintenance of agricultural activity and the income generation, it is necessary more knowledge about ways to use efficient and sustainable this vegetation.

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HOW NATURAL RECOVERY POST-FIRE AFFECTS ANT COMMUNITY IN CERRADO AREAS?

E.O. CANEDO-JÚNIOR[1,2], R.G. CUISSI[1], C.J. LASMAR[1], G. SANTIAGO[1], N.H.A. CURI[2], K. MALVES[2], G. R. DEMETRIO[2] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras, Lavras, MG, CEP: 37200-000, Lavras, Brasil, e-mail: canedojr.e.o@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

Fires are frequently used as a management technique in pasture areas, causing several impacts on biological communities. These effects may become more severe when the frequency of fires increases by anthropogenic interventions. In this study we aimed to verify how post-fire recovery time affects the ant community in Cerrado areas. Specifically we tested the following hypothesis: 1) with the increase in post-fire recovery time there is an increase in ant species richness, (2) with the increase in post-fire recovery time there is an increase in the similarity of ant species among burned areas and control area, (3) there are environmental factors important to determination of ant species composition, (4) each burned area and control area have a set of ant indicator species. We carried out this study in a natural reserve called Sumidouro State Park, located in Minas Gerais, Brazil. We collected the ants by pitfall traps in epigaeic and hypogaeic strata, which remained 96 hours in field. The samplings were conducted in September and October 2012, in four areas, one control and three areas that were burned in 2010, 2011 and 2012. In each sampled area we established one transect of 100m with ten sampling points, 10m distant from each other. We also collected some environmental variables related to resources and conditions for ants, such as moisture and soil temperature, soil compression, heterogeneity and depth of litter, cover (%) and richness of herbaceous plants and canopy cover. The area burned in 2012 showed the lowest species richness and the other sampled areas did not show differences in species richness when compared with the control area. All the sampled areas showed differences in species composition among themselves ($R=0.433$; $P=0.001$), however species composition of 2010 (the oldest recovery area) showed the highest similarity with species composition of the control area ($R=0.298$; $P=0.001$). The most important environmental variables for determination of species composition were temperature ($R^2=0.041$; $P=0.019$; proportion of explanation = 4.13%), soil moisture ($R^2=0.088$; $P= 0.003$; prop. expl.= 4.62%) and litter depth ($R^2=0.134$; $P=0.003$; prop. expl.= 4.67%). Fire causes an immediate decrease in ant species richness, but about one year after fire the species richness can be similar to that in the control areas. Fire may change ant species composition because it changes the plant structure. This could be reflected in environmental variables pointed out as the most important to species composition, since an increase in habitat complexity can allow more exigent species, for example species belonging to the *Carebara* genus, pointed out as an indicator of the oldest burned area (2010). Knowledge about how communities respond to fire is an important tool to help develop better management techniques that cause less impact on diversity in Cerrado areas. (FAPEMIG, CAPES, CNPq)

INCREASING OF ATTRACTIVENESS OF BAITS WITH VENOM GLAND EXTRACT FOR *Atta sexdens rubropilosa* FOREL (HYMENOPTERA: FORMICIDAE)*

TATAGIBA ARAUJO, G.[1,2], VIANA-BAILEZ, A. M.[1] & BAILEZ, O. E.[1].

[1]Laboratório de Entomologia e Fitopatologia/ Setor de Semioquímicos/ Centro de Ciências e Tecnologias Agropecuárias/ Universidade Estadual do Norte Fluminense Darcy Ribeiro (UENF), Av. Alberto Lamego, 2000, Pq. Califórnia, CEP: 28013-602 - Campos dos Goytacazes/ RJ/ Brasil. E-mail: gabidft@yahoo.com.br, amaria@uenf.br, obailez@uenf.br.
[2]Programa de Pós-Graduação em Produção Vegetal/ Universidade Estadual do Norte Fluminense Darcy Ribeiro/ Campos dos Goytacazes/ RJ/ Brasil.
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INTRODUCTION

Leaf-cutting ants are of great economic importance in Brazil, and the *Atta* ants are the main pests of implanted forests, such as *Pine* and *Eucalyptus* (Boaretto & Forti, 1997). According to Zanetti *et al.* (2000), before the planting of eucalyptus all the nests should be removed and the cultivation should remain without nests for at least one year, otherwise loss by leaf-cutting attack can be total. Efficient control of these ants is obtained with insecticides by primarily using granular bait, but most of these baits are lost during field application, as not all are loaded and many are rejected after loading.

The sulfluramide, main active ingredient of bait, belongs to the group of perfluorooctane sulfonate and was classified as persistent organic pollutant by the Stockholm Convention in 2009. This contradicts the recommendations for ideal bait, which should be attractive at a distance, loaded quickly into the nest, have delayed toxic action in the nest, be specific and have low toxicity to mammals and birds (Verza *et al.*, 2006).

In order to improve the properties of baits, some studies seek to turn them more attractive and the use of pheromones of the ants themselves is a possible procedure to be explored (Robinson & Cherrett, 1978; Robinson *et al.*, 1982; Vilela & Howse, 1988). Another pheromone studied for its effect of attraction is the larva pheromone (Glancey *et al.*, 1970; Robinson & Cherret, 1974; Viana, 1996).

Within this context, this work was performed in order to verify the effect of using cuticular extracts of larva (larva pheromone) and venom gland extract (trail pheromone) in the formulation of baits on the acceptance and transportation to nests of *Atta sexdens rubropilosa*.

MATERIAL AND METHODS

Laboratory conditions - Nests of *A. sexdens rubropilosa* (± 6L fungus each) were kept in glass jars inside plastic trays at the Myrmecology unit of the Laboratório de Entomologia e Fitopatologia (LEF) at the Universidade Estadual do Norte Fluminense Darcy Ribeiro (UENF). The condition of the creation rooms was 80 ± 10% humidity and 25 ± 2ºC temperature.

Experimental area - Nests of *A. sexdens rubropilosa* located in an urban area park with high human action, in the municipality of Campos dos Goytacazes, state of Rio de Janeiro, were selected giving priority to those with intense foraging activity and at least 100 meters apart. The nests foraged hibiscus plants *(Hibiscus rosa-sinensis L.)*, chestnut *(Terminalia catappa L.)* and mango *(Mangifera indica L.)*. The experiments were conducted in February 2011 with variation in temperature between 23.5ºC and 34ºC and relative humidity ± 66.6%.

Preparation of Homocolonials Extracts - Larval cuticle extract (LCE) was obtained by the method of washing the cuticle with solvent (Viana *et al.*, 2001), using five larvae / 1 ml of dichloromethane (DCM). The venom gland extract (VGE) was obtained by extraction and subsequent maceration of glands in solvent (10 glands/ 1 ml of DCM) (Tatagiba Araujo *et al.*, 2012). The extracts were stored in Wheaton tubes (5 ml) at a temperature of 4ºC.

Making of baits – Homemade baits were made of granules with 5mm in diameter and 3 mm high. The paste was obtained by mixing 4 parts of flour, 2 parts of citrus flour, 1 part and a half of orange juice, one part and half of soybean oil and 1 part of distilled water (Tatagiba Araujo *et al.*, 2012). The citrus flour was made with dried oranges in an oven at 60°C for 15 days, crushed in industrial blender and sieved. The baits were marked with gouache for treatment differentiation.

Preliminary test – Firstly, a control test (white) was performed in order to assess any possible effect of the solvent. Baits made from citrus pulp were supplied in the foraging area of nests kept in laboratory after passing through a period of 24 hours of fasting. Two Petri plates with 7 cm in diameter were placed, each containing 50 baits. One plate contained baits without added solvent and the other contained baits impregnated with DCM 30 minutes before testing. The transportation of baits to the nest was observed for 30 minutes or until only one bait was left in one of the plates. Two repetitions were made in five nests and the data were analyzed using the Kruskal-Wallis test with 5.0% probability.

Evaluation of the attractiveness of homemade baits in laboratory - 150 baits were supplied placing them in three Petri plates with 7 cm in diameter. 50 baits were placed in each plate. These baits had been impregnated with: (1) 10µL of VGE / bait (0.01 venom gland/ bait), or (2) 10µL LCE/ bait (0.05 larvae/ bait), or (3) 10µL of DCM/ bait (control) 30 minutes before the test. The plates were supplied in three different positions in the foraging area, after the nests were 24 hours without substrate for growing fungus. The position of supply and the coloration of the baits were alternated randomly with each repetition. The tests lasted 30 minutes or until there was just one bait to be loaded in one of the plates. At this time the baits were counted. The tests were conducted in three nests with 10 repetitions and data were submitted to ANOVA test, followed by Tukey test, considering 5.0% of significance with the help of the STATISTICA ® program, version 5.0.

Assessment of attractiveness of baits in field - The time and the trail of greater foraging activity of the nests were observed. This trail was used in the demarcation of the local for the supply of bait. Firstly, distances of 0.2 m, 1.0 m, 5.0 m and 10.0 m from the ant hole were marked in the center of the track (Fig 1A). Then, the distances of 0.2 m, 1.0 m, 5.0 m and 10.0 m from the center were marked out of the trail (Fig 1B). The end marker characterized the local for baits supply (Petri plates of 3.5 cm in diameter): 50 baits at 0.2 m, 50 baits at 1.0 m, 50 baits at 5.0 m and 50 baits at 10.0 m away, on the right and the left of the trail. Thirty minutes before each test, rubber septa were impregnated with 100µL of VGE (0.1 venom gland/ septum) and placed on the plate next to the baits. Plates with septum (treatment) and without septum (control) were supplied on different sides of the trail and the distances were differentiated by the coloration of baits. Visual observations were made with the aid of a camera for 2 hours, starting at 7 p.m., which was the greatest time of foraging in the nests. Within the observation period, it was checked the time spent to initiate the recruitment of workers, the time required to carry all the baits, the number of baits loaded at the end of this period and the presence of non-target species. There were 5 repetitions in three nests. Data were analyzed using the χ^2 test for the time spent on recruitment and the time required to carry all the baits. To analyze the number of transported baits the ANOVA test was used, followed by Tukey test. Statistical tests considered $\alpha = 5.0\%$ and were analyzed with the STATISTICA ® program, version 5.0.

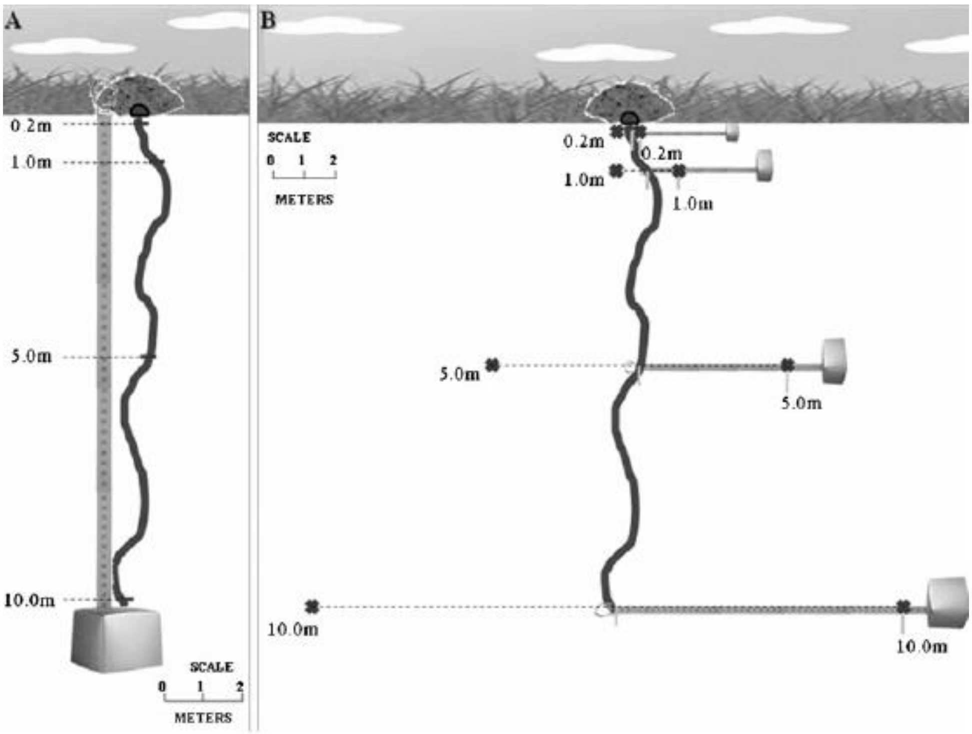

Figure 1: Place of baits supply in trails of *Atta sexdens rubropilosa* in the field. (A) Marking in the center of the trail at distances of 0.2 m, 1.0 m, 5.0 m and 10.0 m from the ant hole (Scale 1: 1). (B) Marking next to the trail at distances of 0.2 m, 1.0 m, 5.0 m and 10.0 m from its center (Scale 0.6: 1). The places of bait supply are represented by (x) in (B).

RESULTS AND DISCUSSION

In preliminary tests, the number of baits impregnated with dichloromethane transported by the ants did not differ from that without DCM (n=10, df=1, χ^2=0.9, P=0.3428), demonstrating the lack of any effect of DCM on bait acceptance by this ant. Baits impregnated with VGE were transported more often than control baits in laboratory assays (F=16.63; df=2; P=0.001), but the number of baits impregnated with LCE transported by ants did not differ from the control baits transported (Fig 2). Thus, the impregnation of VGE increased the transport of bait to the nest, unlike the impregnation with LCE, similarly to what has been reported in assays with *A. cephalotes* (Robinson & Cherrett, 1974). But addition of the synthetic trail pheromone methyl-4-methylpyrrol-2-carboxylate to baits were shown to increase the attractiveness of baits to *A. cephalotes*, *A. sexdens* and *A. octospinosus* (Robinson & Cherrett, 1978, Robinson *et al.*, 1982).

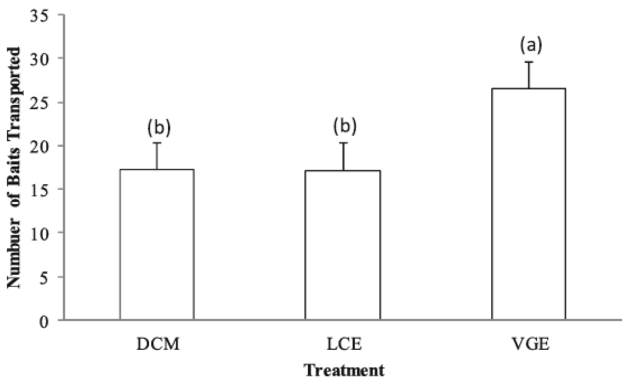

Figure 2: Number of baits impregnated with dichloromethane (DCM) (control), homocolonial larval cuticle extract (LCE) and homocolonial venom gland extract (VGE), transported to the nest by workers of *Atta sexdens rubropilosa* in laboratory conditions. Different letters indicate significant difference (Tukey test, P<0.001).

Baits placed at 0.20 m from the nest entrance were almost totally transported at the end of the observation period in our field tests, while only 30% of the baits placed at 1 or 5 m were transported by the ants. Baits placed at 10.0 m away from the nest entrance were never foraged by ants (F=70.92; df=2; P<0.001). Field experiments with *A. sexdens rubropilosa* using commercial baits impregnated with the trail pheromone showed that ants transported baits from the trail, but abandoned them in the nest entrance (Vilela & Howse, 1988). Furthermore, Cross *et al.* (1979) found that baits impregnated with a mixture of the pyrazines 3-ethyl-2-5-dimethylpyrazine and 2-ethyl-2-5-dimethylpyrazine, did not have increased their response to baits in the field. However, our experiments demonstrated that the baits impregnated with VGE were effectively transported into the nest, even though the number of baits transported with VGE did not differ from that observed for the control baits (n=15; df=2; F=0.112; P=0.7387; Fig 3), similarly to a previous report by Cross *et al.* (1979).

Nevertheless, the time spent to find and to transport VGE impregnated baits into the nest when baits were placed at 0.2 m from the nest entrance was reduced if compared to control baits.

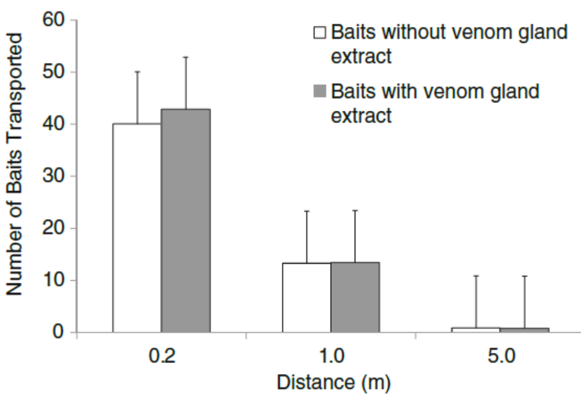

Figure 3: Number of baits with septum impregnated with venom gland extract (VGE) or with septum impregnated with solvent, transported by worker ants of *Atta sexdens rubropilosa* into the nests under field conditions. The baits were supplied at 0.2, 1.0, and 5.0 m from the nest entrance and from the trail.

One factor that probably reduced the response to baits impregnated with VGE in the field was the presence of ants of the genera *Ectatomma* and *Pheidole*, which were also foraging baits within the Petri dishes. *Pheidole* were attracted by VGE-treated baits and settled into the plates. The presence of this ant certainly disturbed the foraging activities of *Atta* affecting bait collection and transport, although *Atta* showed greater foraging persistence in baits with VGE compared to control regardless the presence of *Pheidole*.

In the first minute of the test, workers of *Atta* contact and start to transport VGE-treated baits placed at 0.2 m from the nest entrance in 8 out of 15 tests, while in only two tests this response was registered in the control (χ^2=5.4, df=1, P=0.0201). Similarly, after 30 min of observation, VGE-treated baits were totally transported in 8 out 15, while only 2 on the control test (χ^2=5.4, df=1, P=0.0201).

In conclusion, the larval cuticle extract of *A. sexdens rubropilosa* did not increase the attractiveness of baits in laboratory tests at the concentration tested, while the venom gland extract did increase ant response to treated baits. Field tests also indicated that VGE impregnated septa facilitated the location of the baits by ants and accelerated its transport into the nest. Baits that remain for a short period in the field are desirable as these can reduce the risk of contamination of non-target organisms with the active ingredient used to control the ants. This possibility should be explored by using synthetic pheromone.

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INTERACTION BETWEEN ACTINOMYCETE, LEAF-CUTTING ANT AND ENTOMOPATHOGENIC FUNGUS

J.C. COUCEIRO[1,2], R.A.C. DÂNGELO[2], D.J. DE SOUZA[3] & T.M.C. DELLA LUCIA[1,4]

[1]Laboratório de Formigas-Cortadeiras, Departamento de Entomologia, Universidade Federal de Viçosa (UFV), Av. P.H. Rolfs, s/n, Campus Universitário, CEP 36570-000 – Viçosa, MG, Brasil, e-mail joel.couceiro@ufv.br; [2]Programa de Pós-graduação em Entomologia, Universidade Federal de Viçosa (UFV), Av. P.H. Rolfs, s/n, Campus Universitário, CEP 36570-000 – Viçosa, MG, Brasil, e-mail romulodangelo@yahoo.com; [3]Fundação Universidade Federal do Tocantins, Campus Universitário de Gurupi, Rua Badejós, Chácaras 69 e 72, Lt. 07, Zona Rural, CEP 77402-970, Caixa Postal 66 – Gurupi, TO, Brasil, e-mail danivalbr@yahoo.com.br. [4]Departamento de Biologia Animal, Universidade Federal de Viçosa (UFV), Av. P.H. Rolfs, s/n, Campus Universitário, CEP 36570-000 – Viçosa, MG, Brasil, e-mail tdlucia@ufv.br.

Leaf-cutting ants, genera *Atta* and *Acromyrmex*, cut large amounts of plant material that are used as substrate for the growth of the symbiotic fungus *Leucoagaricus gongylophorus* that they eat. Due to the habit of cutting, they destroy crops and pastures, causing economic damages. (Cherrett, 1986; Della Lucia, 2003). Because of this, many strategies were and have been developed to control these insects. The mostly used is the toxic granulated bait, whose active compound was dodecachlor, but as chlorines were prohibited in Brazil in 1993, sulfluramide came to be used (Della Lucia *et al*., 2011). Other methods are also used to control leaf-cutting ants, such as thermofogging and dry powders. The discovery of synthetic products which were quite effective in combating ants grew since the 1950s. However, these methods and products cause negative environmental impacts. So present research on control methods try to minimize the effects of insecticides in the environment, with new alternatives such as the use of insecticidal plant extracts (Bueno & Bueno, 2011). These products, often less aggressive to the environment, are also effective in many cases. Generally, they can be used in the integrated management of leaf-cutting ants. Utilization of biological control agents has been more emphasized. In this study, we tested if actinomycetes (*Pseudonocardia* predominant) that live in cuticle of *A. subterraneus subterraneus* workers protect them against entomopathogenic fungi. A solution containing 50 mL of water and 25 µL of Tween 80 was prepared. Two mL of this solution were dropped on a Petri dish containing a pure colony of the fungus *Aspergillus ochraceus* with abundance of spores and the surface was scraped using Drigalski spatula. The content was filtered and put on a beaker. The material was diluted with 100 mL of distilled water and a drop of Tween 80. An aliquot was deposited on a Neubauer chamber to count conidia, to obtain a concentration of 10^6 conidia/mL. This concentration was chosen based on an experiment conducted with *Atta bisphaerica* (Ribeiro *et al.*, 2012). Five colonies of *A. subterraneus subterraneus* were selected for the experiment. The solution of conidia was applied to three groups of workers: those working outside the fungus-garden, without visible actinomycete covering the body (G1); those inside fungus-garden, without visible actinomycete covering the body (G2); those inside fungus-garden, with visible actinomycete covering the body (G3). A solution of 0.05% of Tween 80 dissolved in distilled water was applied to the control group. A total of 24 ants/group was used (12 received the treatment). After the application, the insects were individually placed in Petri dishes with two holes in the upper part, each one containing two plastic tubes with cotton: one with distilled water and the other with distilled water and honey. All Petri dishes were evaluated daily in terms of mortality during 10 days. To confirm that the deaths were caused by the fungus, dead workers went through a graded wash (alcohol 70%, sodium hypochlorite 2% and distilled water) for disinfection and were placed on Eppendorf tubes with moist cotton, which were stored in BOD incubator for 10 days, to verify extrusion of the fungus. The results were analyzed using Kaplan-Meier Method at 5% significance level. There was no significant difference between treatment and control groups ($p = 0.075$), indicating that conidia solution had no effect in mortality (figure 1). Treatment groups were also analyzed in pairs. No significant difference was found between G1 and G2 ($p = 0.676$) and between G2 and G3 ($p = 0.19$), while significant difference between G1 and G3 ($p = 0.031$) was detected, indicating that conidia solution had more effect in causing mortality in ants without the actinomycete. *Acromyrmex* ants have a symbiotic association with bacteria of the genus *Pseudonocardia*, which produce substances against pathogens. Thus it was expected that individuals from group 3 (workers inside fungus-garden, with visible actinomycete covering the body) would have the lowest mortality rate; this happened in all colonies, except for number 4. High mortality of this group in colony 2 may be due to the stress to which the workers were subjected (Ribeiro *et al.*, 2012). Hughes *et al.* (2002) reported that workers of *A. echinatior* had more chance of surviving to an infection with *Metarhizium anisopliae* when were maintained with nestmates. Stress may also have been responsible for higher mortality of control groups in colonies 1 and 2. The significant difference found between groups 1 and 3 indicates that *Pseudonocardia* protects the ants on which they occur. The absence of significant difference between groups 1 and 2 indicates that mortality difference between these groups probably is due to metapleural gland defensive secretions, whereas absence of difference between groups 2 and 3 indicates that workers inside fungus-garden have more effective protection mechanisms against entomopathogens, and *Pseudonocardia* presence is more relevant when workers inside fungus-garden are compared to those outside. Currie & Stuart (2001) reported increased rate of fungus-grooming in colonies contaminated with *Escovopsis* and *Trichoderma*, whereas Hughes *et al.* (2002) reported increased rate of self-grooming and allogrooming in *A. echinatior* workers infected with *M. anisopliae*. Thus, low mortality of groups 1 in colonies 3, 4 and 5 may be due to increase in this type of behavior. Castilho *et al.* (2010) performed experiments similar to the present study, using *M. anisopliae* and *Beauveria bassiana*, and have found significant differences between isolates, indicating that pathogenicity may vary among species and isolates. Thus, it is likely that the material used in this study has lower ability to cause mortality, being considered less virulent. To confirm this hypothesis, other tests should be conducted, with different isolates obtained from different sources, such as other contaminated ants, other insect species or even from soil, where *A. ochraceus* is found. We concluded that *A. ochraceus* can cause mortality in workers, however the low mortality found in this study indicates that the virulence of the isolate and/or the concentration of the conidia solution were low. Other isolates should be tested, in different concentrations, to find a solution more efficient in causing mortality.

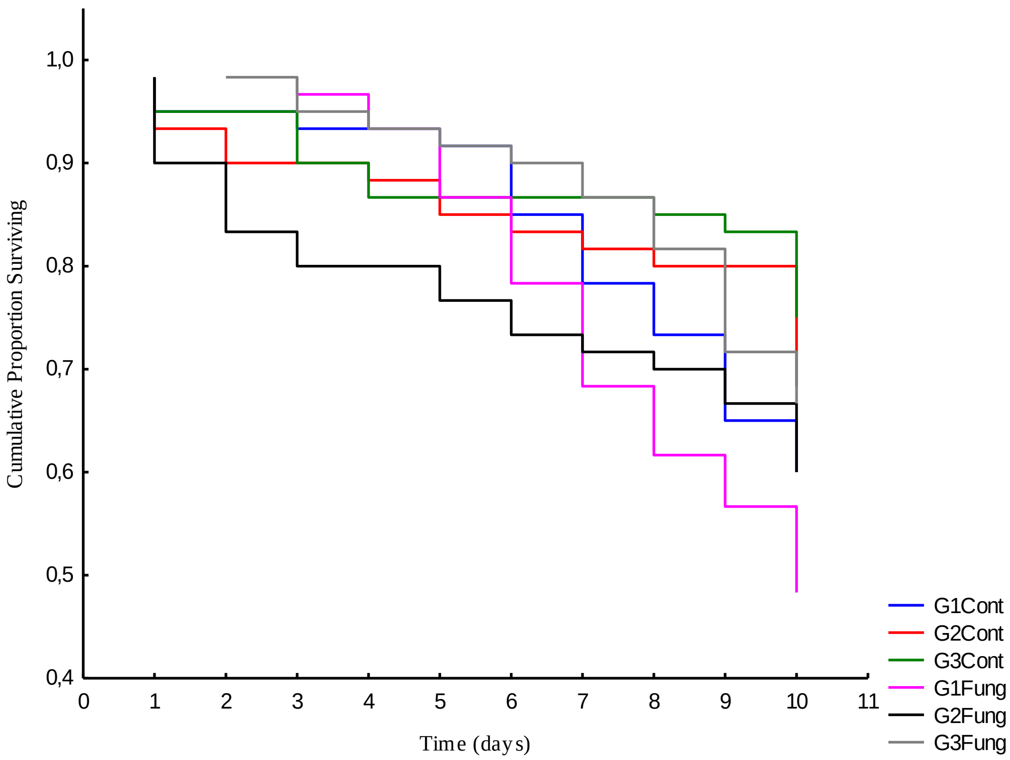

Figure 1 – Cumulative proportion surviving of *Acromyrmex subterraneus subterraneus* in all treatments (cont = control; fung = fungus)

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RESUMOS / *ABSTRACTS*

PÔSTERES / *POSTERS*

TAXONOMY, SYSTEMATICS, BIOGEOGRAPHY AND PALEONTOLOGY

A PRELIMINAR BIOGEOGRAPHICAL ASSESSMENT ABOUT THE ARMY ANTS SITUATION OF THE GENUS *Eciton* (FORMICIDAE; ECITONINAE) IN SOUTHERN BAHIA, BRAZIL

L.S. CARVALHO[1,2]; G.M. REUSS-STRENZEL[1]; H.S.S. POVOAS[1]; I.M.A. GOES[1]; I.C. NASCIMENTO[3] & J.H.C. DELABIE[1,2]

[1]Departamento de Ciências Agrárias Ambientais, Universidade Estadual de Santa Cruz (UESC), 45662-900 Ilhéus, BA, Brazil, e-mail: laiss.sc@hotmail.com;[2]Laboratório de Mirmecologia, Centro de Pesquisas do Cacau (CEPLAC), Cx. P. 7, 45600-970 Ilhéus, BA, Brazil; Departamento de Ciências Biológicas, Universidade do Sudoeste da Bahia, Campus de Jequié, 45206-190 Jequié, BA, Brazil.

The Cocoa Coast landscape, in the Southern Coast of the state of Bahia, Brazil, is a mosaic of cocoa plantations (essentially *cabruca*) and Atlantic rain forest fragments under several stages of succession, distributed in an anthropic matrix formed by pastures, plantations, urban areas and degraded soils. This landscape is structured by Tertiary sedimentary deposits of the "Barreiras" group and Precambrian outcrops on the west and coastal plain and mangroves on the east. Such structures influence the land use patterns and consequently, the ant community biogeography. These influences over the occurrence of the army ants *Eciton mexicanum* (Roger, 1863), *Eciton burchelli* (Westwood, 1842), *Eciton vagans* (Olivier, 1971) and *Eciton rapax* (Fr. Smith, 1855) were investigated from data (ants) collected between 1987 and 2004. The ant individuals deposited in the collection of the Laboratory of Myrmecology of CEPLAC were georeferenced and compared to a map of land use drawn for the Una and Ilhéus regions at the scale of 1:100000, using TM imagery acquired in July 2013. From the map of land use, indicators of the landscape fragmentation were calculated using the free software Patch Analyst. Also, geomorphometric indicators, available at www.topodata.inpe.br, were used. The data were inserted in a Geographic Information System (GIS) and overlaid on the mapping of the genus *Eciton*. The results were applied in analyses using Multidimensional Scaling (MDS) in order to verify correlations between the occurrence of species, the distribution of the landscape fragmentation metrics and the geomorphometric indicators. We observed higher abundance of individuals of *Eciton burchelli* and *Eciton mexicanum* close to native vegetation at Una and Ilhéus, but these results can be yet an artifact of sampling. More analyses are need to understand the current situation of these ants in the region, since the fragmentation certainly is a disadvantages for these ants which need large foraging territories in continuous forested land or forest-like plantations, such as cocoa agriculture. (PRONEX SECTI-FAPESB/CNPq. Project PNX 0011/2009)

AN INTRODUCTION TO THE ESPECIALIZED ANT GENUS *Basiceros* SCHULZ, 1906 (FORMICIDAE: MYRMICINAE: BASICEROTINI)

R.S. PROBST[1,2] & C.R.F. BRANDÃO[2]

[1]Programa de Pós-Graduação em Sistemática, Taxonomia Animal e Biodiversidade, Museu de Zoologia da Universidade de São Paulo/MZSP, Av.: Nazaré, n° 481, Ipiranga, São Paulo/SP, Brasil, CEP 04263-000, e-mail: probstrodolfo@gmail.com; [2]Laboratório de Hymenoptera, MZSP, São Paulo/SP, Brasil.

Basiceros is composed by medium-sized, slow-moving cryptic ants, which exhibits thanatosis when disturbed. Little is known about its natural history and until recently it was believed that these ants were comparatively difficult to find. They present a cryptic coloration similar to the ground in an extreme degree due to the accumulation of litter and soil particles, which adhere to a double layer of specialized hairs. Members of this genus nest and forage in rotten wood, leaf litter or in the soil, close to trees roots. *Basiceros* is restricted to the New World, from the rainforests of Honduras to southern Brazil. Preliminary observations of specimens in collections have shown the existence of new records for the geographic distribution of the genus. *Basiceros* presents currently eight nomenclaturaly valid species: *B. conjugans* Brown, 1974, *B. convexiceps* (Mayr, 1887), *B. disciger* (Mayr, 1887), *B. manni* Brown e Kempf, 1960, *B. militaris* (Weber, 1950), *B. redux* (Donisthorpe, 1939), *B. scambognathus* (Brown, 1949) e *B. singularis* (Smith, 1858) and its last revisionary study was done by Brown and Kempf in 1960. Synonyms were later diagnosed as well as the description of new species by several authors, cited below. Brown (1974) presented additions to the taxonomy of *Basiceros* (diagnoses and revised key) and Feitosa *et al*. (2007) updated the genus diagnosis and species, with the synonymy of *Creightonidris* under *Basiceros*. Also in 2007, De Andrade & Baroni Urbani, using comparative morphological data, suggested the synonymy of all the genera of the tribe under *Basiceros,* claiming that "no explicit synapomorphy characterized *Basiceros*". Longino and Boudinot (2013) pointed that there is currently a polemic on the acceptance of Baroni Urbani & de Andrade's reclassification, making clear that a broader study incorporating morphological and molecular data will be necessary before the genus boundaries are understood. This scenario suggests that a comprehensive taxonomic revision and phylogenetic analyses has the potential to reveal the evolutionary relationships of this genus, contributing thus to a better understanding of the cladogenesis, dispersal, and differentiation events within *Basiceros*.

AN INTRODUCTION TO THE NEOTROPICAL ANT GENUS *Hylomyrma* FOREL, 1912 (MYRMICINAE: MYRMICINI)

M.A. ULYSSÉA[1,2] & C.R.F. BRANDÃO[2]

[1]Programa de Pós-Graduação em Sistemática, Taxonomia Animal e Biodiversidade, Museu de Zoologia da Universidade de São Paulo/MZSP, Av.: Nazaré, n° 481, Ipiranga, São Paulo/SP, Brasil, CEP 04263-000, e-mail moniqueta_poliqueta@yahoo.com.br; [2]Laboratório de Hymenoptera, MZSP, São Paulo/SP, Brasil.

The only taxonomic review published for the ant genus *Hylomyrma* (Kempf 1973) recognized 12 species: *H. balzani* (Emery 1894), *H. blandiens* Kempf 1961, *H. columbica* (Forel 1912), *H. dentiloba* (Santschi 1931), *H. dolichops* Kempf 1973, *H. immanis* Kempf 1973, *H. longiscapa* Kempf 1961, *H. praepotens* Kempf 1973, *H. reitteri* (Mayr 1887), *H. sagax* Kempf 1973, *H. transversa* Kempf 1973, and *H. versuta* Kempf 1973. In 1977, Kutter described *H. reginae*, totaling 13 currently known species. *Hylomyrma* is widely distributed in the Neotropical region, occurring from Mexico to Southern Brazil and adjacent areas of Argentina and Paraguay. *Hylomyrma* includes monomorphic and relatively small ants, with workers ranging from 3.7 to 5.4 mm, cryptic habits, and inhabitants of the leaf litter. Initially, the genus was classified as rare due to the sampling difficulty and its underrepresentation in collections. However, the application of specialized collecting techniques, like Berlese-Tullgren Funnels and Mass-Sifting, allowed a better sampling of *Hylomyrma*, and the first review of the group. Even so, part of *Hylomyrma* species has its identity questioned due to the morphological uniformity and because they were described from very small series (at most three specimens). The use of very few specimens to base species descriptions restricts our understanding of characters' variations. Recently, surveys using Winkler extractors to investigate the leaf litter fauna in different localities and biomes permitted the frequent sampling of cryptic ants living in this habitat, including *Hylomyrma*. The Ant Collection of the Museu de Zoologia da Universidade de São Paulo/MZSP houses a significant number of *Hylomyrma* specimens, showing broad geographic representation and morphological variation of the recognized taxa, including several types as well as specimens that clearly do not belong to species already known. Therefore, its study provides enough material to carry out a robust taxonomic review and phylogenetic analysis of *Hylomyrma*. A preliminary exam of the *Hylomyrma* species records enables us to confirm the known Northern limit of occurrence in Vera Cruz State/Mexico, and the Southern limit in Nova Petrópolis, Rio Grande do Sul State/Brazil. In South America just Uruguay and Chile present no recorded of *Hylomyrma* species. In Central America, only El Salvador and Honduras have no record among continental countries, and among island countries *Hylomyrma* were registered only in Trinidad & Tobago. Also, we were able to confirm that *H. columbica* types, recorded as not localized by the unpublished review of the genus in 2005 by Nicolas Albuquerque, are housed in the Muséum d'Histoire Naturelle, Genève/Suisse (MHNG). (FAPESP 2012/21309-7)

ANT DIVERSITY IN CHACO PHYTOGEOGRAPHICAL REGION, "LOS LLANOS" AREA, LA RIOJA PROVINCE, ARGENTINA

F. BAUDINO[1], L.M. BUFFA[1] & A.M. VISINTIN[1]

[1]Cátedra de Entomología, Centro de Investigaciones Entomológicas de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba. Av. Vélez Sarsfield 299, (5000) Córdoba, Argentina. e-mail: lbuffa@efn.uncor.edu.

Ants are eusocial insects with a high abundance and present in a wide variety of habitats, performing multiple functions in the ecosystems and responding quickly to environmental changes. In La Rioja province, Argentina, records of previous studies on these insects have been carried out in Talampaya National Park as well as in cultivated environments, where Formicidae was the most abundant group. Other studies of this family in the rest of the phytogeographical regions of the province are scarce. The objective of the present work was to study ants diversity in three different environments in Los Llanos region (30º37'50''S, 66º16'3''W), General Belgrano department, southeast La Rioja province. According to vegetation characteristics, three sites were selected, as follows: 1. Salinas, 2. Transition Monte-Salinas, 3. Monte. Site 1 presents scarce vegetation development and poor leaf coverage, being *Allenrolfea patagonica* and *Heterostachys ritteriana* the dominant species; site 3 is mainly dominated by a trees (3-6 m height) and shrubs (0.5-3 m height), while site 2 has intermediate characteristics between site 1 and site 3, being the trees replaced by cacti (*Stetsonia coryne*), and the landscape dominated mainly by shrubs. In each site four transects were delimited, 50 meters apart from each other, where four pitfall traps were set up at a distance of five meters. Totally, 48 traps were used, remaining active for a period of seven days during spring season. The *Species diversity & richness* program was used to calculate the different diversity indexes. A total of 35 species were collected, distributed in 15 genera and 6 subfamilies: Myrmicinae (6:12)*, Dolichoderinae (3:7), Formicinae (2:7), Ecitoninae (2:2), Ponerinae (1:2) and Pseudomyrmecinae (1:1) *(Nº of genera:Nº of species). The genera with higher richness were *Camponotus* (S=6), *Pheidole* (S=5) and *Dorymyrmex* (S=4). Out of 15 registered genera in the area, 10 were found in Salinas, 11 in Transition and 14 in Monte. Categories of dominance were determined, being *Forelius* and *Pogonomyrmex* eudominants (Do>10%), while *Pseudomyrmex* and *Ectatomma* were rare (Do<1%). Monte presented the highest abundance values (H'=2.589), equitability (J'=0.740) and dominance (D=8.737) in relation to the other sites. The results obtained with the applied methodology, reflect a great complexity in the community structure, particularly for Monte, providing important tools which allow proposing Los Llanos region as an area of vital interest to be included in protection and conservation policies.

CHARACTERS OF TAXONOMIC IMPORTANCE TO SEPARATE MORPHOSPECIES OF *Cyphomyrmex* MAYR, 1862: *rimosus* GROUP

E.Z. ALBUQUERQUE[1,2] & C.R.F. BRANDÃO[1]

[1]Museu de Zoologia da Universidade de São Paulo, Av. Nazaré 481, 04263-000 São Paulo, SP, Brasil, e-mail: emilia_albuq@hotmail.com. [2]Programa de Pós-Graduação em Entomologia, Faculdade de Filosofia Ciências e Letras de Ribeirão Preto – FFCLRP/USP.

Cyphomyrmex is composed by 23 relatively small, slow-moving fungus-growing ant species, which are restricted to the New World, in all habitats. They nest within the litter, in the ground, in roots, in holes on trees or decomposing logs and more rarely in live trees. Their bodies are opaque due to micro-reticulations, and the majority of the species does not display defined surface sculpturing; there are no tubercles on the first gastral tergum, with the exception of *C. hamulatus*. The frontal lobes are exceptionally broad, completely concealing the antennal sockets, and the head is usually widest across the frontal lobes. The mesosomal spines are, in the majority of the species, replaced by low, blunt tubercles, vestigial in some species. According to Kempf, the Rimosus group is characterized by: (i) a preocular carina curving above the compound eyes (with exceptions of *C. costatus, C. longiscapus, C. muelleri* and *C. wheeleri*), not joining with the postocular carina that extends from the occipital corner to the posterior or inferior borders of the compound eye, (ii) mandibles with five teeth, and (iii) two or none median pronotal tubercles. The species of this group are very commonly collected generating a large volume of material demanding identification or separated only into morphospecies. Moreover, *Cyphomyrmex* has been considered a taxonomic challenge, even for people used to ant identification, because of high level of morphological variation within species, which hampers delimitation of taxonomic unities and the reduction and attenuation of several characters by virtue of their relatively small size. In this study, we propose eleven characters that can be useful to separate *Cyphomyrmex* morphospecies of the Rimosus group: 1) comparative length of the antennal scape; 2) presence of a supraocular tooth; 3) presence of an occipital process; 4) presence of median pronotal tubercles; 5) presence of lateral pronotal tubercles; 6) comparative size of mesonotal tubercles; 7) propodeum shape; 8) predominant hairs on head and gaster; 9) presence of hind femur carina; 10) petiolar form (proportion between high and length) and 11) post-petiolar shape. (FAPESP)

CYTOGENETIC CHARACTERIZATION OF *Pachycondyla ferruginea* (FR. SMITH, 1858) AND ITS POSITION BETWEEN THE NEOTROPICAL *Pachycondyla* (FORMICIDAE; PONERINI).

I.N. GUIMARÃES[1,2], J.H.C. DELABIE[1,2], R.M. FEITOSA[3] & C.S.F. MARIANO[1,2]

[1]Universidade Estadual de Santa Cruz/DCB/DCAA (UESC), BR-415, 45662-000 Ilhéus - BA, Brasil, e-mail: iasmynguimaraes@yahoo.com.br.; [2]Laboratório de Mirmecologia, Centro de Pesquisas do Cacau, Comissão Executiva do Plano da Lavoura Cacaueira (CEPEC-CEPLAC), 45600-970 Itabuna-BA Brasil; [3]Departamento de Zoologia, Universidade Federal do Paraná, 81531-980 Curitiba-PR, Brasil.

Pachycondyla is the genus with the greatest species diversity in the subfamily Ponerinae. Species of this genus occur in the tropics around the world and nest in different strata of the environment such as litter, hollow trees, dried fruits and decaying wood, for example. Several studies indicate the paraphyly of the genus which, in its current form, includes as synonyms several old names, such as *Mesoponera, Neoponera, Termitopone, Trachymesopus* and *Wadeura*. In the Neotropics, 92 species of *Pachycondyla* are described, grouped in 18 complexes according to morphological criteria in a recent review of the genus (MacKay & MacKay, 2010). Another study based on molecular data together with morphological information (Schmidt, 2011) points out the paraphyly of the genus. Cytogenetic studies on the diversity of Neotropical Ponerinae also provide arguments regarding the evolution and paraphyly of *Pachycondyla*. For example, we observed morphological variations in species that seem to be related to their geographic distribution together with large variations in their karyotype, which makes us assuming the occurrence of a much higher species diversity in the genus than that described. We developed multidisciplinary studies in different species of the subfamily Ponerinae that include karyotype analyzes. Hereafter, we present a preliminary result on the karyotype evolution of the group *Pachycondyla stricto sensu* (or *sensu* Kempf, 1972), with the addition of a still unpublished result, the karyotype of *Pachycondyla ferruginea* (Fr. Smith, 1858). A colony of this rarely collected species was found in the Atlantic Forest reserve “RPPN Serra Bonita”, county of Camacã, state of Bahia. It was studied for its nesting, population and cytogenetic characteristics. Mitotic metaphase cells were obtained from the cerebral ganglia of workers and the chromosomes were classified according to the centromere position. The karyotypes were analyzed together with information already published on other species of the genus. Through the comparison with two recent studies on *Pachycondyla*, we infer about the karyotype evolution in a group of species based on the karyographic analysis of Imai (1988). The diploid karyotype of *P. ferruginea*, with 2n = 38, has its karyotype formula: 2K=16M+ 4SM+18A. This species belongs to the complex Ferruginea *sensu* MacKay & MacKay (2010), composed by two species. Schmidt’s study (2011) points out that *P. ferruginea* is quite different from all other genera currently aggregated under the name *Pachycondyla* in its current acceptance and cannot be grouped with any formerly recognized genus. Also, with an atypical karyotype compared with those already described for five of the eight species of *Pachycondyla s.s.*, *P. ferruginea* appears as an isolated point in the karyograph that joins and compares all available information. All the species grouped into *Pachycondyla s.s.* have their karyotypes composed by a large number of small chromosomes (2n=62, 70, 94, 96, 104), which is the same pattern that the one observed in four species of the genus *Dinoponera* (2n=82, 92, 114, 118-120), with is the sister group of *Pachycondyla s.s.* according to Schmidt. These cytogenetic results strongly support the conclusion of this last study whereby *P. ferruginea* should be removed from *Pachycondyla* and reinforce the importance of integrative taxonomy in evolutionary studies in Ponerinae. (SECTI-FAPESB/CNPq PNX 011-2009, RED0012/2012, CAPES/PROTAXA). Ref: IMAI, HT. *et al.* 1988. *Jpn. J. Genet*. 63: 159-185; KEMPF, WW. 1972. *Stud. Entomol*. 15:3- 344; MACKAY, WP & MACKAY, EE. 2010. *The systematics and biology of the New World ants of the genus Pachycondyla (Hymenoptera: Formicidae)*. Edwin Mellen Press, Lewiston; SCHMIDT, CA. 2010. PhD thesis, University of Arizona.

IMAGE BANK OF ANT TYPES OF THE MUSEU DE ZOOLOGIA DA UNIVERSIDADE DE SÃO PAULO COLLECTION.

L.P. PRADO[1,2] & C.R.F. BRANDÃO[2]

[1]Programa de Pós-Graduação em Sistemática, Taxonomia Animal e Biodiversidade, Museu de Zoologia da Universidade de São Paulo/MZSP, Av.: Nazaré, n° 481, Ipiranga, São Paulo/SP, Brasil, CEP 04263-000, e-mail: livia.pires7@gmail.com.br; [2]Laboratório de Hymenoptera, MZSP, São Paulo/SP, Brasil.

The Museu de Zoologia da Universidade de São Paulo (MZSP) houses today one of the leading zoological collections of Latin America, with approximately 8.5 million animals liquid or dry preserved. There are about seven thousand primary types deposited in the collections of MZSP. The ant collection holds one of the most important collections worldwide, due to the acquisition of the Kempf-Borgmeier collection in 1977, besides material added more recently by several collaborators and by C.R.F. Brandão (curator since 1981) and his students and associates, especially material from localities not represented before. Because of this, efforts are being made for publication of the types deposited in the collection. Several catalogs have been published thus far or are under preparation with the purpose of providing information on labels, the condition of the specimens and the current taxonomic status of the corresponding nominal species, according to the International Code of Zoological Nomenclature. Furthermore, FAPESP is funding the Project "Adequação das instalações, informatização e disponibilização do acervo do Museu de Zoologia da USP", which one of its goals is to record and make available by virtual access, high-resolution images of each the primary types (holotypes, neotypes, lectotypes) and syntypes of the collection. Initially all circa 250 ant holotypes, lectotypes and neotypes deposited in the collection are being photographed, belonging to 11 subfamilies and 63 genera. High resolution images are obtained through resolution Leica Application Suite V3® of the Hymenoptera Lab of the MZSP. When necessary, adjustments are made in Adobe Photoshop® CS3. For each specimen three images are obtained: head view, profile view and label. When completed, these images will be available at the MZSP server. (FAPESP)

MOLECULAR ANALYSIS OF THE LITTLE FIRE ANT *Wasmannia auropunctata* (HYMENOPTERA: FORMICIDAE) ROGER, 1863 OF THE STATE OF SÃO PAULO

L.M.R. SILVA[1], V.G. MARTINS[1], C. MARTINS.[1,2] & O.C. BUENO[1]

[1]Centro de Estudos de Insetos Sociais, Instituto de Biociências, Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP), Avenida 24-A, nº1515, Bela Vista, CEP 13.506-900, Rio Claro, SP, Brasil, e-mail: larimrs@rc.unesp.br; [2]Universidade Federal do Piauí (UFPI), Campus Parnaíba, Avenida São Sebastião, 2819, CEP 64202-020, Parnaíba, Piauí, Brasil

Wasmannia auropunctata is native to the Neotropics and has spread to all biogeographic regions of the world, except the East. Known for its small size, golden-brown color, and burning sting, it was ranked among the ten worst invasive species of the world. Although studies on invasive populations have been made, little is known about the genetic pattern of geographic distribution of this ant in Brazil, within its natural occurrence. In this work, we present a preliminary study characterizing the diversity of mitotypes (mtDNA haplotypes) of six colonies of *W. auropunctata* from six cities in the state of São Paulo, through the sequencing of the mitochondrial genes: cytochrome oxidase I (COI), leucine transfer RNA (tRNA), and cytochrome oxidase II (COII). Workers were collected from colonies in the cities of Rio Claro (RC), Pirassununga (CE), Anhembi (An), Agudos (Ag), Piracicaba (Pi), and Sorocaba (So). Each DNA extraction was performed with one individual using the Wizard Genomic DNA Purification Kit (Promega) following the protocol of the supplier. For the PCR reactions, primers LepF1 and WaR were used to amplify two fragments corresponding, respectively, to 666 bp of COI and 797 bp related to the end of COI, intergenic spacer, leucine tRNA, and the beginning of COII. The sequencing reactions were performed using BigDye Terminator chemistry (Applied Biosystems Inc.) and the fragments were sequenced in an automated sequencer, model 3130 Genetic Analyser (Applied Biosystems). The sequences obtained were analyzed using the BioEdit software, aligned with the ClustalW tool, and manually edited. It was observed that: the leucine tRNA was the same for all samples; the COI was the same for the samples CE, An, and Ag; and the COII of the sample Ag varied in only one nucleotide compared to the samples CE and An, while the other samples showed more variation than the first samples. Using the two fragments concatenated, totaling 1463 bp, a net of mitotypes was drawn with Network software. The network analysis indicated the existence of five mitotypes divided into two groups: group 1 (CE, An, and Ag) and group 2 (RC, Pi, So). In group 1, the sample Ag presented only one variation compared to the samples CE and An, which showed the same mitotype. In group 2, the network presented two hypothetical (unsampled) mitotypes: for the first, there was a separation of the So mitotype and the second hypothetical mitotype; for the second, there was a separation of the RC and Pi mitotypes. Through this preliminary study it was possible to carry out the molecular characterization of the colonies studied and the observation of the diversity of mitotypes of this species in the state of São Paulo. (CAPES)

PHYLOGEOGRAPHY OF *Acromyrmex balzani* AND *A. subterraneus* IN BRAZIL

E.C. QUEIROZ[1], P.R. STRÖHER[1]& M.R. PIE[1]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Setor de Ciências Biológicas, Departamento de Zoologia, Programa de Pós Graduação em Entomologia, Universidade Federal do Paraná (UFPR), Caixa Postal 19020, CEP: 81531-980 – Curitiba, PR, Brasil, e-mail: elisianequeiroz@gmail.com

The leaf-cutting ants belong to the genera *Atta* and *Acromyrmex* - the most derived in Attini tribe - and are adapted to different types of environment. In this study we infer the evolutionary history of *Acromyrmex balzani* and the differentiation of subspecies of *A. subterraneus*. We used a mitochondrial marker and two *epic* nuclear markers for molecular analyses of 66 samples. Of those, 22 samples of *A. balzani* were obtained from the Brazilian states from RJ, SP, MG, IP, MS, ES and 44 samples of *A. subterraneus* were obtained from RJ, PR, MG, SP, MS, BA, SC. Samples were obtained either from field collecting or received as donation from other researchers. *Acromyrmex balzani* showed divergence between populations in areas of cerrado (savanna) (Botucatu/SP, Selvíria Corumbá/MS) from those in forested regions (Campos dos Goytacazes/RJ, Piracicaba/SP, Viçosa/MG, Sooretama/ ES, Parnaíba/PI). These results are particularly interesting given the specialization of this species to cut grasses. *Acromyrmex subterraneus* is common throughout Brazil and is currently subdivided into three subspecies: *A. subterraneus brunneus*, *A. subterraneus molestans*, and *A. subterraneus subterraneus.* However, the taxonomic characters separating them are ambiguous because they are based on coloration and in a highly labile character (inferior pronotal spine form). The results of our study are not consistent with distinct genetic groups for the subspecies. This study is ongoing and more samples from other locations will be incorporated into our database. (CAPES, CNPq)

PROPOSAL FOR A TAXONOMIC REVISION OF THE GENUS *Octostruma* FOREL (FORMICIDAE: MYRMICINAE: BASICEROTINI).

L.P. PRADO[1,2] & C.R.F. BRANDÃO[2]

[1]Programa de Pós-Graduação em Sistemática, Taxonomia Animal e Biodiversidade, Museu de Zoologia da Universidade de São Paulo/MZSP, Av.: Nazaré, n° 481, Ipiranga, São Paulo/SP, Brasil, CEP 04263-000, e-mail: livia.pires7@gmail.com.br; [2]Laboratório de Hymenoptera, MZSP, São Paulo/SP, Brasil.

The objective of this project is a taxonomic revision of *Octostruma*. Preliminary observations have shown the existence of new geographic distribution records for the genus, possible new species and new records for at least two forms hitherto unknown for a gyne (*O. stenoscapa*) and a male (*O. iheringi)*. Of the six genera of Basicerotini ants, only two have been recently revised, *Basiceros* and *Eurhopalothrix*. *Octostruma* has currently 13 valid species and its last revisionary study is now more than 50 years old. It differs from other genera of the tribe mainly by the presence of eight antennal segments in females. With respect to biology, members of this genus nest and forage in rotten wood, leaf litter, in the soil, or even on epiphytes. *Octostruma* is restricted to the New World, from the rainforests of Mexico to southern Argentina. Tropical rainforests are home to a considerable number of ant species, mainly in the leaf litter, which holds some 50% of the total species found in a given region. Over the recent years, with the development and improvement of collection techniques and methods and the litter ant fauna inventoried in different biomes, much material has accumulated in myrmecological collections, including *Octostruma*. However, many not studied specimens do not fit the descriptions of the known species, suggesting that a comprehensive taxonomic revision has the potential to reveal new species and contribute significantly to the increase of knowledge about the taxonomy of the genus.

REVISION OF THE *foetida* SPECIES COMPLEX, GENUS *Pachycondyla* SMITH, 1858 (HYMENOPTERA: FORMICIDAE: PONERINAE) IN BRAZIL

I.O. FERNANDES[1], M.L. DE OLIVEIRA[1] & J.H.C. DELABIE[2]

[1]Programa de Pós-Graduação em Entomologia – PPGENT. Instituto Nacional de Pesquisas da Amazônia – INPA. Av. André Araújo, 2936. Petrópolis, CEP 69.067-375, Cx. Postal 2223. Manaus, AM, Brasil, e-mail: itanna.fernandes@gmail.com. [2]Centro de Pesquisas do Cacau (CEPEC), Laboratório de Mirmecologia, UESC/CEPLAC, Ilhéus, BA, Brasil.

The *Pachycondyla foetida* species complex has 11 New World species, and it is the second largest in number of species within the genus. In Brazil four species are known: *P. foetida*, *P. inversa, P. theresiae* and *P. villosa.* The taxonomic status of the *foetida* species complex to Brazil remains unclear, although a recent review has been published. The aim of this study is clarify the taxonomic status of this complex to Brazil from the examination of the primary type, redescription of the species, expanding the known of geographical distributions and presenting an identification key for workers, queens and males. We examined 860 specimens of the *foetida* species complex occurring in Brazil: *P. curvinodis* (first register for Brazil)*, P. foetida*, *P. inversa* and *P. villosa*. The material obtained of *P. curvinodis* enabled the description of the previously unknown males of this species, including their color variation (black and brown petiole; yellow gaster and legs), a character hitherto observed only in males of *P. villosa.* New information is given about the distribution of *P. curvinodis* on Brazil. To clarify the status of *P. curvinodis* we compared the original description and figure with the type material of *P. inversa* and we confirmed they are different species. The petiole of *P. inversa* has a strongly curved anterior face, while *P. curvinodis* has a more pronounced curve in the upper half of the petiole. *P. inversa* is widely distributed in Brazil. *P. foetida* have striations on the upper side face of petiole, while striae occur on the infero-lateral surface of petiole in *P. theresiae*. *P. foetida* is reported only from some northern Brazilian states, while *P. theresiae* is reported only to Amazonas state. The material type consulted of the *P. villosa* allowed to clarify the diagnosis of this species: the anterior face of the petiole is vertical with its posterior face convex, it has a broadly rounded posterior face, characters absent in all the other species. *P. villosa* can be also differentiated from other species of the *foetida* species complex by the anterior margin of its clypeus, which is medially concave and has no striae. Like other species of the *foetida* species complex, *P. villosa* has a wide distribution and occurs in all Brazilian states. Our study has provided identification keys for males, queens and workers to the New World, defined morphological limits and expanded the distribution of all the known Brazilian species. (CAPES, SECTI/FAPESB-CNPq PRONEX)

BIOLOGY/NATURAL HISTORY, BEHAVIOR

ANTS NESTING IN LITTER TWIGS OF URBAN PARKS

T.T. FERNANDES[1,2], L.P. SAAD[1], G.M. PEREIRA[1] & M.S.C. MORINI[1]

[1]Laboratório de Mirmecologia do Alto Tietê (LAMAT), Núcleo de Ciências Ambientais (NCA), Universidade de Mogi das Cruzes (UMC), Av. Dr. Cândido Xavier de Almeida de Souza, nº 200, CEP 08780-911 – Mogi das Cruzes, SP, Brasil, e-mail: morini@umc.br
[2]Programa de Pós-graduação em Biotecnologia, Universidade de Mogi das Cruzes, Mogi das Cruzes, SP, Brasil.

Various strata of tropical forests are rich in ants, especially the litter. This richness is also associated with variety nesting sites. Ant nests can be found in various microhabitats, including twigs from fragmentation of fallen branches of trees. In litter, these twigs are in different stages of decomposition. This paper investigates twigs as nesting resource in four urban parks with Rain Forest native vegetation in southeastern Brazil. These parks suffer different influences of urbanization in their vicinity. At each collection site, 30 plots of 16 m^2 were demarcated 10 m distant from each other. All twigs in the plots were collected. A total of 1,493 twigs were collected but only 7.36% with ant colonies. The range of length variation of twigs with colonies was 12 to 74.5 cm; the diameter from 4.97 to 44.91 mm. A total of 25 species of ants were recorded and the subfamily Myrmicinae was the richest with eight genera and 15 species. The richness in urban parks ranged from 4 to 18 species distributed in 4-61 colonies; the richest parks in species and most abundant in colonies are located in the less urbanized areas. The most frequent species were *Pheidole* sp.14 in 25% of the branches; *Brachymyrmex admotus* and *Pheidole* pr. *senilis,* both in 13% of branches. In 92% of colonies was recorded the presence of immature individuals; colonies of *B. admotus* were the largest (number of workers). The winged individuals were recorded in 28% of the colonies; those of *Linepithema neotropicum* were the most abundant. Queens were found in 19% of the colonies. Colonies of five species (*Brachymyrmex admotus*, *Megalomyrmex goeldii*, *Pheidole pr. senilis* and *Pheidole* sp.14) had more than one queen. Only colonies of *Pachycondyla mesonotalis* and *Strumigenys cosmostela* had not immature, winged and queen. Our data indicate that the twigs can be part of the life cycle of many ant species and important in maintaining the biodiversity in urban parks. (CAPES, FAEP)

BEHAVIOR OF *Acromyrmex crassispinus* IN TRAIL BIFURCATIONS AND INFLUENCE OF ANT FLOW ON ERROR RATE OF NESTBOUND LADEN WORKERS

M.A. NICKELE[1], M.R. PIE[1] & W. REIS FILHO[2]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, PR, Brasil, email: nickele.mariane@gmail.com.
[2]Epagri/Embrapa Florestas, Colombo, PR, Brasil.

Ants are faced with a succession of bifurcations along their foraging trails. Given that there is no directionality in pheromone trails, each bifurcation is potentially an opportunity for error in the trajectory of workers to the nest, which could entail in considerable inefficiencies in the transportation of food to the colony. The behavior of leaf-cutting ants of the genus *Acromyrmex* in trail bifurcations is still largely unexplored. Thus, this study aimed to assess the behavior of *Acromyrmex crassispinus* workers in trail bifurcations and to investigate if differences in trail traffic influence in the number of errors of workers that return to the nest with load. Four colonies of *A. crassispinus* were monitored in Curitiba, state of Paraná, Brazil. One bifurcation of each colony was recorded on video during 5 minutes, totaling 20 videos for each colony. We counted the number of workers leaving and returning (with or without load) in each video, and the number of ants returning with load that committed errors. The trajectories of all workers of one video with low and another with high ant flow were followed for each colony, for a total 1335 analyzed worker paths.The error rate of workers returning with load decreased with increasing worker flow. Most workers walked in the central part of the foraging trails and these ants occupied a larger area of the foraging trail and bifurcation when the ant flow was high. The walking speed of *A. crassispinus* is influenced by the ant flow, load, temperature and relative humidity. These results provide a better understanding of *A. crassispinus* traffic organization and their foraging strategies. (CAPES)

BEHAVIORAL AND CHEMICAL MEDIATORS OF THE INTRASPECIFIC RECOGNITION IN THE ANT *Ectatomma brunneum* SMITH, 1858 (HYMENOPTERA: FORMICIDAE)

M.C. PEREIRA[1,2], E.L.B. FIRMINO[2], R.C. BERNARDI[3,4], S.M. LIMA[4], C.A.L. CARDOSO[5] & W.F. ANTONIALLI-JUNIOR[2].

[1]Programa de Pós Graduação em Entomologia e Conservação da Biodiversidade, Faculdade de Ciências Biológicas e Ambientais, Universidade Federal da Grande Dourados (UFGD), Rodovia Dourados – Itahum, Km 12, CEP 79.804-970 – Dourados, MS, Brasil, e-mail: marloncesarp@yahoo.com.br. [2] Laboratório de Ecologia, Universidade Estadual de Mato Grosso do Sul (UEMS), Dourados, MS, Brasil.[3] Programa de Pós Graduação em Recursos Naturais, Universidade Estadual de Mato Grosso do Sul (UEMS), Dourados, MS, Brasil. [4] Grupo de Espectroscopia Óptica e Fototérmica, Universidade Estadual de Mato Grosso do Sul (UEMS), Dourados, MS, Brasil. [5] Laboratório de Análise Instrumental, Universidade Estadual de Mato Grosso do Sul (UEMS), Dourados, MS, Brasil.

The integrity of an ant colony is exclusively dependent on the social relationships among their individuals and, therefore, on their ability of recognition among nest mates. Therefore, the existence of mechanisms that allow this recognition is essential during inter- and intraspecific interactions. The aim of this study was to investigate the mechanisms of recognition during intraspecific interactions based on the "Dear Enemy Effect”. We collected 10 colonies of *E. brunneum*, 5 nesting in the same area and other 5 from another distinct area, thereby ensuring that the colonies of these two areas have not had any previous contact. Then, the colonies were housed in artificial nests in the laboratory. Nests of two separate colonies were connected to a single foraging arena, in which it was possible for members of two colonies to interact during foraging. To assess the aggressiveness level during the meetings of workers of distinct colonies, the agonistic behaviors displayed were given a score scale. To assess whether there is a relationship between the levels of aggressiveness and the composition of the cuticle’s superficial pheromones, we carried out analyses of cuticular hydrocarbons through the FTIR-PAS and Gas Chromatography techniques (GC-FID). We performed 120 hours of observations and our results show that, regardless of which area the colonies were from, the foragers always had a certain level of aggressiveness during interactions. However, this level was lower among colonies nesting in the same area. Regarding the cuticular hydrocarbon profile analyses, both techniques showed that, even though each colony has its own signature, there is a broader overlap of colonies nested in nearby sites. Thus, it is possible to affirm that the "Dear Enemy Effect" applies to the ant species *Ectatomma brunneum*, and one of the mechanisms used for recognition among the colonies must be the chemical variation of cuticular hydrocarbon profile. (CAPES, CNPq)

BEHAVIOURAL TYPES IN UNPREDICTABLE HABITATS: QUEENLESS ANTS AS A MODEL SYSTEM

M.C.N. OLIVEIRA[1,2], C.F. SIQUEIRA[1], M.C.L. SILVA[1] & L.R.S. ZANETTE[1,2]

[1]Laboratório de Ecologia Evolutiva de Insetos, Departamento de Biologia, Universidade Federal do Ceará (UFC), Av. Humberto Monte, s/n, CEP 60455-760- Fortaleza, CE, Brasil, email: marciacristina_neris@hotmail.com [2]Programa de Pós-graduação em Ecologia e Recursos Naturais, Universidade Federal do Ceará, Fortaleza, CE, Brasil.

Personalities (behavioural types) may be defined as behavioural differences that are constant in time and are correlated in different situations or contexts of an animal's life. Behavioural flexibility, however, may be very important for organisms exposed to unpredictable conditions and resource availability. Hence, it can be expected that within colonies the variability of behavioural types is high in more unpredictable environments. We tested this hypothesis using colonies of *Dinoponera quadriceps*, a queenless Ponerinae common in the Brazilian semi-arid region. We collected eight colonies in "Serra de Maranguape" (overall mean no. of individuals per colony = 47 ± 23.08 S.D.). All ants were individually marked with enamel paint and gamergates were identified. The frequency of exploratory types within four colonies was estimated experimentally ("maze of chambers") using 14-20 foraging ants per colony. The number of chambers visited by each ant was used to measure its level of exploratory behaviour. To verify the constancy of behavioural responses, which characterizes behavioural types, individual experimental tests were repeated after two weeks. The number of chambers visited did not change significantly over time (mean difference = 1.217 ± 1.211 S.D.; Wilcoxon signed rank test, V = 656, P = 0.201, n= 68). The frequency of explorative types was significantly different between colonies (GLM, res. dev. deviance = 8.842, p = 0.031). Our initial results suggest that personalities modulate the range of behavioural responses observed in *D. quadriceps* and that within colonies personalities may vary little, even in unpredictable semi-arid regions. Future comparisons with colonies from less predictable environments will allow us to further test our hypothesis. (PPGERN)

CHARACTERISTICS OF THE CHEMICAL TRAIL PRODUCED BY THE LEAF-CUTTING ANT *Atta robusta* (HYMENOPTERA: FORMICIDAE)

F.B. ENDRINGER[1,2], G. TATAGIBA ARAÚJO[1], L. FURTADO[1], A.F. SILVA[1], O. BAILEZ[1], & A.M. VIANA-BAILEZ[1]

[1]Laboratório de Entomologia e Fitopatologia, Universidade Estadual do Norte Fluminense (UENF/ CCTA) Av. Alberto Lamego, 2000 - Pq. Califórnia 28013-602 - Campos dos Goytacazes / RJ. Email: fabiola.endringer@hotmail.com. [2]Programa de Pós-graduação em Ecologia e Recursos Naturais, Universidade Estadual do Norte Fluminense, Campos dos Goytacazes, RJ, Brasil.

Pheromone trails are used to orient individuals of a colony to locate a food source and then return to the nest. In ants this pheromone is synthesized in the venom gland, present at the end of the gaster. However, for the species *Atta robusta* no studies have been conducted focusing on pheromone. Therefore, the objective of this study was to verify if the contents of the venom gland contain pheromones which are used to mark trails in *A. robusta*, and to investigate the concentration that triggers this behavior and the duration of the venom gland extract on the trail. Foragers were collected from trails in the field located on the “restinga” of Grussaí / Iquipari - RJ and also from one the nest maintained in laboratory conditions at UENF. For the preparation of venom extracts, glands were removed and placed in vials with 1 ml of dichloromethane. Concentrations of 0.3, 0.5, 1.0 or 1.5 equivalent / glands were tested. In an arena, ten ants were exposed to a filter paper disc divided into four quadrants with their perimeters impregnated with extract or solvent (control). During three minutes, the number of ants that walked at least one quarter of the perimeter was quantified. A concentration of 0.3 equivalent / venom gland resulted in the highest response in the field and laboratory ants. Under the same conditions as the previous experiment, the extract at a concentration of 0.3 venom gland was offered for 10, 30 minutes and 1, 2, 3, 4, 5, 6, 12, 24, 36 hours. A decrease in the number of workers following the extract trail two hours following impregnation was observed using ants of the field and laboratory. The *A. robusta*pheromone was much more volatile than in other leafcutter ants. This is probably associated with the fact that the trails of this species are constructed in sandy soils and in an environment with very strong winds. (FAPERJ)

DO THE HITCHHIKERS OCCUR OVER ANY TRANSPORTING FRAGMENT?

I.N. HASTENREITER[1,2], T.A. SALES[1,2], N.G. ALMEIDA[2] & J.F.S. LOPES[1,2]

[1]Programa de Pós-graduação em Ecologia, Universidade Federal de Juiz de Fora, Rua José Lourenço Kelmer, s/n Campus Universitário – São Pedro, 36036-330, Juiz de Fora, MG, Brasil. [2]MirmecoLab, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, MG, Brasil. belnetoh@gmail.com

The hitchhiking behavior is characterized by minimal workers over the leaves fragments which are transported into the nest. Although the occurrence of hitchhikers is not rare they are not observed over all leaves fragments along the foraging trail. Here, we analyzed if leaf fragments of different sizes and plant species are related with the hitchhikers' occurrence. We tested disks of three different diameters (5, 7, 8mm) of *Rosa* sp. (Rosaceae), *Acalypha wilckesiana* (Euphorbiaceae), *Spathodea campanulata* (Bignoniaceae) and *Rubus* sp. (Rosaceae). For each size and plant species we offered 200 disks to three laboratory colonies with a similar fungus garden volume. We registered the hitchhikers' frequency and weight, and the foraging flow along a 1.5m longer trail, until all the fragments had been transported. Also we determined the average weight of each size and plant species disk. We found that the variation of the hitchhikers' frequency is not related to plant species ($df=3$, $F=0.41$, $p= 0.74$) neither to disks size ($df=2$, $F=1.31$, $p=0.28$). Although a higher frequency of hitchhikers is related with a higher flow of unloaded workers along the trail ($df=1$, $F=8.76$, $p=0.006$). This relation was not verified with the flow of loaded foragers ($df=1$, $F=0.67$, $p=0.42$) or foragers that leave the nest ($df=1$, $F=3.03$, $p=0.09$). The weight of hitchhikers was significantly smaller for *Spathodea* disks ($df=3$, $F=3.08$, $p=0.03$) in comparison with the other plant species, independently of the disk sizes ($df=2$, $F=2.21$, $p=0.11$). Interestingly, we found no differences among the weight of plant species ($df=3$, $F=0.87$, $p=0.47$) or disk sizes ($df=2$, $F=0.70$, $p=0.50$). Our results demonstrate that hitchhikers could occur in any fragment foraged, but their weight ranged within plant species. In this way, *Spathodea* disks had the smaller hitchhikers because their flowers are thinner than Rosaceae and Euphorbiaceae leaves, despite have similar weight. The increase of hitchhikers in function of a higher flow of unloaded workers could be explained by the fact that unloaded workers along the trail are mainly the smaller ones, which are potential hitchhikers. Thus, when a stimulus happens, they assume the condition and functions of a hitchhiker. This stimulus could even be the crowded trail, assuming the hitchhiker role the minimal workers avoid unnecessary bottlenecks, u-turns and head collisions. Too many minimal workers along the trail could disturb the flow and to avoid a delay on return to the nest, minimal workers could adopt the condition of hitchhiker. This work delineates another ecological and behavioral hitchhiker importance on foraging trails, filling gaps about the complex foraging process of leaf-cutting ants. (CNPq, UFJF)

DOES AN ANT FUNGUS GARDEN ACT AS A TEMPLATE FOR CONSTRUCTING CHAMBERS?

R.S. CAMARGO[1], J.F.S. LOPES[2] & L.C. FORTI[1]

[1]Laboratório de Insetos Sociais-Praga, Departamento de Produção Vegetal, Faculdade de Ciências Agronômicas/UNESP, 18603-970, PO Box 237, Botucatu, SP, Brasil. E-mail:camargobotucatu@yahoo.com.br [2]Mirmecolab, Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas. Rua José Lourenço Kelmer, s/n - Campus Universitário, Bairro São Pedro, 36036-900 - Juiz de Fora, MG – Brazil.

Adult nests of leaf-cutting ants (genus *Atta* and *Acromyrmex*) are composed of thousands of underground chambers that harbor their population, fungus garden and waste. But how are the chambers constructed? To answer this question, we hypothesized that the fungus garden acts as a template for constructing chambers. Thus, we used 20 colonies, aged 6 months, divided into four treatments: Normal (Control); Half Symbiotic Fungus; Double Symbiotic Fungus and No Symbiotic Fungus. The variables studied were: morphology, (tunnels and chamber formed); flow of worker activities and volume of soil excavated. As expected, the No Symbiotic Fungus treatment presented only tunnels without chambers, whereas the other treatments produced at least two chambers, with similar dimensions. During 72 hours, the per-minute flow of workers carrying soil pellets differed between treatments. The volume of soil excavated by workers was a function of their excavation rate, and thus differed among the treatments. Our results confirm the hypothesis that the symbiotic fungus acts as a template for chamber construction. The inexistence of a functional structure such as a chamber when symbiotic fungus is absent proves the hypothesis.

ECOLOGY, DIET AND ACTIVITY SCHEDULE OF THE DOMINANT ANT *Pheidole oxyops* FOREL, 1908

I.J.M.T. GOMES[1] & H.L. VASCONCELOS[2]

[1]Departamento de Biologia Geral, Universidade Federal de Viçosa (UFV), Campus Universitário, Ed. Chotaro Shimoya, sala 242b, CEP 36570-000, Viçosa, Minas Gerais, Brazil, email: inacioteles@gmail.com. [2]Instituto de Biologia, Universidade Federal de Uberlândia (UFU), Uberlândia, Minas Gerais, Brazil.

The life history of ants spans an enormous range of attributes that allow them to exploit numerous terrestrial habitats. Unfortunately, the knowledge about which and how those attributes allow ant species to adapt to terrestrial habitats is minimal. Studies on natural history and ecology of species can provide us the better understand of selective pressures acting on species. In this work we aimed to provide some data on spatial use of habitat, diet and activity schedule of the dominant ant *Pheidole oxyops*. Our experiments were performed at Estação Ecológica do Panga, a natural reserve of the Brazilian savanna in Uberlândia, Minas Gerais. We established seven plots on each of five physiognomies of Cerrado (*cerrado ralo, cerrado típico, cerrado denso, cerradão distrófico, mata seca semidecidual*) and on a road that cross the reserve. During two years, we monitored all found nests of *P. oxyops*. We collected data on occurrence, emigration/death and establishment of nests. The food items retrieved by *P. oxyops* were surveyed by removing it from the mandibles of returning foragers from any nest out of the plots. Furthermore, as *P. oxyops* use their nests as pitfalls traps to improve their arthropod collection, we used pitfalls to collected arthropod that could be captured by this particular strategy. The activity schedule of the ants was determined by observing, for 3 minutes each 2 hour intervals throughout 24 hours, all individuals that went in and out from 3 different nests. This procedure was performed during rainy and dry seasons. There was no difference in *P. oxyops* occurrence among the areas studied. Penetrability of soil and grass cover does not explain its preference among habitats. Diet of *P. oxyops* consisted of many arthropods, mainly termites, other ants and collembola. Its rhythm of daily activity is essentially diurnal, with peaks of activity on crepuscular hours, but never ceasing the activity of colony. As no pattern of occurrence was observed, we can conclude that *P. oxyops* is an opportunistic and generalist species. (FAPEMIG, CNPq)

EFFECT OF CHEMICAL TRAIL ROTATION (180°) ON FORAGING IN *Atta sexdens*

M.S. BRUGGER[1,2], N. CALDATO[1], P.C. DIAS[1], L.C. SILVA[1], L.C. FORTI[1] & J.F.S. LOPES[2]

[1]Laboratório de Insetos Sociais-Praga, Departamento de Produção Vegetal, Universidade Estadual Paulista (UNESP), Rua José Barbosa de Barros, nº 1780 CEP: 18.610-307, Botucatu, SP, Brasil, e-mail: mbruggerbio@yahoo.com.br; [2]MirmecoLab, ICB, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brasil

Different gradients of pheromone concentration are used by insects to detect nestmates, brood, sexual partners and food source. Leaf-cutting ants use pheromones as their main communication channel, which suggest that chemical trails could present gradients of pheromone concentration to guide forager workers between colony and resource. Thus, a trail rotation must have effect on chemical trail laying and u-turn frequency and therefore on foragers flow. The effect of chemical trail rotation in 180° during the foraging was tested in *Atta sexdens* laboratory colonies connected a foraging source through glass bridges. This foraging path had 50 discs of *Acalypha wilckesiana* (0,5cm) and the bridges had 0,5, 1 and 2 m length. For the test bridges, after 50% of the discs had been transported, they were handled and rotated in 180°, so the edge of test bridges which were initially connected to the colony were then connected to the foraging patch and vice-versa. At the same way, the control bridges were handled, but without doing the rotation. We measured foragers flow and chemical trail laying and u-turn frequency for 5 min at three bench marks: at 10 cm from the colony exit, at the middle bridge and at 10 cm before foraging patch entrance. Registers were taken with 3 min intervals among each benchmark. We carried out a series of laboratory experiments - 10 tests and 10 control replicates - with 3 colonies for each bridge length (n = 180). OUT (outbound workers), INL (inbound laden) and INU (inbound unladen) flow data were analyzed by repeated measures ANOVA, to compare the trail handling effect (before and after), the trail laying frequency, the bridge length and the treatment (test or control) in each bench mark. The U-turn frequency was also analyzed by repeated measures ANOVA comparing the handling effect, bridge length and treatment. The bridge rotation exerts no effect over workers flow neither over u-turn frequency in any benchmark. The Workers flow variation among bridges length was random being not possible to establish a direct relationship between these variables. According to the expected, higher trail laying frequency results in higher worker flow in opposite direction. Our data suggests that *A. sexdens* chemical trail has no different gradients of pheromone concentration. (CNPq)

EFFECT OF PHYSICAL TRAILS' WIDTH OVER FORAGING IN *Acromyrmex subterraneus molestans*

J.F.S. LOPES[1], M.S. BRUGGER[2], I.N. HASTENREITER[1], T.A. SALES[1] & L.C. FORTI[2]

[1]Universidade Federal de Juiz de Fora – UFJF, PPG Ecologia, Rua José Lourenço Kelmer, s/n, Bairro São Pedro, Campus Universitário, 36036-900, Juiz de Fora, MG, Brasil, julianeflopes@yahoo.com.br, [2]Universidade Estadual Paulista "Júlio de Mesquita Filho", Botucatu, SP, Brasil.

To leaf cutting ants, the construction and maintenance of physical trails are associated with an energy cost arising from these activities. On the other hand, they promote information exchange about the food allocation among forager workers, because they restrict an area at the external environment where the workers transit between the nest and the food patch. Thus, physical trails are thought to have an optimum width to allow communication and avoid the truck-driver effect at the same time. The head-on collision rate, for example, is dependent not only on the workers' traffic, but also on their density along the trail. It means that for an identical flow, the foraging efficiency could increase as the trail width decreases. In order to verify the effect of three different trail widths (1, 2 and 3 cm) on the foraging, we used glass bridges to connect the fungus garden chamber to the foraging arena in three *Acromyrmex subterraneus molestans* laboratory colonies. We evaluated the workers' flow and the frequency of head-on collisions during the transport of a standard quantity of *Acalypha wilckesiana* leaves. The flow of laden and unladen foragers that were returning to the nest was not influenced by the trail width manipulation, and a marginal effect was found in the flow of foragers who left the nest. The highest flow of workers leaving the nest was verified for 2cm-width trail. Head-on collisions between workers leaving the nest with laden ones had a significant effect on the flow of workers that leave the nest. Data pointed out that the contact among workers by head-on collisions influences the recruitment of new individuals to forage independently of trail width. (CAPES-COFECUB, CNPq, UFJF)

EFFECT OF TRAIL ROUGHNESS ON LOAD MODULATION AND FORAGING PERFORMANCE IN *Acromyrmex subterraneus molestans*

L.F. RIBEIRO[1,2] & J.F.S. LOPES[2]

[1]Laboratório de Ecologia de Comunidades, Departamento de Entomologia, Universidade Federal de Viçosa (UFV), Av. P.H. Rolfs, s/n, CEP 36570-000 - MG, Brasil, e-mail: lailafribeiro@gmail.com. [2]Laboratório de Mirmecologia, Programa de Pós-graduação em Comportamento e Biologia Animal, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brasil

The foraging behavior in leaf-cutting ants covers different strategies selected to supplies nutritional requirements for the growth of symbiotic fungus, offspring development and consequently, for the colony. These ants stand out for the construction and maintenance of physical trails, which are true traffic avenues where a large contingent of workers carries leaf fragments. It is known that the movement along the physical trails can result in an increase of 4 to 10 times the foraging speed. Thus, paths with a high degree of roughness can result in a high-energy cost for load transport. In order to investigate the adjustment of the load carried by workers of *Acromyrmex subterraneus molestans* according trails with different degrees of roughness, and the consequences for foraging performance, the burden, mass and speed of 150 forager workers were measured in each treatment tested: (i) high roughness - gravel substrate, (ii) low roughness - sand substrate, (iii) zero roughness - smooth substrate. Furthermore, it was investigated the effect of time elapsed after recruitment on burden determination, speed and performance of the foragers. The manipulation of roughness caused different values of burden and walking speed, which were negatively correlated variables. Lower speed values were recorded in the gravel substrate, which were similar regardless of burden value. As a compensatory mechanism, foragers of all sizes increased their burden on this substrate, decreasing the negative effect of lower speed and maintaining the food delivery rate to the colony per unit of time. Beyond that, an expressive and differential allocation of large workers was observed foraging in this substrate. Confirming the efficiency of load adjust and allocation of large workers, the performance obtained in the gravel substrate was similar to that found in sand substrate, even considering the low speed values recorded. On the trails covered with sand, the walking speed of workers was intermediate to those recorded in trails without roughness (smooth substrate), and with high roughness (gravel substrate). Because the characteristics of the smooth substrate, speed and burden increased were not harmful, therefore the highest performance was found, compared with the other two substrates. In smooth substrate, larger burden was transported compared to sand, suggesting that an easiest locomotion in the smooth substrate allowed an increase of the load without loss of speed. Furthermore, there was a progressive increase in the burden in function of time elapsed after recruitment, which corroborates the hypothesis of information transfer. The results of roughness manipulation indicate the importance of physical trails cleaning to the foraging, and that the efficiency of leaves transport is dependent on the surface where the workers travel. (FAPEMIG, CAPES)

FACILITATION OR SELF STIMULATION: WHAT HAPPENS IN *Dinoponera quadriceps* WORKERS IN THE NATURAL ENVIRONMENT?

D.L.O. AZEVEDO, W.A. SILVA NETO & A. ARAÚJO

Laboratório de Biologia Comportamental, Programa de Pós-graduação em Psicobiologia, Departamento de Fisiologia, Centro de Biociências, Universidade Federal do Rio Grande do Norte, Av. Senador Salgado Filho, s/n, Lagoa Nova, Caixa Postal 1511, CEP 59078-970 – Natal, RN, Brasil, e-mail: dinalillia@gmail.com.

Group effect can be a change in behavior caused by non-directed signals neither in the space nor in time. The increase in an activity or behavioral response from the observation of other individuals making the same behavior is called social facilitation. *Dinoponera quadriceps* Santschi (Hymenoptera, Formicidae, Ponerinae) is a species whose foraging is solitary and there is no recruitment under any circumstance. From this information the question of this study arose: Does the return of a worker after foraging have any effect on the departure of others workers and the own worker that returned, and how long after the return could still there be such influence? We observed three colonies of *D. quadriceps*, in an area of secondary Atlantic Forest in FLONA-ICMBio of Nísia Floresta/RN. Each colony was observed for 20 days, 12 hours per day. The workers were individually marked and we recorded their timings of departure and return, and if they returned with or without food. From the data of the returns we counted how many different workers left the nest and whether the same worker left again, 5, 10 and 15 minutes after the return. Our results showed that returns with or without food and time have no effect on other workers. Foragers left the nest in the three considered situations, regardless of the return of the workers was successful or not. In relation to the departure of the same worker that returned, both the food and the time had an effect on the next departure. The same worker left again within 5 minutes when it had returned with food. The return without food was not a stimulus for a new exit. Therefore, we can infer that social facilitation does not take place on this species, since the arrival of a successful forager did not cause an increase in the movement of other foragers leaving the nest immediate in the time. However, we can also conclude that there is a self-stimulation of successful worker, which increases their outward movement to search for new food. (PRONEX-FAPESB/CNPq, CNPq, CAPES)

FORAGING ACTIVITY AND SURVIVAL RATE IN *Dinoponera quadriceps*

I.A. MEDEIROS & A. ARAÚJO

Universidade Federal do Rio Grande do Norte, Centro de Biociências, Programa de Pós-graduação em Psicobiologia, Caixa Postal 1511, Campus Universitário, Lagoa Nova, CEP: 59078-970, Natal, RN, Brasil, E-mail: ingridaraujo_88@hotmail.com.

Foragers face adverse environmental conditions. Therefore, foraging activity is considered risky when compared to activities performed within the colony in the natural environment. The aim of this study was to examine whether the survival rate of workers of *D. quadriceps* that remain inside the nest is different from individuals that leave the nest to forage under experimental conditions. For the study, three colonies of this species were collected in Natal, Rio Grande do Norte and transferred to the Laboratory of Behavioral Biology, at the Federal University of Rio Grande do Norte (UFRN). For this study we used only the workers that emerged in the laboratory, where we recorded the date of emergence and death, when it occurred. The workers were marked with numbered tags glued to the thorax to be identified. The colonies were observed three times a week, two hours per day of observation for each colony, in the period from March to October of 2012. The behavioral records were performed using the instantaneous sampling method with records every 15 minutes. These data were compared with the statistical test of Survival Analysis (T). 64% of 45 workers observed during the study never left the nest and 31% of these workers died during the experiment. 25% of 16 workers that sometime foraged died during the study. Foraging did not affect the survival rate of workers (T=0.041; p=0.840). This result could be expected, because the risk variables such as temperature, presence of predator, nutrition, are controlled in the laboratory and were not influencing the action of foragers. (CAPES, PRONEX-FAPESB/CNPq)

FORAGING STRATEGIES AND OPTIMIZATION IN *Dinoponera quadriceps*: PRELIMINARY RESULTS.

W.A. SILVA NETO[1], D.L.O. AZEVEDO[1] & A. ARAÚJO[1]

[1]Laboratório de Biologia Comportamental, Programa de Pós-graduação em Psicobiologia, Departamento de Fisiologia, Centro de Biociências, Universidade Federal do Rio Grande do Norte (UFRN), Av. Sen. Salgado Filho, s/n, Lagoa Nova, Caixa Postal 1511, CEP 59078-970 – Natal, RN, Brasil, e-mail: alvesneto@gmail.com.

The search for food is an activity of great relevance for the ecological success of animals. It is the energy obtained foraging that animals use to perform other important activities such as reproduction, territory defense and parental care. Selective pressures selected individuals performing foraging activity more efficiently, and this efficiency is directly influenced by decisions during foraging. This paper investigates the choices of paths for foraging by workers of *Dinoponera quadriceps* Santschi (Hymenoptera, Formicidae, Ponerinae) when confronted with different path lengths and reward probabilities. The study was conducted at the Laboratory of Behavioral Biology, Biosciences Center, at UFRN. In phase 1, each worker was observed for 10 trips. On each trip the animal could choose between the short path (2.5 m) and long path (5.0 m), and the food was always offered at the end of the path of each trip, regardless of the path choice. In phase 2, each worker made 10 trips, with two choices of paths. However, at this phase the workers had a 50% probability of food reward being offered at the end of each journey, regardless the path choice. Before the execution of each phase the colony was deprived of food for 2 days and the paths were opened so the workers could freely walk and get to know the paths. We recorded the decisions made by workers after each trip: return to the same path after a successful trip earlier, return to the same path after a failure in previous trip; shift the path after a successful trip earlier; shift the path after a failure in the previous trip; visits to the long and short paths. In both phases, there was no significant difference between the number of visits to the short and long paths. However, in both phases the number of returns to the same path after success was greater than the number of exchanges path past success ($p = 0.011$ and $p = 0.005$, respectively). There was also a larger number of exchanges after failure compared to the number of returns to a path after failure in the two phases ($p = 0.035$ and $p = 0.002$). Comparing the total number of exchanges paths between phase 1 and 2, it was seen that workers *D. quadriceps* exchanged over path in phase 2 compared to phase 1 ($p = 0.040$). These preliminary results indicate that foragers tend to return to the destination where they found food, or change the destination in the event of failure before. The frequencies of these decisions are related to the odds against food, suggesting an optimization of foraging. (PRONEX-FAPESB/CNPq, CAPES e CNPq)

IMMATURE RECOGNITION IN *Ectatomma brunneum* SMITH, 1858 (HYMENOPTERA: FORMICIDAE)

M.C. PEREIRA[1,2] & W.F. ANTONIALLI-JUNIOR[2]

[1]Programa de Pós Graduação em Entomologia e Conservação da Biodiversidade, Faculdade de Ciências Biológicas e Ambientais, Universidade Federal da Grande Dourados (UFGD), Rodovia Dourados – Itahum, Km 12, CEP 79.804-970 – Dourados, MS, Brasil, e-mail: marloncesarp@yahoo.com.br. [2]Laboratório de Ecologia, Universidade Estadual de Mato Grosso do Sul (UEMS), Dourados, MS, Brasil.

The ability of ants to distinguish their nest mates from those of other colonies is a key component to the great evolutionary success of the group. Through chemical signals all individuals should be able to recognize both adults and immatures of their own colony. The species *E. brunneum* belongs to subfamily Ectatomminae in which there is no morphological polyesthism in the worker caste, however, the behavioral repertoire changes with age, the so called age polyethism. Our work aimed to investigate if the workers of this species, regardless of age, are able to recognize immatures of their own colony over others. We collected 4 colonies of *E. brunneum* in the municipality of Dourados/MS. They were kept in artificial nests, in laboratory conditions under constant temperature and relative humidity and fed every 2 days with larvae of *Tenebrio molitor* and molasses and water *at libitum*. Workers were separated into 3 categories according to age: newly emerged, with up to 7 days, nurses, from 8 to 45 days, and foragers with more than 45 days. All workers were allocated in a glass arena in “T” format, in which each one could opt between a larva from their own colony at one end, and on the other, a larva from another colony. The results show that there is a specific group of workers with greater ability to recognize their immatures, since only one newly emerged was able to recognize her own immature with a time of 699s; nurses made the right choices 73% of the times with mean time of 240±118.7s, and foragers 20% with mean time of 317.3± 92.5s. It can be inferred, therefore, that the nurses, because they have more contact with immatures, have greater ability to recognize their chemical signals. On the other hand, newly emerged workers do not have all chemical composition of the colonial signature, therefore, they have difficulties to recognize these signs in immatures. In the same way, foragers spend most of the time outside of the colony, which diminishes this ability, since they have little contact with all immature stages. (CAPES, CNPq)

INTERNAL STRUCTURE OF REFUSE CHAMBERS AND NUTRITIONAL ASSESSMENT OF SOIL RELATED TO NESTS OF *Atta capiguara* Forel (HYMENOPTERA: FORMICIDAE)

P.C. DIAS[1], M.S. BRUGGER[1], R.V. TRAVAGLINI[2], N. CALDATO[2], L.C. SILVA[2] & L.C. FORTI[1-2]

[1]Universidade Estadual Paulista - UNESP, Instituto de Biociências – Botucatu, SP, Brasil, CEP 18618-970. Programa de Pós graduação em Ciências Biológicas/Zoologia; e-mail: gmmpa_2005@yahoo.com.br. [2]Universidade Estadual Paulista - UNESP, Faculdade de Ciências Agronômicas – Botucatu, SP, Brasil, CEP 186102-307. Programa de Pós graduação em Agronomia/Proteção de Plantas.

Leaf cutting ants of the genus *Atta* are social insects extremely important for humans and the environment, owning crucial role in nutrients flow. They build underground chambers to deposit waste, contributing to a substantial increase in the concentration of nutrients and soil penetrability. The aims of this study were to describe the internal structure of refuse chambers and evaluate nutritionally the soil related to nest, in order to support studies on the beneficial effects of this species to the habitat in which they live. For this, three adult colonies of *Atta capiguara* were dug, the exhausted fungal substrate was collected and refuse chambers sized. In the first nest, two refuse chambers were dug, with length of 1,13 and 0,8m respectively and average depth of 2m. The first chamber was empty and the second contained 51,73 kg of waste. In the second nest, nine refuse chambers were dug with length ranging from 0,41 to 1,29 m, depth ranging from 1 to 1,6 m, and 0,11 kg, 5,8 kg, 1,03 kg, 35 kg, 2,13 kg, 0 kg, 7,85 kg, 8,4 kg and 6,7 kg of waste, respectively. In the third nest, seven refuse chambers were dug with length ranging from 0,3 to 2,2 m, depth 1,72 to 3,9 m, and respectively; 393,7 kg, 0 kg, 333 kg, 133 kg, 38,6 kg, 0 kg and 13 kg of trash. All excavated chambers, being of the same species, had the same conical shape, with earlier narrow (duct) and wider base (chamber). While opening the chambers of the third nest, composite soil samples were collected for measuring pH value and nutritional assessment of soil (calcium chloride, aluminum, potassium, calcium, magnesium, sulfur, boron, copper, iron, manganese and zinc). The samples were collected on the following regions: below the mound, and 1,5m from this, and on refuse chambers basis and 1,5m from theses, in the same depth. The pH value was statistically similar for all samples, with a value of 4.25 (considered very low). From all assessed nutrients, only potassium, calcium, magnesium and sulfur had a significant concentration increase in soil inside the chambers compared to the soil located 1.5 m away from them. The other nutrients had similar concentrations in both regions. The initial hypothesis that the soil located just below the chambers has higher concentration of nutrients than the soil around it was confirmed, indicating that nutrients not used by the fungus garden and are still in the exhausted leaves lodged in the waste are reincorporated to the soil, leading to enrichment of this and facilitating access of vegetation adjacent to these critical nutrients. (FAPESP)

LABORATORY OBSERVATION OF FORAGING BEHAVIOR OF *Atta sexdens rubropilosa* (MYRMICINAE, ATTINI)

R.V. TRAVAGLINI[1], N. CALDATO[2], M.I.B. ALVES[1], L.C. SILVA[1], P.C. DIAS[1], & L.C. FORTI[1]

[1]Laboratório de Insetos Sociais Praga - LISP, Departamento de Produção vegetal, Faculdade de Ciências Agronômicas – FCA – UNESP, Fazenda Lageado, CEP: 18.610-307 - Botucatu, SP – Brasil, Telefone: (14) 3880-7100 email: raphaeltravaglini@fca.unesp.br

Leaf-cutter ants are common pests that create economic harm to the agriculture. As a control measure, granulated baits and micro-bait-holders made of citrus pulp are used in forests to avoid these ants from damaging plant leaves. To better understanding foraging behavior of leaf-cutter ants, current experiment was designed using colonies of *Atta sexdens rubropilosa*. Rectangular glass table (Area 2.15 m x 0.95 cm) was used and edges were covered with glass frame and sealed with fluon to prevent the leakage (1.51 m above the ground) to observe the behavioral acts of ants during encountering leaves, cutting and carrying back to the colony. Three colonies of *Atta sexdens rubropilosa* were connected to the inner glass frame of the table with the transparent hoses containing grooves for better grips during ants' movement. Leaves substrate of *Acalypha wilkesiana, Gmelina arborea, Rosa* sp. and *Ligustrum japonicum* were placed on the inner glass frame (one meter) opposite to the transparent hoses. Behind this outlet was positioned a dark cardstock 0.5 m² guidance to assist the ants workers. Colonies used in the experiment contained one year old active garden-litter fungi. Based on the hypothesis of random walk, path followed by the worker ants also called "scout" that finds leaves first were analyzed using overhead projector pen, chronometer and curvimeter. Distance traveled from end of hoses to leaves and back and the time spent in each stage were recorded. Fifteen repetitions for each colony were performed. The amount of total time required for foraging the leaves and back was longest at the first attempt but decreased with the increasing repetitions. The longest time was 4hs23min and the shortest time was 19 min. The average time for the "scouts" found the leaves was 7min20sec with an average speed of 0.585 m / min. On the other hand, the average time to carry leaf to the nest was 2min20sec with an average speed of about 0.606 m / min. Results show that ants require longer time to search for the leaves and shorter time to get it back to their colonies. However their velocity remains relatively same irrespective of the foraging behavioral changes. The speeds not differ by Tukey test at 5% probability. (CNPq)

MULTIPLE STRATEGIES IN THE SELECTION OF TRACKS BY LEAF CUTTER ANT UNDER INFORMATION CONFLICT

D.V. CARMO[1,2], A.C RÖDDE[3], P.L. RIBEIRO[2,4] & A.F. HELENE[1,2]

[1]Laboratório de Ciências da Cognição, Departamento de Fisiologia, Instituto de Biociências, Universidade de São Paulo (USP), Rua do Matão 101, Cidade Universitária, CEP 05508-900 – São Paulo, SP, Brasil, e-mail: danivictoratti@usp.br. [2]Programa de Pós Graduação em Fisiologia Geral, Universidade de São Paulo, São Paulo, SP, Brasil. [3] Laboratório de Biologia Molecular, Centro Ciências da Saúde, Universidade do Vale do Rio dos Sinos, Av. Unisinos, 950, Bairro Cristo Rei, CEP: 93.022-000 - São Leopoldo, RS, Brasil, [4]Laboratório de Ecofisiologia Departamento de Fisiologia, Instituto de Biociências, Universidade de São Paulo (USP), Rua do Matão 101, Cidade Universitária, CEP 05508-900 – São Paulo, SP, Brasil.

Different studies have investigated the importance of the information given by a pheromone trail in contrast to other information, such as the use of environmental cues or egocentric strategies. The present study aimed to evaluate the decision-making in a conflict condition between the information given by pheromones and those given by the previous experience on the maze (such as the use of environmental cues or strategies egocentric). For this study, one colony of leaf cutter ants *Atta sexdens rubropilosa* was connected to a Y-shaped maze. The first stage involves the training of the ants on the maze. Leaves were offered in the end of only one of the Y arms for two hours. At the end of this stage were collected eleven workers that were carrying leaves to the nest - trained ants (TA). In the same moment, eleven ants that had not been exposed to the maze were also collected - untrained ants (UA). To avoid the marked trails, all the system was changed. In the stage 2, on the opposite arm was offered leaves, establishing a new track foraging. Therefore, a pheromone natural deposition trail was created in the opposite arm that TA ants was trained. Then, the ants were removed and the maze was closed. In the third stage, was carried out the test, in which there was conflicting information: the pheromone foraging trail was in the opposite arm of the trained trail, for the TA. The maze was separated from the colony and TA and UA were placed in the Y maze and their behavior until the choose, or not, of one of arms was observed. In the linear movement the worker passed in the maze without pause and not displayed exploratory behavior; In the non-linear movement the ant stayed a period exploring the initial part of the Y maze and after passed it. The results shown that TA moved linearly through the maze they passed in the first part that did not have the pheromone and chosen directly one of the arms on 68.2% ($p=0.0407$, binomial test) while UA showed random movement (linear 54.5%, 45.5% non-linear, $p=0.1542$) through the maze. In a Factorial ANOVA (dependents variable: number of individuals; factors: TA, UA and arm choose), considering arms and training, was not observed effects ($p>0.05$) of arm (marked x unmarked) and training (TA and UA) but an effect of interaction of arm and training ($p=0.0369$). Interestingly, TA ants showed a preference for the marked arm and UA for unmarked arm. Therefore, the pheromones appear to be more attractive to TA than the UA. It is also possible to conclude that the train in a foraging task favors decision-make to find food in a situation where there is information conflict. (CAPES, FAPESP)

MYGRATORY ACTIVITY OF *Acromyrmex crassispinus* (HYMENOPTERA: FORMICIDAE).

M.F.O. MARTINS[1,2], W.R. FILHO[1,3], S.R.C. PENTEADO[1] & M.A. NICKELE[4]

[1]Laboratório de Entomologia, Embrapa Florestas, Estrada da Ribeira, km 111, Jardim Cristina, Caixa Postal 319, CEP: 83411-000, Colombo, PR, Brasil, e-mail: milafomartins@hotmail.com. [2]FUNCEMA- Fundo Nacional de Combate à Pragas Florestais, Colombo, PR. [3]EPAGRI- Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, Florianópolis, SC. [4]Universidade Federal do Paraná, Curitiba, PR.

The migratory activity has been described as a common phenomenon for some ant species. For leaf-cutting ants, colony migration is a poorly studied phenomenon, however ants belonging to genus *Acromyrmex* can emigrate easier than *Atta* species, because their nests have few chambers, being more superficial and smaller than *Atta* nests. The colony migration in *Acromyrmex* genus, has been observed for *Acromyrmex octospinosus*, in Paraguay, reaching 60 meters away, and the same distance was observed for one nest of *A. crassispinus*. The factors that triggered the migration were attributed to natural phenomena, such as flooding, competitive pressure between colonies or attributed to human interferences during soil preparation and leaf-cutting ants control activities. The recognition of a nest that the colony emigrated to a new location is important, because is possible to distinguish from a controlled nest (dead) with applications of insecticides. A controlled nest has decomposed fungus or dead ants, while the nest that colony emigrated is left empty. In June 17, 2013, at Embrapa Florestas area, Colombo-PR, it was observed the emigration of a colony of *Acromyrmex crassispinus*. The distance between the original and the new nest was 80 meters. The original nest had 1.10 x 0.87m in diameter and, the new nest had 1.08 x 0.87m, maintaining the same proportions in diameter. The observations were carried out only during the day and the migratory activity had duration of two days. There was no observation of transportation of pieces of the fungus garden, larvae and pupas during observations. It is possible that the transport of the fungus and brood took place at night. But, it was verified, yet, a great number of minor workers carried by major workers. Colony migration probably occurred because of rainfall in the previous day of observation (33.4 mm), which may have saturated the soil. However, further studies are needed to better elucidate the causes of this migration, whereas fifteen days before, precipitation was high (28.6 mm) followed by a dry period (4.2 mm, of fourteen days) and after migration there was a rainy period (269.2 mm distributed along 12 days). This fact raises a hypothesis that *A. crassispinus* can "predict" the occurrence of wet periods, but this mechanism was not recognized on this occasion.

NEST MAINTENANCE ACTIVITY OF *Dinoponera quadriceps* IN NATURAL ENVIRONMENT

J.C. MEDEIROS[1,2], D.L.O. AZEVEDO[1,2], M.A.D. SANTANA[1,2], T.R.P. LOPES[1] & A. ARAÚJO[1,2]

[1]Laboratório de Biologia Comportamental, Departamento de Fisiologia, Centro de Biociências, Universidade Federal do Rio Grande do Norte (UFRN), Av. Senador Salgado Filho, s/n, CEP 59078-970 - Natal, RN, Brasil, e-mail: jeniffercm@gmail.com. [2]Programa de Pós-graduação em Psicobiologia, Universidade Federal do Rio Grande do Norte, Natal, RN, Brasil.

Environmental changes over time occur in any habitat. Some changes in environmental conditions occur regularly in predictable cycles, just as the daily and seasonal variations. Animals respond to such variations adjusting their behavior to these cycles. This study characterizes the nest maintenance activity of the queenless ant *Dinoponera quadriceps* (Santschi) (Hymenoptera: Formicidae: Ponerinae) in its natural environment and determine the effect of environmental variables on both seasonal and daily rhythmic variations. Four colonies of *D. quadriceps* were observed in an area of secondary Atlantic forest in northeastern Brazil. Data collection was performed over 72 hours every three months during an annual cycle. Each colony was observed continuously for 20 min/h, when all workers leaving or entering the nest were recorded. Those workers that left the nest carrying sand or waste and returned within two minutes were considered to be engaged in nest maintenance activity. Colonies of *D. quadriceps* exhibited seasonal variation in nest maintenance activity, which began to increase in the late dry season, peaked in the early rainy season and suddenly declined in the end of this season. The seasonality of nest maintenance was mainly generated by the variation of this activity during the light phase of the day. Nest maintenance activity at night did not vary significantly over the year. The seasonal rhythm of nest maintenance was positively related to relative humidity and negatively related to prey availability, but colony differences also explained part of the variance within a given environmental condition. In the months when the maintenance activity was low, there was no difference between the phases of the day on the number of workers involved in this task. However, in May, early rainy season, when nest maintenance was more intense, it was predominantly diurnal. The daily rhythm of nest maintenance activity in the early rainy season was positively influenced by temperature and again colony differences explained part of the variance within a given environmental condition. Our results indicate that *D. quadriceps* workers adjust their nest maintenance activity both in seasonal and in daily scales according to environmental conditions. Nest maintenance activity increases in months with higher humidity and lower prey availability. In months with high frequency of nest maintenance, this activity is distributed throughout the daily cycle according to temperature conditions. (PRONEX-FAPESB/CNPq, CNPq, CAPES)

NOTES ON THE BIOLOGY OF BRAZILIAN ANT POPULATIONS OF THE *Pachycondyla foetida* SPECIES COMPLEX (FORMICIDAE: PONERINAE)

I.O. FERNANDES[1], M.L. DE OLIVEIRA[1] & J.H.C. DELABIE[2]

[1]Programa de Pós-Graduação em Entomologia – PPGENT. Instituto Nacional de Pesquisas da Amazônia – INPA. Av. André Araújo, 2936. Petrópolis, CEP 69.067-375, Cx. Postal 2223. Manaus, AM, Brasil, e-mail: itanna.fernandes@gmail.com. [2]Centro de Pesquisas do Cacau (CEPEC), Laboratório de Mirmecologia, UESC/CEPLAC, Ilhéus, BA, Brasil.

The reproductive structure in the ant genus *Pachycondyla* varies widely and the aggressiveness seems to be an important factor in structuring the organization and reproductive division in the colony. The aim of this study was to add information about the natural history of Brazilian populations of the *Pachycondyla foetida* species complex, with data about nesting sites, foraging schedules, nuptial flight period, and reproductive organization in the colony. Three species of the complex *P. foetida* were observed and collected in three Brazilian localities. Further observations were performed in the laboratory under controlled temperature (26° C) and relative humidity (60% ± 30%). Nests were kept in incubators BOD within plastic trays. A total of 67 ants, 41 workers, 25 males and one queen of *P. villosa* were collected in Itacoatiara city, on state of Amazonas. A total of 95 individuals, with 85 workers, nine males and one queen of *P. curvinodis* were obtained in Campinas city, in the Mata of the Santa Genebra, on the state of São Paulo. The nest with two queens of *P. inversa* was collected near Manaus city, in Adolpho Ducke Forest Reserve, on state of Amazonas. This study added information about *P. inversa*, including nesting sites, the social hierarchy system, mediated by aggressive interactions, the relationship of dominance and subordination, and the founding of nests by two queens (pleometrosis) resulting in secondary monogyny, and oophagy (egg cannibalism). We also added information about nesting sites, foraging schedules, and nuptial flight period for *P. villosa* (October), *P. inversa* (August) and *P. curvinodis* (November). Species such as *P. curvinodis* and *P. inversa* showed less aggressiveness compared to *P. villosa*. We observed a variation in the tegument of the legs and gaster (black or yellow color) of *P. curvinodis* males. The occurrence of males in nests of *P. inversa* and *P. curvinodis* also allowed the description of males. In ants, biological studies are especially important to complete the information aiming to identify species belonging to unresolved or confused taxa. Such observations allowed the inclusion of biological data to the group, something that preserved specimens in collections do not reveal.
CAPES, SECTI/FAPESB-CNPq PRONEX)

QUANTIFICATION OF CASTES IN THE WASTE OF *Atta sexdens* (HYMENOPTERA: FORMICIDAE)

F.G. LACERDA[1], T.M.C. DELLA LUCIA[2] & L.M. SOUZA[3]

[1]Universidade Federal do Espírito Santo, Alto Universitário, s/n, Guararema, CEP 29500-000, Alegre, ES, Brasil. e-mail: lacerdafg@gmail.com. [2]Universidade Federal de Viçosa, Viçosa, MG, Brasil. [3]Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brasil

The waste of leaf-cutting ant colonies consists of old fungus garden, dry leaves and corpses of dead workers. This material can be hazardous to the colony, given that it can harbor entomopathogenic fungi and antagonist fungi of the mutualistic fungus of the ants. The present study aimed to quantify worker castes prevalent in waste material of *Atta sexdens* colonies. Four laboratory colonies kept at 25 ± 2° C, 75 + 3% RH and 12 h photophase, were used in this experiment. Waste of the colonies material was weighed and caste quantification was based on a sample of 20% of the waste mass per colony. Workers were categorized according to head capsule widths: gardeners or minima workers (0.6-1.2 mm); generalists (1.3-1.6 mm); foragers (1.7-2.4 mm); soldiers (>3.0 mm). The predominant caste in waste of the colonies was the gardeners (68%). The function of this caste in the waste would be, possibly, the rearrangement of small pieces of refuse material. However, there may be other yet unknown functions of these minute workers in the trash. The second most abundant caste was the generalist workers (21%), followed by foragers (10%) and soldiers (1%). The function of the medium-sized worker (generalist and foragers) is the rearrangement of garbage fragments, since it is not interesting for the colony that waste stays spread facilitating the spread of diseases. Such workers are also involved in the transport of waste to the outside of the fungus garden. Soldiers are the less abundant caste, both in the waste and in the rest of the colony, because producing large size workers involves high costs for the colony. Low frequency of this caste in the waste may be due to the fact that at this location there is no great need for their presence, since it is unlikely bodies intruders from entering this compartment. Therefore, the existence of various castes engaged in tasks related to garbage demonstrates an apparent efficiency of workers of *A. sexdens* in dealing with the waste material, isolating it from the fungus garden, since it constitutes a risk of diseases to the colony. (CAPES, CNPq–grant #474819/2006-0)

RECURRENCE ANALYSIS OF ANT MOVEMENT PATTERNS

F.M. NEVES[1], M.R. PIE[1] & R.L. VIANA[2]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Departamento de Zoologia, Universidade Federal do Paraná (UFPR), Av. Cel. Francisco H. dos Santos, 210, CEP 81531-980 – Curitiba, PR, Brazil, Email: fmarcelneves@ufpr.br. [2]Laboratório de Física Teórica Computacional, Departamento de Física, Universidade Federal do Paraná (UFPR), Av. Cel. Francisco H. dos Santos, 210, CEP 81531-990 – Curitiba, PR, Brazil.

Eusocial insects are ideal model organisms to study emergent temporal-spatial patterns that are characteristic of many complex systems. Ants, in particular, have considerable variation in social, morphological, ecological and behavioral traits at the colony-level across different species. Emergent processes of self-organization can be recognized and there is empirical evidence for collective synchronization of group activities. In this study we use individual tracking methods to investigate the dynamics of movement (displacement, angle and activity/non-activity) presented by workers in species that differ with respect to their morphological, behavioral and social traits. Three ant species were studied: *Gnamptogenys striatula* Mayr 1884, *Linepithema micans* (Forel) and *Pheidole* sp. (majors and minors workers). For a comparison with non-social insects, we used the beetle *Tenebrio molitor* Linnaeus 1758, a beetle species with gregarious behavior. In the experiments were used different numbers of workers (1, 4 and 16 individuals) with 30 replies in each different density. We used digital video recordings and computational software to extract x-y coordinates of individuals (N= 3150 time series and 7402500 frames) moving along a two-dimensional plane. Recurrence analyses were used to quantify the dynamics (e.g. chaotic or periodic) in each time series and have been successful used to observe, interpret and correlate complex patterns in different systems. The results demonstrate different dynamic patterns of time series of movements between and within species (i.e., the case of the dimorphic worker caste of the genus *Pheidole*) correlated with the biology of the species and castes. Our results also indicate a tendency for increasing complexity in activity patterns resulting from an increase in worker density. (CNPq)

REPRODUCTIVE PHENOLOGY OF *Pachycondyla* (FORMICIDAE, PONERINAE) IN URBAN AREAS IN THE CITY OF SÃO PAULO

S. CANTONE[1] & A.E.C. CAMPOS[1]

[1]Instituto Biológico, Av. Conselheiro Rodrigues Alves, 1252. São Paulo, SP, 04014-002. E-mail: cantonestefano@gmail.com

Pachycondyla is found in tropical and subtropical ecosystems, in natural, rural and urban environments. Nuptial flights have been observed in the city of São Paulo especially in the dry season. In order to know which species of *Pachycondyla* use the urban area to reproduce, urban parks and terraces of tall buildings (between 45 m and 80 m height) were investigated. The buildings were chosen as study sites, as Instituto Biológico receives complaints on winged females painfully stinging people. For the study, we evaluated 13 parks located in the southern, central and northern regions of the city, where active collections were made for poneromorph ants. In a building at the south region of the city visits were made when the owner informed about the presence of ant winged females. On a second building in the north region of the city, a light trap was installed and insects were collected weekly. The trap was placed in October 2012 and weekly collections were made until August 2013. In parallel with the field collections it was provided an artificial rearing of *P. striata* in boxes of 50 cm x 30 cm, comprising substrate and 30 inseminated females in each box in order to monitor the period of formation of alate throughout the year. The species found in the parks were workers of *P. striata* and *P. marginata*. Between July 10 and September 6, 2012 there was a series of nuptial flights of *P. striata* and *P. harpax* around midday. In particular, on August 28, 2012, hundreds of winged individuals of *P. striata* and *P. harpax* in the terraces of both buildings were observed. Coincidently on August 28, 2013 the same phenomenon occurred. In the rearing experiment males were observed in April 22, 2013 and May 6, 2013 and subsequently on days 1, 8 e 9 August 2013 males and winged females were registered. In the light trap it was recorded a large number of winged *P. striata* in August, 2013 (> 90 specimens), especially in the last weeks of the month. *P. laevigata* made nuptial flights from December, 2012 to June, 2013, but few individuals were collected (≤ 4 specimens). *P. unidentata* nuptial flights were registered from November, 2012 to June, 2013 except for the month of December, 2012 (≤ 8 specimens). The reproductive phenology will be accompanied by a further period of twelve months for registration of nuptial flights and compared with the first year of collection. (CAPES)

SUBSTRATE PREPARATION AND INCORPORATION INTO FUNGUS GARDENS OF *Atta sexdens rubropilosa* Forel (HYMENOPTERA: FORMICIDAE)

L.C. SILVA[1], L.C. FORTI[1,2], R.V. TRAVAGLINI[1], M.B. SILVA[1,2], N. CALDATO[1] & P.C. DIAS[1,2].

[1]Laboratório de Insetos Sociais-Pragas (LISP) – Faculdade de Ciências Agronômicas, Universidade Estadual Paulista (FCA-UNESP), Departamento de Proteção Vegetal Programa de Pós -Graduação em Agronomia – Proteção de Plantas, Rua Dr. José Barbosa de Barros, 1780, CEP 186102-307 – Botucatu, SP, Brasil, e-mail: lais@agronoma.eng.br. [2]Programa de Pós-Graduação - Ciências Biológicas- Zoologia - Instituto de Biociências, Distrito de Rubião Junior S/N, CEP 18618-970 - Botucatu, SP, Brasil.

Leaf-cutter ants live in association with symbiotic fungus that provides a complement to the colony proper nutrition by being the main food source for the larvae, as well as part of the diet of adults. The substrate used for growing the fungus is preferably green leaves, although other parts of vegetable origin are also used. The objective of this study was to observe the behavioral repertoire of *Atta sexdens rubropilosa* Forel (Hymenoptera: Formicidae) during the preparation and incorporation of the substrate and the participation of each caste in those tasks. Observations were made under a stereomicroscope in three colonies, and in each of six observations were made (five hours each), totaling 30 hours of observation per colony. In one of the colonies used in the experiment, a sample of 50 ants of varying sizes was previously removed for measuring the greatest width of the head through a stereomicroscope equipped with an ocular micrometer, after being measured capsules were stored in 70% alcohol. Subsequently the sample was classified and defined castes. The substrate offered to the colonies, was leaves of *Citrus* sp. cut into disks of 63.58 mm^2. Fifteen disks were offered to each colony and the observations were started from the moment the first disk was carried or the fungus garden. Eight behavioral acts were recorded for the three castes found in the colonies, with the following frequencies: (1) Transporting leaf disc to the surface of the fungus garden (3.39%), (2) Holding the leaf disks (5.9%), (3) licking the surface and edges (38.9%) (4) Perforating disks into smaller fragments (12.5%) (5) Pressing edges (17.7%) (6) Depositing fecal fluid (2.9%) (7) Incorporating the fungus garden (12.1%) (8) Depositing on fungal hyphae fragments incorporated (6.6%). The behavior most frequently performed by all castes was licking, each caste had different contributions to the implementation of this behavior. The planters were responsible for 61.6% execution of this task, the generalist 25.0% and 13.3% forage. To lick the substrate feed the workers and at the same time perform aseptic even eliminating microorganisms that can harm the symbiotic fungus. (CAPES)

TEMPORAL ASPECTS OF THE COLLECTIVE ORGANIZATION OF FORAGING IN THE LEAF-CUTTING ANT *Atta sexdens rubropilosa*

M.A.F. TOLEDO[1], P.L. RIBEIRO[1] & A.F. HELENE[1]

[1]Departamento de Fisiologia, Instituto de Biociências, Universidade de São Paulo (USP), Rua do Matão, Travessa 14, 321; São Paulo, SP, Brasil, e-mail: toledo.marcelo@usp.br

Leaf-cutting ants foraging trails are highly organized. From the trail formation and maintenance mechanisms to the task allocation concerning polymorphic ants, they reflect the typical complexity of eusocial organisms. In this scenario it's particularly challenging to identify the relationship between what is seen in individual behavior particular of ants of a given size, and the global collective patterns observed in the colony. One of the aspects involved in the interplay between task allocation concerning ants polymorphism and foraging trail organization and maintenance is the temporal organization of the activity by ants of different size. In the case of *Atta sexdens*, despite the widely known importance of polymorphism in division of labor, its role in determining the temporal activity patterns has not been investigated. It's a matter of major interest in foraging trails, considered the perspective that soldiers, which are big ants patrolling trails, perform a task whose demand is time constant, at least in non adverse conditions, while medias are largely responsible for foraging, which has preferential time for performance. In order to access if workers of different size differ among their respective temporal activity patterns in trails, we video recorded a 10 cm length of a laboratory captive colony foraging trail, under a set photoperiod, and controlled temperature. By the development of a computational video analysis tool, we could later on count the ants and measure each of them. In six days we did track more than two hundred thousand ant trips through the recording area of the trail. The following results may be highlighted: (i) trail activity is more intense during darkness than during light (binomial, $p < 0.01$) ; (ii) activity intensity within each phase is not uniform in time (Kolmogorov-Smirnov, light: $K = 0.0714$, $p < 10e-17$, dark: $K = 0.1269$, $p < 10e-17$, showing phase anticipation related transients, despite the absence of twilight in the experiment; (iii) ants of different size distinguish among their temporal activity distributions (Kolmogorov-Smirnov, $K = 0.0606$, $p = 7.4365e-17$), although not as the previously stated expectations; (iv) a global consequence of the temporal difference in activity between groups of ants of different size can be seen in the mean ant size variation observed throughout the experiment (multiple regression, $r^2 = 0.3562$, $F = 142.7369$, $p < 0.05$) . This observed differences of temporal activity patterns among ants of different size may result from endogenous rhythm mechanisms, and or from behavioral mechanisms of division of labor based in differential response thresholds. As for the general trail activity, although we have observed its peak during darkness, others have shown it moving from daylight to darkness in greater time spans.

THE BEST OF HEAVY QUEENS: INFLUENCE OF INITIAL WEIGHT ON THE COLONY PRODUCTIVITY AND MORTALITY IN *Acromyrmex* (FORMICIDAE)

T.A. SALES[1,2], N.G. ALMEIDA[2], I.N. HASTENREITER[1,2] & J.F.S. LOPES[1,2]

[1]Programa de Pós-graduação em Ecologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, Rua José Lourenço Kelmer, s/n, Campus Universitário – São Pedro, CEP 36036-330, Juiz de Fora, MG, Brasil, e-mail: tatiane.archanjo@gmail.com. [2]Mirmecolab, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, MG, Brasil.

During the colony founding, the high mortality rate is assigned to factors like predation, competition and adverse climatic conditions. Within this perspective we can argue if there are intrinsic differences among these mated queens that lead to a successfully new colony founding. This subject is especially true if we consider that females' size is often associated with their fitness, so that larger females have greater chances of having larger and/or more numerous offspring and higher probability of survival during the establishment of new colonies. Thus, this study investigated the mortality rate of *Acromyrmex* queens during the colony founding and the beginning of the period ergonomic, as well as whether there was relationship between the deaths and the colony productivity with the queens' weight. Sampling occurred after the nuptial flight in two consecutive years (2011 and 2012). Queens were kept in laboratory, inside individualized containers, under controlled temperature and humidity (25ºC – 80%). The mortality, weight of the queens and colonies' productivity (number of eggs, larvae, pupae and workers) were checked weekly until 14th week after the nuptial flight. Productivity data refer only to the year 2011. In two years were collected 1,134 queens, with 45% of deaths registered until the first week after the collect. After the second week, the percentage of deaths was comparatively low, ranging between 0.5 and 5.0%. At the end of 14th week, 39% of the colonies had survived. For these colonies was verified a not significant correlation between the productivity and the initial queens weight (Pearson: $t = -0.38$, $df = 92$, $p = 0.69$). Considering all the sampled queens, their weight ranged between 0.0229 and 0.0598g. Actually, the comparison between the initial weight of queens who died with the ones who survived until the end of the observations, showed that the number of deaths was greater for the lighter ones ($W= 141144.5$; $p = 0.002$). Obtained results could be considered as a reflex of the reproductive strategy of colonies, in which a massive number of sexual individuals are produced. So the investment is done at the quantity, producing a high variation of weight. The death of the lighter queens reduces the weight variation and can explains why there was no correlation between the initial weight of the queens and productivity in terms of ergonomic growth. Still, the high mortality in the first week could be assigned to intrinsic factors of the queens, like weight, since factors like predation, competition, adverse climatic conditions were eliminated. (PGECOL-UFJF)

THERMAL LIMITS FOR FORAGING IN ANTS *Atta sexdens rubropilosa* (MYRMICINAE, ATTINI)

P.L. RIBEIRO[1], A.C. DA SILVA[1], A.F. HELENE[2] & C.A. NAVAS[1]

[1]Laboratório de Ecofisologia do Instituto de Biociências da Universidade de São Paulo, (USP). Rua do matão Tv 14, CEP 05508-900 - São Paulo, SP, Brasil, e-mail pedrolribeiro@gmail.com; [2]Laboratório das Ciências da Cognição do Instituto de Biociências, Universidade de São Paulo, São Paulo, SP, Brasil.

The morphological differentiation associated with behavior provides an intricate relationship between individual and collective behavior, and understanding the colony as a single organism, or super-organism, becomes necessary. The perception that in addition to morphological differences may exist physiological differentiation may add a new dimension to the division of tasks in *Atta*. Regarding thermal physiology, most workers of adult *Atta* colonies are never exposed to temperatures near their limits, but foraging requires exposure to unprotected surfaces in at least some individuals. To understand the influence of environmental temperature on the foraging activity of *Atta* ants, this study investigated the relationship between temperature and foraging intensity (experiment 1); and the possible differences in the thermal tolerance of workers that foraged at high (38ºC) and low temperatures (8°C) (experiment 2). Both experiments were performed in a thermally controlled foraging arena on which food was provided. In Experiment 1 the temperature of the foraging trail started at 25°C and increased at a rate of 1°C per minute to approximately 40ºC. The response variable quantified during this experiment was the amount of food-carrying ants returning to the colony per a given time interval. The same protocol was applied to a cold trail in which the initial temperature of 25ºC decreased to 10ºC. In Experiment 2 (maximum critical temperature) ants were collected while foraging at extreme low and high temperatures (8ºC and 38ºC, respectively), creating two groups of ants that had individual body mass and maximum critical temperature assessed. The maximum and minimum temperatures for foraging activity were 38°C and 8ºC. The intensity of foraging was positively related to temperature between 10°C and 25°C ($N = 40$; $r = 0.69$; $p < 0.001$) and negatively related between 25°C and 40°C $N = 69$; $r = -0.57$; $p < 0,001$). However, critical maximum temperature ($N = 80$; t test = 0,26; $p <0.05$) and body mass of workers ($N = 80$; t test = 0.87; $p<0.05$) were similar for ants foraging at 8ºC and 38ºC. Therefore, the thermal limits for foraging are likely close to the physiological limits. Physiological variation may not be an issue in the division of labor, but this subject requires further investigation. (FAPESP, CAPES)

TIME PASSES, THE TASK CHANGES: THE CASE OF *Dinoponera quadriceps*

I.A. MEDEIROS[1] & A. ARAÚJO[1]

[1]Universidade Federal do Rio Grande do Norte, Centro de Biociências, Programa de Pós-graduação em Psicobiologia, Caixa Postal 1511, Campus Universitário, Lagoa Nova, CEP: 59078-970, Natal, RN, Brasil, E-mail: ingridaraujo_88@hotmail.com.

The division of tasks between individuals and groups of individuals is seen as a determining factor for the ecological success of social insects, because it contributes to the optimization of activities and thus influences the survival and success of the colony. Thus, the aim of this study was to examine whether the distribution of tasks changes depending on the age of the workers of *Dinoponera quadriceps*. For the study three colonies of this species were collected in Natal, Rio Grande do Norte and transferred to the Laboratory of Behavioral Biology, at the Federal University of Rio Grande do Norte (UFRN). For this experiment we used only workers that emerged in the laboratory, and these were marked with numbered tags glued to the thorax. The workers were followed for five months, and observations were made three times a week with two hours of observation for each colony, between March and October of 2012. The behavioral records were performed using the instantaneous sampling method with records every 15 minutes. In this study we emphasized the behavioral categories: foraging tasks, immature care, defense and nest maintenance. The behaviors were analyzed with ANOVA for repeated measures and the Friedman test (data did not have normal distribution). When comparing each activity between months, we noted that maintenance was similar ($\chi^2_F(4) = 6.71$; $p = 0.152$), unlike the other activities, such as, caring ($F(2.93, 85.03) = 18.11$; $p < 0.001$), foraging ($\chi^2_F(4) = 12.87$; $p = 0.012$) and defense ($\chi^2_F(4) = 39.90$; $p< 0.001$). The test to see if the activities differ between them at different ages showed a significant difference for all months: 1^0 month ($\chi^2_F(3) = 79.82$; $p < 0.001$), 2^0 month ($\chi^2_F(3) = 79.45$; $p < 0.001$), 3^0 month ($\chi^2_F(3) = 65.04$; $p < 0.001$), 4^0 month ($\chi^2_F(3) = 57.02$; $p < 0.001$) 5^0 month ($\chi^2_F(3) = 44.96$; $p < 0.001$). With these results we can infer that age is a factor that influences the division of labor in colonies of *D. quadriceps*, since important activities colony as foraging, defense and care differ between worker ages. (CAPES, PRONEX-FAPESB/CNPq)

VARIATION IN WEIGHT OF *Dinoponera quadriceps* WORKERS: WILL THE ACTIVITY OF WORKER INFLUENCE ITS NUTRITIONAL STATUS?

P.F.G.A. SANTOS[1], D.L.O. AZEVEDO[1, 2] & A. ARAÚJO[1, 2]

[1]Laboratório de Biologia Comportamental, Centro de Biociências, Departamento de Fisiologia, Universidade Federal do Rio Grande do Norte, Av. Senador Salgado Filho, s/n, Lagoa Nova, Caixa Postal 1511, CEP 59078-970 – Natal, RN, Brasil, e-mail: pablo.sant@hotmail.com. [2]Programa de Pós-graduação em Psicobiologia, Universidade Federal do Rio Grande do Norte, Natal, RN, Brasil.

Dinoponera quadriceps Santschi (Hymenoptera, Formicidae, Ponerinae) is a species with absence of queen and morphological differentiation among individuals, but there is a variation in weight among the workers. Given that weight is a parameter to evaluate the nutritional status of individuals, this study aimed to analyze if the place where the activities are performed (external / internal to the nest) influences the weight of workers. Three colonies of D. quadriceps were maintained in the laboratory and their workers individually marked. We weigh all the workers of each colony by adopting the following scheme: after six days with food *ad libitum*, it was carried out the 1st weighing (CA); then the colony was kept without food for three days and then it was carried out the 2nd weighing (SA). In both situations the ants had access to a foraging arena. This sequence was repeated three times consecutively. The collected data showed normal distribution, so we conducted GLM univariate test, two-tailed. The weight (g) of workers with internal activities (0.3425 ± 0.0254) or external (0.3342 ± 0.0303) to nest in CA is similar ($p>0.05$). However, after the lapse of the SA, the workers who performed work outside the nest (0.3306 ± 0.0301) had lower body weight than the other (0.3391 ± 0.0248) ($p<0.05$). The weight variation in the workers is influenced by the activity performed inside/outside of the nest. Even though the workers that play a labor outside of the nest have greater access to food, their rate of weight loss will be greater in relation to performing work inside the nest, suggesting increased energy expenditure for external work.
(PRONEX-FAPESB/CNPq, CNPq, CAPES)

VARIATION ON ANT SPECIES ATTENDING APHIDS THROUGHOUT THE DAY

G.P. ALVES[1], E.O. CANEDO-JÚNIOR[1,2], A.C.M. QUEIROZ[1,2] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras, Lavras, MG, CEP: 37200-000, Lavras, Brasil, e-mail: guialves.biologia@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

The objective of this work is to assess which ants attend aphids and if there is a change in ant species that attend aphids during the day. The experiment was conducted on the campus of UFLA (Federal University of Lavras) with sample collections at 1 a.m., 7 a.m., 1 p.m., 7 p.m. (after midnight, morning, afternoon and evening), for three consecutive days. We observed and sampled ants attending aphids in ten plants of *Bidens pilosa* ("Spanish Needle") during 10 minutes per plant on each day, in June 2013 (dry season). In six plants we observed a variation in ant species present in the different periods of the day, showing that each species has its activity peak in a specific time during the day. In the collections made at 1 a.m. we collected *Camponotus* sp.1, *Camponotus* sp.2, *Pheidole* sp.1, *Pheidole* sp.2, *Crematogaster* sp.1, *Crematogaster* sp.2 and *Linepithema* sp.1. In the collections made at 7 a.m. we collected: *Camponotus* sp.1, *Camponotus* sp.3, *Pseudomyrmex* sp.2, *Pseudomyrmex* sp.3, *Pheidole* sp.1, *Pheidole* sp.2, *Pheidole* sp.3, *Crematogaster* sp.1, *Crematogaster* sp.2 and *Linepithema* sp.1. In the collections made at 1 p.m. we collected: *Camponotus* sp.3, *Pseudomyrmex* sp.1, *Pseudomyrmex* sp.2, *Pheidole* sp.2, *Crematogaster* sp.2 and *Linepithema* sp.1. In the collections made at 7 p.m. we collected: *Camponotus* sp.1, *Pseudomyrmex* sp.3, *Pheidole* sp.1, *Pheidole* sp.2, *Pheidole* sp.3, *Crematogaster* sp.1, *Crematogaster* sp.2 and *Linepithema* sp.1. In four plants the aphids were attended by a single ant species, such as *Pheidole* sp.2, *Linepithema* sp.1 and *Crematogaster* sp.2 in some of the periods of observation. These species also occur together with other species in other plants but, in most cases, the species present activity peaks in specific times during the day. This can be explained by at least three different hypotheses: competition among the species, habitat condition restrictions to ant species foraging (temperature for instance) or that the ant species are not territorial. A major factor that defines the degree of aggressiveness of ants attending aphids is the nutritional needs of the colony. Usually, newly founded colonies or those which invaded a new area, tend to be more aggressive and territorial, since aphids represent a reliable and lasting food source, ensuring the success of the foundation of the new colony, or the installation of the colony in the new area. In other situations, the ants use the honeydew produced by aphids as a nutritional supplement with no dominance or aggressiveness and consequently sharing aphids with other ant species. Understanding ant-aphid interaction is important, because depending on the ant species-attending aphids, there may be a change in the structure of the entire community by excluding other ant species that use the same resource, and other arthropods occurring in the host plant. (CAPES, FAPEMIG)

MORPHOLOGY, PHYSIOLOGY & GENETICS

COMPARISON OF CHEMICAL CONTENT OF POST-PHARYNGEAL GLANDS AND CUTICLE OF *Atta sexdens rubropilosa* FOREL, 1908 (FORMICIDAE: MYRMICINAE: ATTINI)

V.C. TOFOLO & O.C. BUENO

Centro de Estudos de Insetos Sociais (CEIS), Instituto de Biociências, Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), Avenida 24-A, nº 1515, Bairro Bela Vista, CEP: 13506-900 - Rio Claro, SP, Brasil, e-mail: vivitofolo@yahoo.com.br.

The post-pharyngeal glands (PPG) are connected to the pharynx and are the largest glands in the head of ants. Their morphology and functions, however, are still under discussion. They may act as a reservoir for many substances and not as a secretory gland, since there is no glandular tissue. Among these substances are lipid compounds ingested as food, which form oily vesicles in the lumen of the PPG; these vesicles are absorbed by the cuticle and later transferred to the hemolymph. The lipids are derived from hydrocarbons, which have an important role in the nestmate communication. The presence of these hydrocarbons is also observed in the cuticle of the ants, which makes some researchers attribute to this gland the function of storage of cuticular hydrocarbons. The objectives of this study were (1) to verify whether the PPG of *Atta sexdens rubropilosa* (Formicidae: Myrmicinae) acts as a reservoir of cuticular hydrocarbons and (2) to analyze the similarity between the cuticular chemical profile of queens, soldiers, and workers. Five ants of each caste had their cuticular hydrocarbons extracted with hexane. The content of the extraction was analyzed by gas chromatography coupled to mass spectrometry (GC-MS) using a GCMS-QP 2010 Plus Shimadzu spectrometer and an RTX-5MS column. The identification of hydrocarbons was performed with the support of the database library Nist08/2008/EPA/NIH and Kovatz Retention Index. After the cuticular hydrocarbons were removed, the same five ants of each caste had their heads dissected. The PPG were removed and stored for the extraction of the hydrocarbons present in the lumen. The chemical identification followed the same methodology described above. Thirty-two hydrocarbons were identified, with chains ranging from 24 to 38 carbons, mostly branched; of this total, only 6 were common to all castes. Also, the chemical profile of queens resembled more the profile of soldiers than that of workers. All cuticular hydrocarbons identified in the queen, soldier and worker castes were found in their respective PPG. However, the PPG showed a greater diversity of hydrocarbons than the cuticle in the queen and worker castes; only in the soldier caste all substances identified were common to both structures. The hypothesis that the PPG may act as a reservoir of cuticular hydrocarbons can be applied to queens, soldiers, and workers of *A. sexdens rubropilosa*, since all substances found in the cuticle of these ants were present in their PPG. On a caste basis, foragers presented cuticular chemical profiles more similar to those of the soldiers, whose profiles, in turn, were more similar to those of queens. The cuticular hydrocarbons that had relatively higher abundances were found in the three castes and they can play an important role in chemical communication between the individuals of a colony. (FAPESP)

ENERGETIC COST OF DIGGING BEHAVIOR IN LEAF-CUTTING ANT WORKERS (*Atta sexdens rubropilosa*)

R.S. CAMARGO[1], J.F.S. LOPES[2] & L.C. FORTI[1]

[1]Laboratório de Insetos Sociais-Praga, Departamento de Produção Vegetal, Faculdade de Ciências Agronômicas/UNESP, 18603-970, PO Box 237, Botucatu, SP, Brasil. E-mail:camargobotucatu@yahoo.com.br [2]Mirmecolab, Universidade Federal de Juiz de Fora, Instituto de Ciências Biológicas. Rua José Lourenço Kelmer, s/n - Campus Universitário, Bairro São Pedro, 36036-900 - Juiz de Fora, MG – Brasil.

During nest excavation, leaf-cutting ant workers (*Atta sexdens rubropilosa*) undergo body reserve reductions, particularly, carbohydrates. This consumption is a direct consequence of the energy metabolism of the organism, and the method used for its determination is through the rate of carbon dioxide production that is expelled. Thus, it was hypothesized that there is a digging energetic cost by workers during the execution of this activity, which is easily measured by CO_2 production. For this purpose, groups of 30 leaf-cutting ant workers were sealed in a hermetic chamber for 24, 48 and 72 hours, with and without soil for digging. Next, the CO_2 concentration was measured using respirometric containers as well as volume of soil excavated (g). As expected, the workers which excavated expelled more carbon dioxide concentrations than the group that did not excavate. Therefore, a worker with body mass of 9.65 ± 1.50 mg dug in average 0.85 ± 0.27 g of soil for 24 hours, consuming c.a. 0.58 ± 0.23 J. In this study, we figure out that the energetic cost of excavation per worker per day is c.a. 0.58 ± 0.23 J, representing a significant energetic cost to ant workers. (FAPESP, CNPq)

IS THE MANDIBLE MORPHOLOGY RELATED WITH THE PREFERENCE OF LEAF-CUTTING ANTS BY GRASSES OR LEAVES?

I.N. HASTENREITER[1], R.S. CAMARGO[2], L.C. FORTI[2] & J.F.S. LOPES[3]

[1]Programa de Pós-Graduação em Ecologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora (UFJF), Rua José Lourenço Kelmer, s/n Campus Universitário – São Pedro, 36036-330,Juiz de Fora, MG, Brasil, email: belnetoh@gmail.com. [2]Laboratório de Insetos Sociais-praga (Lisp), Departamento de Produção Vegetal, Faculdade de Ciências Agronômicas/UNESP, Botucatu, SP, Brasil. [3]MirmecoLab, Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora – MG, Brasil.

Grass and leaf-cutting ants species belong to the same Attini tribe, but show behavior and morphological differences that could be probably related with their preference to the cutting and processing of grass and leaf fragments. Both grass and leaf-cutting species do a complex treatment of the substrates since the cutting to their incorporation into the fungus garden. Ants' mandibles are essentials tools to execute these tasks and so their morphometry and morphology could exert a great influence on plant species selection and workers behavior. About this difference, we just know that grass-cutting species have more massive and shorter mandibles, while leaf-cutting ones have longer and less massive mandibles. Here, we studied in detail the morphological differentiation between mandibles of grass-cutting (*Atta capiguara*, *Acromyrmex balzani*) and leaf-cutting (*Atta sexdens*, *Acromyrmex subterraneus*) ant species. Mandibles from these species were removed, treated with Hoyers solution and mounted in slides in order to evaluate their morphometry. We submitted mandible morphometry data to Non-Metric Multidimensional Scaling (NMDS) and it was verified that *Atta laevigata* and *Atta bisphaerica* present similar mandible morphology, being larger and more elongated, with numerous teeth (6-9 teeth). The main difference is related to the distal tooth, which is longer in *Atta bisphaerica* than *Atta laevigata. Acromyrmex balzani* mandibles are more robust and massive, with only two teeth, a typical grass-cutting ant mandible. *Acromyrmex subterraneus* mandibles are thinner and have a larger number of teeth (approximately 10), creating a V-like blade with the two last teeth, characterizing a typical leaf-cutting mandible. The analysis shows a high dissimilarity among the four studied species, specially for *Acromyrmex balzani* being more distant from the others. This work highlights morphological differences among mandibles of grass and leaf-cutting ant species, which could lead to a refined preference for grasses or eudicotyledoneas leaves. (CAPES/Cofecub, CNPq, FAPESP)

KARYOTYPE DIFFERENTIATION BETWEEN *Dolichoderus attelaboides* AND *Dolichoderus decollatus* (HYMENOPTERA: FORMICIDAE) AND THE CHROMOSOME DIVERSITY OF FIVE OTHER NEOTROPICAL *Dolichoderus* SPECIES.

I.S. SANTOS[1], C.F.S. MARIANO[1, 2], J.H.C. DELABIE [1,2], M.A. COSTA[1] & J.G. SILVA[1]

[1]Universidade Estadual de Santa Cruz - Departamento de Ciências Biológicas - Campus Soane Nazaré de Andrade, Rodovia Jorge Amado, km 16, Bairro Salobrinho, CEP 45662-900. Ilhéus-Bahia. santossigor@yahoo.com.br. [2]Laboratório de Mirmecologia – Comissão Executiva do Plano da Lavoura Cacaueira - km 22, Rodovia Jorge Amado, CEP 45.660-000, Ilhéus-BA

The genus *Dolichoderus* is one of the most diversified in the subfamily Dolichoderinae. These ants, mostly arboreal, are very common in tropical rainforests. In Brazil there are 35 *Dolichoderus* species, which are grouped into nine different species complexes. Some of these complexes, such as Attelaboides and Decollatus complexes, are distinguished based on slight morphological differences, suggesting a close phylogenetic relationship between them. The aim of this study was to investigate the karyotype differentiation between seven species of this genus [*D. attelaboides* (Attelaboides complex), *D. decollatus* (Decollatus complex), *Dolichoderus lutosus*, *Dolichoderus diversus*, *Dolichoderus voraginosus* (Diversus complex), *Dolichoderus bidens* (Bidens complex) and *Dolichoderus imitator* (Imitator complex)], implying in the most comprehensive cytogenetic characterization for Neotropical species of this genus. Collections were made in experimental areas of the Cocoa Research Center – CEPLAC (14º 45' S, 39º 13' W), in Ilhéus, Bahia, Brazil. Metaphases were obtained from the cerebral ganglia of prepupae and chromosomes were analyzed using classical and molecular cytogenetics techniques. The chromosome number ranged from 2n = 10 in *Dolichoderus lutosus* to 2n = 58 in *D. attelaboides*, the highest chromosome number ever recorded for Dolichoderinae subfamily. The karyotype formulas are: *D. lutosus* (2k=4 M + 6 SM), *D. bidens* (2k= 6M + 12 SM), *D. voraginosus* (2k= 14 M + 6 SM), *D. diversus* (2k= 10 M + 12 SM), *D. imitator* (2k= 6M + 28 SM+ 4 A), *D. decollatus* (2k= 6 M + 32 SM), *D. attelaboides* (2k= 2M + 50 SM + 6 A). The $CMA3^{+}$ / $DAPI^{-}$ markings were identified in the pericentromeric regions of the chromosomes of *D. lutosus*, *D. diversus*, *D. voraginosus* and *D. bidens*. In the species *D. attelaboides* and *D. decollatus*, marking $CMA3^{+}$ / $DAPI^{-}$ appears only in the second chromosome pair. In *D. attelaboides* this marking extends over the entire length of the short arm and the long arm of chromosomes of that pair. FISH results showed that there are only two sites of ribosomal cluster located in homologous chromosomes among species of this genus. The markings were detected in the 1st chromosome pair in *D. voraginosus, D. diversus, D. bidens* and *D. imitator* and 2nd chromosome pair in *D. lutosus*, *D. attelaboides* and *D. decollatus*. Our results reveal a large karyotypic divergence between species *D. attelaboides* and *D. decollatus*, probably indicating that the chromosomal rearrangements played a major role in the diversification of these complexes. The differences in 45S ribosomal cluster location between the species of the Diversus complex indicate the occurrence of pericentric inversions during karyotypic diversification of this complex. Karyotype evolution of the genus *Dolichoderus* is probably related to the size reduction and concomitant increase in the number of chromosomes in most derived lineages. (PRONEX FAPESB CNPq PNX0011/2009).

MOLECULAR CHARACTERIZATION OF PARTIAL MITOCHONDRIAL GENES COI AND COII OF *Camponotus textor* FOREL, 1899 (HYMENOPTERA, FORMICIDAE)

M.O. RAMALHO[1], C. MARTINS [1,2], V.G. MARTINS[1] & O.C. BUENO[1]

[1]Universidade Estadual Paulista- "Júlio de Mesquita Filho", Unesp -Rio Claro, IB, CEIS, Av. 24 A, 1515, Bela Vista, CEP 13506-900, Rio Claro –SP, Brasil, email: manutsmk@hotmail.com. [2]UFPI, Universidade Federal do Piauí, Campus Universitário de Parnaíba, Av. São Sebastião, 2819, CEP 64202- 020 Parnaíba, Piauí, Brasil.

This paper discusses a study on *Camponotus textor*, a weaver ant commonly found in the Central and South American forests. In general, studies on *C. textor* describe the behavior of weaving and building nests. Further studies on this ant can be revealing, as they may nest in coffee (*Coffea arabica*), thus preventing the establishment of other pest organisms, such as the coffee berry borer (*Hypothenemus hampei*). The sequencing of cytochrome oxidase I gene has been widely used as a DNA barcoding differentiation and identification of species, and cytochrome oxidase II is one of the most widely used for studies on insects. This work was partially sequenced partial mitochondrial genes COI and COII, tRNA (transfer RNA) and its intergenic spacer for molecular characterization of colonies of *Camponotus textor*, as well as to verify the relationship between geographic distance and genetic distance of these colonies. Workers of six colonies of ants were collected from some cities in the states of São Paulo, Minas Gerais and Bahia and stored in 80% ethanol until DNA extraction with TNES. The fragment amplification was performed with primers designed to work with each total reaction volume of 25μL containing template DNA, PCR buffer, $MgCl_2$, dNTP's and Taq DNA polymerase (Invitrogen). Purification was done GFX PCR kit Gel Band Purification and (GE Healthcare) and sequencing with the BigDye Terminator (v.3.1) from Applied Biosystems, at 3130 Genetic Analyzer automated sequencer (Applied Biosystems). Sequences were edited in BioEdit and compared with the sequences deposited in GenBank by BLAST tool. The genomic annotation was made of COI (1103 bp), IGS (69 bp), tRNA-Leu (71 bp) and COII (244 bp). There was also a strong phylogenetic signal with transitions exceeding transversions. The Pearson correlation analysis between genetic distance and geographic indicated that a relationship exists: - greater geographic distance largest genetic distance, featuring a standard phylogenetic old colonization. Phylogenetic analysis of the colonies (maximum parsimony and Bayesian inference) network and haplotype confirmed the existence of this correlation.

PROTEOME OF VENOM OF THE ANT *Pachycondyla striata* F. SMITH (1858) (FORMICIDAE: PONERINAE)

P.P. SANTOS[1]; P.D. GAMES[2]; L.L. OLIVEIRA[3]; M.C. BARACAT-PEREIRA[2] & J.E. SERRÃO[3]

[1]Department of Entomology, Federal University of Viçosa, Av. P.H. Rolfs, Viçosa, MG, e-mail: pollyannaps@yahoo.com.br. [2]Department of Biochemistry and Molecular Biology, UFV. [3]Department of General Biology, UFV.

The ant venom is a complex mixture of alkaloids, hydrocarbons, carboxylic acids, proteins, peptides and other bioactive compounds, used for individual and colony defense and predation. This study identified the soluble proteins in the venom of *Pachycondyla striata*, using electrophoresis-dimensional (1D) and two dimensional (2D) followed by MALDI-TOF/TOF analysis and reverse-phase liquid chromatography (HPLC) followed by electron-spray analysis. For the study six colonies were collected in Viçosa, MG, Brazil (20° 48'S 42° 51'W) and 60 workers from each colony were cryo-anesthetized, dissected and the venom reservoir transferred to protease inhibitor cocktail 1 % (1D and 2D) or 0.1 M sodium phosphate buffer pH 7.2 (HPLC).The one-dimensional separation from the venom showed the presence of 13 proteins with molecular weights range from six to 200 kDa. In two-dimensional separation 66 spots were detected with molecular masses from 10 and 296 kDa and isoelectric point from 3.1 to 9.8. The HPLC analysis detected the presence of 74 proteins/peptides, being, so far, identified proteins ctenitoxin Pn1a-U10-; protein Wnt-7a; aminopeptidase N and hialuronoglucosaminidase. These data suggest that *P. striata* has a complex mixture of proteins/peptides in the venom, which may play a role in the colony defense as well as other unknown activities. (CNPq, FAPEMIG, FINEP, CAPES,FAPESB/PRONEX)

RESPIRATORY RATE IN REPRODUCTIVE INDIVIDUALS OF *Atta laevigata*

L.C. GANDRA[1], T.M.C. DELLA LUCIA[2] & R.N.C. GUEDES[3]

[1]Programa de pós-graduação em Entomologia, Universidade Federal de Viçosa (UFV), Av. PH Rolfs, s/n, Campus Universitário, Viçosa, MG, Brasil, e-mail: laillabio@yahoo.com.br. [2]Departamento de Biologia Animal, Universidade Federal de Viçosa (UFV). [3]Departamento de Entomologia, Universidade Federal de Viçosa (UFV).

Leaf-cutting ants are considered pests in many cultures; they cause great losses in the agricultural and forestry production. Although these insects are important much of their biology remains unclear, especially in relation to the reproductive forms. This study aimed at evaluating the respiratory rate of reproductive individuals of *Atta laevigata*. The experiment consisted of three groups of individuals: virgin winged females leaving their nests, virgin males leaving their nests and mated wingless females. The individuals were taken to the Leaf-cutting ants laboratory/UFV, where they were individualized in respirometric tubes. The tubes were connected to a CO_2 analyzer (TR2, Sables System International, Las Vegas, NV, USA) at Ecotoxicology laboratory/UFV. Data were submitted to variance analysis and followed by the Tukey test ($p<0.05$). All the values obtained were different and the individuals that showed the greatest rate of CO_2 release were the virgin queens (average of 122.551 µmolCO_2/h). Mated queens showed median rate of CO_2 release (average of 87.991 µmolCO_2/h) and the virgin males had the lowest rate of CO_2 release (average of 47.632 µmolCO_2/h). The results showed that the virgin females leaving their nests had the highest respiratory rate; this may be consequence of the effort the wings and muscles demand for maintenance during the flight. (CNPq, FAPEMIG)

SPERMATHECA MORPHOLOGY OF THE FERTILE QUEEN IN *Ectatomma tuberculatum* (FORMICIDAE: ECTATOMMINAE)

I.J. SERRÃO[1], R.R. HORA[1], J.C. ZANUNCIO[1] & J.E. SERRÃO[1]

[1]Departamento de Biologia Geral, Universidade Federal de Viçosa, Av. P.H. Rolfs s/n, CEP: 36570-000 - Viçosa, MG, Brasil, e-mail: igor.serrao@ufv.br

The spermathecae are the famale sperm storage organ and in social insects likely ants, this organ of the female reproductive tract play an important role, since queens have a long life cycle. The morphology of the *Ectatomma tuberculatum* (Formicidae: Ectatominae) was studied through scanning and transmission electron microscopy. The spermathecae of *E. tuberculatum* was located closely above the vagina. The spermathecae consists of a globular reservoir, spermathecal duct and spermathecal gland. The duct and reservoir have a single layered epithelium. The cells of spermathecal reservoir are cuboidal cells lined by a thick cuticle with a thin epicuticle. The cell nucleus is spherical with decondensed chromatin. The basal plasma membrane has some infoldings reaching 1/3 basal cytoplasm, associated with mitochondria. The main feature of apical cytoplasm is the great amount of storage glycogen granules. These ultrastructural features suggest that spermathecal epithelium has a high metabolic activity and may play a role in the maintenance of spermatozoa within the organ lumen. The present work provide the first decription of the spermathecae morphology in queen of *E. tuberulatum* that can be used as a basis for future studies, about reproduction, caste or behavior characteristics of Ectatomminae. (PRONEX SECTI-FAPESB/CNPq, projeto PNX 0011/2009, CNPq, FAPEMIG)

STUDY OF CHANGES IN THE COMPOSITION OF POISON AND CUTICULAR HYDROCARBON PROFILE OF ANTS

M.C. PAULA[1,2], E.L.B. FIRMINO[1,3], R.C. BERNARDI[1,3], M.C. PEREIRA[1,2], W.F. ANTONIALLI-JUNIOR[1] & S.M. LIMA[1]

[1]Laboratório de Ecologia, Centro Integrado de Análise e Monitoramento Ambiental (CInAM), Rodovia Dourados – Itahum, Km 12, CEP 79804-970 – Dourados, MS, Brasil, e-mail:michelecastro.ufgd@gmail.com. [2]Programa de Pós Graduação em Entomologia e Conservação da Biodiversidade, Universidade Federal da Grande Dourados, Dourados, MS, Brasil. [3]Universidade Estadual de Mato Grosso do Sul, (UEMS), Dourados, MS, Brasil.

Social insects, particularly ants, evolved the capability of synthesize substances that are parts of a self-defense mechanism. In other venomous animals like snakes and scorpions, it is possible to find intraspecific differences in the poison composition due environmental variation, showing that the animals obtainchemicals to help them compose their poison. Thus, this paper aims to evaluate the influence of the environmental factors onthe chemical compounds of the poison of ants. For that, we collected two colonies of the species *Ectatomma brunneum* for diet maintenance and control of the population in laboratory. As a control, we analyzed the glands of recently collected foragers, which thereby, were under natural diet. Additionally to this analysis, we evaluated from the same material, the abdomen of each worker to analyze the influence of their diet ontheir cuticular hydrocarbon profile. The intra and interspecific differences of venom composition were evaluated from workers of different populations of *E. brunneum* and *E. tuberculatum*. The analyses were performed by two techniques, FTIR-PAS (optical spectroscopy by Fourier transformed in medium infrared by photoacoustic detection) and CG-DIC (gas chromatography with flame ionization detection) and the results submitted to discriminant analysis. The results show that both the venom composition and the cuticular hydrocarbons profile are influenced by the diet, and that the individuals being kept under controlled diet began to have their venom composition and cuticular hydrocarbons modified from 30 days on. The influence of the diet on venom composition is reinforced when we evaluate the results of *E. brunneum* and *E. tuberculatum* colonies, which overlapped themselves, showing significant differences to the data of an *E. brunneum* colony of another population. This shows that the environmental components, specially the diet are, in fact, responsible by most differences and similarities found in venom composition and cuticular hydrocarbons of different populations of a same specie and among different species of ants, and in some cases showed that, it is more significant than the genetic factors.(Financial support CNPq and CAPES)

POPULATIONS AND COMMUNITIES ECOLOGY

A PRELIMINARY STUDY ON THE COMMUNITY OF LEAF-LITTER ANTS (HYMENOPTERA: FORMICIDAE) IN THE ZOO-BOTANICAL PARK OF ITAPETINGA-BA.

M.S. ANJOS[1], V.M. NOVAIS[1], M.L. OLIVEIRA[1], T.B. GUIMARÃES[1], L.O. SILVA[1], T.B. GUIMARÃES[1], M.S. D'ESQUIVEL[1], R.B. LEMOS[2], S. LACAU[1] & L.S.R. LACAU[1].

[1]Laboratório de Biossistemática Animal, Universidade Estadual do Sudoeste da Bahia, Itapetinga-BA, Brasil; UESB, e-mail: m.anjos_06@hotmail.com. [2]Parque Municipal Zoobotânico da Matinha, Itapetinga-BA, Brasil.

Forest soils are favorable environments for small arthropods. The ants (Hymenoptera: Formicidae) are the main representatives of this fauna, by having a high diversity, numerical dominance and sensitivity to environmental changes. The aim of this study was to investigate the composition of leaf-litter ant fauna in a fragment of the Atlantic Forest biome. For this, 50 leaf-litter samples (1m² sized and 50m apart from each other) were collected in November of 2011, inside a 24 ha area of the Parque Zoobotânico da Matinha, Itapetinga-BA, Brazil. The extraction of ants was performed using Winkler extractors during 72 hours. The ants were then sorted and morphotyped at generic level. Data were analyzed using the software EstimateS 9.1.0. A total of 49 ant species were collected, belonging to 25 genera, 16 tribes and six subfamilies. Myrmicinae was the most diverse subfamily (68.75% of total species), followed by Ponerinae (18.75%). The most diverse genera were *Pheidole* (18.75%) and *Hypoponera* (10.41%). The average number of species per sample was 3.72, varying from one to ten species. Most of the species were rare, since 22 (44.89%) have been collected only once. The richness estimator (Chao 2) was 86.73 ± 22.51, and the diversity (Shannon-Wiener index) was 3.44. The sample-based accumulation curve did not reach an asymptote indicating that the number of samples has not been sufficient to record all the species in this area. However these results are only preliminary and may be significantly improved in the future, through the use of other collection methods.

ADOPTION OF SURROGATE QUEENS BY ORPHAN *Atta cephalotes* (HYMENOPTERA: MYRMINICINAE) COLONIES

D.S. ORTIZ[1]; J. RODRÍGUEZ[1]; G. SOTELO[2] & J. MONTOYA-LERMA[1]

[1]Grupo de Ecología en Agroecosistemas y Hábitats Naturales (GEAHNA), Universidad del Valle, Av. Pasoancho No 100-00, Cali, Colombia. e-mail: james.montoya@correounivalle.edu.co; [2]Laboratorio de Forrajes CIAT, Palmira, Colombia.

In nature, *Atta cephalotes* is a monogynous species. Each colony has a single, permanent queen fed and protected by thousands of sterile workers. It is estimated that each queen lives about 15 years and is irreplaceable; that is, when dead her colony disappears in time. The workers, especially soldiers, are territorial and defend the colony from presence and / or attack by intruders, including ants of the same species but from a different colony. Our aim was to investigate whether artificial colonies of *A. cephalotes*, a month after being orphaned (without queen), accept and host queens from different colonies. In laboratory, five pairs of colonies were selected. At random, half of them were deprived of their queens (-QC), larvae and pupae. The queens of the other half were kept inside colonies that were termed donor colonies (+QC). Each colony had (i) feeding zone, (ii) contacting area, (iii) fungi sponge (with or without a queen) and (iv) garbage area. A queen plus its symbiotic fungus and larvae from a+QC was placed in the contact area of each - QC. Thepassage of orphaned workers to the contact area was allowed during10 minutes and then blocked. Next, 50 g of fungal symbiont from the +QC was added. This procedure was repeated four times overa 40-minute period. Early aggression was observed among some workersalthough none of the surrogate queens was ever attacked butintegrated withthe orphanfungus. Furthermore, larvae were removed from the donor colony by the orphaned workers and carriedto the fungal symbiotic sponge. After 24 hours, the two colonies were joined. There was calm and normal flow between all zones. Two months later, all surrogate queens were still alive and there was presence of larvae and pupae. The results show that artificial colonies of *A. cephalotes*, after a period of orphanhood, accept surrogate queens and remain stable and active. (Universidad del Valle. COLCIENCIAS)

ANT COMMUNITIES IN MANGROVES OF BAIXADA SANTISTA (SOUTHEAST BRAZIL)

M.T. ANGELONI[1], R.S. PROBST[2] & M.A.A. PINHEIRO[1]

[1]UNESP – CLP (Universidade Estadual Paulista "Júlio de Mesquita Filho" – Campus Experimental do Litoral Paulista); Praça Infante Dom Henrique s/nº Bairro: Parque Bitaru, 11330-900 – São Vicente/SP, Brasil; e-mail: tartarottimichel@gmail.com. [2]Laboratório de Hymenoptera, Museu de Zoologia da Universidade de São Paulo, São Paulo/SP, Brasil.

Mangroves are common estuarine systems along the Atlantic coast of Brazil. Among the many ecosystem functions provided, although poor in plant species, mangroves stabilize the banks (reducing the risk of erosion), retain sediments, nutrients and toxic elements, export biomass and support a very broad array of fauna. Although low in plant diversity, they are one of the most productive ecosystems and offers different types of resources to non-aquatic organisms. In this way, a lot of insects are associated with these ecosystems, such as arboricolous ants. Amongst entomofauna, ants are a group with well-defined ecological importance as bioindicators of environmental changes. In this way, this study aims to evaluate the ant community of mangrove areas located at the southeast coast of Brazil, with recognized different levels of anthropic influence. A first study was conducted in a mangrove sited at Praia Grande County (Portinho's mangrove - 23°59'15.3"S, 46°24'23.5"W) at August 2013, characterized by the dominance of black mangrove (*Avicennia schaueriana*), with few red mangrove *(Rizophora mangle*) trees. The ants were collected by pitfall traps tied on trees baited with sardine that stayed in field for 48 hours. Samples were taken along a transect of about 200 meters, being pitfalls at 10 meters intervals. A total of six species (three subfamilies) have been collected (8.86 - estimated species richness by the first-order Jackknife richness estimator), with the most frequent species belonging to the genus *Crematogaster* (26%). Other similar studies have pointed that this genus, followed by the genus *Azteca*, is the most common and frequent at the mangrove's woodlands. Furthermore, at Portinho's mangrove the diversity index (H') was 1.14. Some of the traps did not capture ants, which is probably associated with the patchy colonization of ants in this type of environment, influenced by the tidal oscillations. The project is underway and another fieldwork is expected to occur later this year. Thus, we will have additional data to establish a better scenario about the ant communities in mangroves of Baixada Santista region, including comparisons between areas with different levels of anthropic influence. (FAPESP)

ANT COMMUNITY IN AN AGRICULTURAL LANDSCAPE: EFFECTS OF COFFEE MANAGEMENT IN DIFFERENT SPATIAL SCALES

D.C. MUSCARDI[1], J.H. SCHOEREDER[1] & C.F. SPERBER[2]

[1]Laboratório de Ecologia de Comunidades, Departamento de Entomologia, Universidade Federal de Viçosa - UFV, Av. P. H. Rolfs, s/n, CEP: 36570-000, Viçosa, MG, Brasil; email: dmuscardi@gmail.com. [2]Laboratório de Orthopterologia, Departamento de Biologia Geral, Universidade Federal de Viçosa - UFV, Viçosa, MG, Brasil.

Understanding the agricultural land use effects on diversity contribute to biodiversity conservation in human-dominated regions. Increasing land cover variability should increase biodiversity, since the offering of different resources would permit the coexistence of more species. We aimed to answer if the presence of different crop managements in the landscape contributes to enhancing regional ant diversity. The study was carried out in nine coffee farms under conventional, agroecological and agroforestry managements. Ants were sampled by pitfall traps and in the leaf litter, which was sampled and taken to Berlese funnels to extract the ants. We used additive partitioning analysis to evaluate if the presence of different coffee management types contributes to regional ant diversity. Total species richness (γ) was partitioned into local richness (α) and richness turnover (β). We identified three scales following the equation: $\gamma_{region} = \alpha_{sample\ point} + \beta_{sample\ point} + \beta_{site} + \beta_{management}$. The results showed: observed α1 was higher than the randomly generated α1 (Sample point scale; p=0.0009); observed β1 (Sample point scale) was lower than the randomly generated β1 (p=0.0009); observed β3 (Management scale) was marginally higher than the randomly generated β3 (p=0.054). Observed β2 (Site scale) did not differ from random β2 (p=0.556). Our results depicted the importance of the presence of different management type to biodiversity: the observed differentiation diversity in management scale was higher than the expected by chance. We can suggest that the maintenance of more than one agroecosystem type in the study region have a higher biodiversity conservation value than if the region was covered by only one agroecosystem type. Our β_2 result suggests that the farmer management and other variables are not strong enough to alter the ant community structure. The β_1 result indicates the similarity between the sample points within the areas. This may be linked to high mobility of ant species among sampling points, but also evidences a local homogeneity. The observed local diversity (α1) may have resulted from using pitfall traps witch stays in the field for a long period, and thus can concentrate species. An alternative explanation is the absence of local species saturation. Our study supports the theory regarding agricultural landscape heterogeneity, since the presence of different agroecosystems in the region enhances ant biodiversity. (FAPEMIG, CNPq)

ANT COMMUNITY ORGANIZATION ALONG AN ALTITUDINAL GRADIENT OF *CAMPOS RUPESTRES*

T.C. LANA[1,2], M.C. ANJOS[1], H.S. BRANT[1], L.D. BRAGA[1], G.W. FERNANDES[2] & F.S. NEVES[1,2]

[1]Laboratório de Ecologia de Insetos, Departamento de Biologia Geral, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais (UFMG), Av. Antônio Carlos, 6627, CEP 31270-901 – Belo Horizonte, MG, Brasil, e-mail: tate.lana@gmail.com. [2]Programa de Pós-graduação em Ecologia, Conservação e Manejo da Vida Silvestre, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brasil

Mountain ecosystems arouse interests in academic researches since they are sensible to climatic changes and exhibited a biota adapted to its particular climatic conditions. In such ecosystems, studies reveal pattern of richness of ant species in intermediate altitudes, while others point a decline of ant species with increasing altitude. C*ampos Rupestres* are a mountain ecosystem included in the Brazilian savanna and are represented by a mosaic of habitats. Despite being one of the world's hotspots for conservation, its structure of ant fauna community is still poorly studied and remains to be described. Therefore, our attempt was to evaluate how ant diversity is influenced by altitudinal variation in *Campos Rupestres*. We tested the hypothesis of (i) decrease of species richness (α) along altitudinal gradient and ii) decline of community's spatial heterogeneity with increase of altitude, considering local β1 a measure of heterogeneity and response variable, and altitude as an explanatory variable. The study was conducted in Serra do Cipó, Minas Gerais, along an altitudinal gradient from 800m a.s.l. to 1400m a.s.l. Samples were taken at each interval of 100m of elevation. In each altitude, 15 pitfall traps were installed, separated in three transects of 200m. We sampled 108 ant species, belonging to eight subfamilies and 40 genera. The most representative subfamily was Myrmicinae, with *Pheidole* being the most frequent and diverse genera. As expected, there was a significant decrease of ant species richness with increment of altitude. Also there was a significant decline of values of local β1 diversity with increasing elevation. Considering fragments of *Campos Rupestres* located at lower altitudes more heterogeneous landscapes, their higher β1 values may be contributing to this higher pool of species and local diversity. On the other hand, lower values of β1 exhibited by higher altitudes reflect a more homogenous landscape. The species that seemed to limit distribution to higher lands were *Prionopelta* sp1, *Acromyrmex* sp4, *Myrmelachista* sp1 and sp2, *Crematogaster brasiliensis* and *Crematogaster* prox. erecta, *Basiceros iheringi*, *Oxyeopoecus* prox. *Bruschi* sp1 and sp2, and *Pseudomyrmex* gr. pallidus. These species are probably more tolerant to climatic severity related to be the most explanatory environment variable influencing ant species distribution in mountain ecosystems. Also, the decreasing of heterogeneity in ant community along altitudinal gradient seemed to be similar to the flora pattern in *Campos Rupestres*. Based on these diversity patterns, we assert the importance of research in these ecosystems, aiming to understand the processes driving the high biodiversity in these tropical mountains. (FAPEMIG and CNPq)

ANT COMMUNITY RESPONSES TO DIFFERENT LAND USES IN THE EASTERN AMAZON

D.L. BRAGA[1], C.R. RIBAS[1], F.A. SCHMIDT[2,3], R. ZANETTI[4] & T. GARDNER[5]

[1]Universidade Federal de Lavras, Setor de Ecologia e Conservação, Departamento de Biologia, Lavras, MG, CEP: 37200-000, Lavras, Brasil, e-mail: braga.dl@gmail.com. [2] Departamento de Biologia Geral. Universidade Federal de Viçosa, Viçosa, MG, Brasil. [3]Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre, Rio Branco, AC, Brasil. [4] Universidade Federal de Lavras, Departamento de Entomologia, Lavras, MG, CEP: 37200-000, Lavras, Brasil. [5]Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK.

Our current understanding of how ants utilize different land use systems is limited due to limitations in the sampling design of field studies, including biased choices of community metrics and a lack of control sites and adequate sample replication at landscape scales. This study aims to overcome some of these limitations by assessing responses of ant communities to land-use change at landscape scales. The ants were collected using pitfall traps in 18 catchments covering seven land uses (mechanized agriculture, pasture, secondary forest, intact primary forest, burned primary forest, primary forest with selective logging and primary forest with selective logging and burning) in the Santarém, Pará region. Variables representing environmental conditions or resources for ants were evaluated to quantify differences between land uses and their possible effects on the ant community. Mechanized agriculture had the lowest ant species richness. The abundance of ants was higher in open areas (mechanized agriculture and pasture). The composition of ants differed among pasture, mechanized agriculture and primary forest systems, while the fauna of the secondary forest, although presenting a distinctive fauna from most land use systems, is not presented as a cohesive group, which may be related to the large temporal variability and the type of matrix around these forests. Two species of ants showed value indication between 45% and 70%, one for the system of mechanized agriculture and one for grazing and can be used as detector species species of impacted systems and useful in monitoring environmental change. The composition and abundance of ants were influenced by all environmental variables, with the exception of the variation in canopy openness, while the average litter was the only variable that had an effect on the richness of ants. The species composition proved to be the best parameter to assess the differences between the different land uses. However, the richness and abundance of ants can give us information when analyzed with environmental variables. The primary forest, regardless of whether it is disturbed or not, has a fauna different from other systems, playing an important role in maintaining ant biodiversity. (CNPq)

ANT FAUNA ASSOCIATED WITH FRESHLY FALLEN LITTERFALL IN A CAATINGA ECOSYSTEM

G.S. ROLIM[1], G.T. RIBEIRO[1], F.B. GONÇALVES[1], B.A.L. FREITAS[1], M.E. CORREIA-OLIVEIRA[1] & J.O. DANTAS[2]

[1]Departamento de Ciências Florestais, Universidade Federal de Sergipe (UFS), Av. Marechal Rondon, s/n, Jardim Rosa Elze, Cidade Universitária Professor José Aloísio de Campos, São Cristóvão, SE, Brasil, e-mail: gabi_rolim18@yahoo.com.br. [2]Instituto Federal de Educação Ciência e Tecnologia de Sergipe (IFS), Br 101, Km 96, Campus São Cristóvão, São Cristóvão, SE, Brasil

Ants (Hymenoptera: Formicidae) are found in most terrestrial ecosystems, with important ecological roles in the dynamics of forests. These insects perform nutrient cycling, decomposition of organic matter, seed dispersal, and also contribute to the regeneration of native forests. The aim of this study was to perform a screening of ant genera associated with the freshly fallen leaflitter of a remaining arboreal Caatinga ecosystem located at Porto da Folha, Sergipe. Samples were collected monthly, between March 2011 and June 2012. Collector devices specific to leaflitter were scattered over an area of 49.8 ha, at a height of 50cm from the ground, for 30 days. Samples were quantified, then the insects were introduced in containers with 70% alcohol and sent to the Laboratory of Agricultural and Forest Pests / UFS for identification of the genus based on a taxonomic key. Data were analyzed using the faunistic indexes: Frequency, Abundance, Dominance and Constancy. We collected 40 individuals distributed in five genera, from which *Cephalotes* was the most constant, followed by *Camponotus*, *Crematogaster*, *Acromyrmex*, and *Solenopsis*. The relatively high amounts of individuals of *Camponotus* and *Cephalotes* collected from freshly fallen leaflitter is related to the arboreal habits showed by species of these genera, which are characterized by nesting on vegetation and fall of individuals from the trees along with the leaflitter. This study contributes to the knowledge of the ant fauna in the Caatinga biome. (CNPq, CAPES, FAPITEC/SE)

ANT FAUNA OF LEAF LITTER IN COCOA CULTIVATION IN AN ATLANTIC FOREST AREA OF THE JIQUIRIÇÁ VALLEY, BAHIA, BRAZIL

R.A. SANTOS[1, 2], A.L.B. SOUZA[1, 3], J.G. SANTOS[1], S.S. SOUZA[1], M.S. MOURA[2]& J.M. SANTOS[2]

[1]Laboratório de Biologia Geral, [2]Laboratório de Citogenética, [3]Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB), Rua José Moreira Sobrinho, S/N, CEP 45206-190 – Jequié, BA, Brasil, e-mail: ramon.bio2012@gmail.com.

Given its ecological importance, the ants are organisms that help us understand the environmental changes. It is known that about 62% of all the ants described in the world live in the soil and/or leaf litter, and up to 50% of the species the tropical forests, may be associated with this habitat. In this study, we carried out a sampling of litter ant fauna in an area of "cabruca" where the cocoa trees are planted under the shade of large trees of Atlantic Forest. Samplings were made in Araça Farm, located in Jiquiriçá Valley, in municipality of Jiquiriçá, Bahia, Brasil. The predominant climate in the region is tropical humid, with average annual temperature between 19º C and 24º C. The methodology used followed the protocol for collecting litter ants, by collecting 20 samples, 50 meters away from each other, in a transect of 1500 m. It was used pitfall traps, which remained in the field for 12 hours. After this period, the traps were collected and transferred to individual vials containing 70% alcohol. In the laboratory of General Biology of UESB the ants were mounted, labeled and identified. Twenty-six species/morphospecies, belonging to five subfamilies and 13 genera, were collected. Myrmicinae subfamily showed the highest number of species (15), followed by Formicinae and Ponerinae (with 4 species), Ectatominae (2 species) and Ecitoninae (1 species). Only one morphospecies showed a frequency higher than 50% (*Ectatomma* sp1), six had an intermediate frequency between 35 and 25% (*Pheidole* sp1, *Pheidole* sp2, *Odontomachus* sp2, *Camponotus* sp1, *Camponotus crassus*, *Wasmannia auropunctata*), and all the others showed low frequency, being found in less than 10% of the samples. The species/morphospecies sample-based accumulation curve was far way to reach an asymptote so that it becomes necessary to make a greater sampling effort to estimate the species diversity in the studied area. It was also observed that there was no correlation (-0.057) between ant species richness and the leaf litter depth. This last result could be explained possibly due to the pitfall allow sampling of the species of ants which forage the soil and do not necessarily inhabit the litter. (UESB)

ANT SPECIES RICHNESS (HYMENOPTERA: FORMICIDAE) IN TWO CERRADO VEGETATION TYPES IN THE MUNICIPALITY OF QUIRINÓPOLIS, GOIÁS - BRAZIL

F.A. SANTANA[1], J.A.V. OLIVEIRA[1] & D.M. SILVA[1]

[1]Universidade Estadual de Goiás (UEG), Unu Quirinópolis; Av. Brasil, Qd 3 Conjunto Hélio Leão II, CEP 75860-000 Quirinópolis, GO,Brasil, e-mail: fassantana@yahoo.com.br

The Cerrado occupies 21% of the national territory, representing the second largest biome in Brazil, surpassed in area only by the Amazon region. It is a heterogeneous vegetation formation, resulting from interactions of biotic and abiotic parameters that determine quantitative and qualitative aspects of its vegetation. These are areas with high biodiversity that are highly threatened by the expansion of anthropic activities, a fact that has qualified the biome as a diversity hotspot. Based on the importance of this designation, the present study aimed to catalog the faunal composition of two forest types in this biome: Riparian Forest and Gallery Forest, which are showing signs of degradation. The study was conducted between the months May and October 2012, including the dry season and the transition to the rainy season, near the Douradinho Farm located 30 km outside the city of Quirinópolis in the state of Goiás - Brazil. To capture the insects, sardine baits and pitfall traps were used, arranged in transects of about twenty-five meters each. The collection area covered approximately 400m. We collected a total of 10,878 ants, with 24 species found in Gallery Forest (GF) and 22 in Riparian Forest (RF), belonging to 6 subfamilies. 4,461 individuals were captured in the GF (0.41%) and 6,417 (0.59%) in the stretch of RF. *Megalomyrmex* sp was the most representative species in abundance with 5,400 individuals collected (49.64%), followed by the genus *Pheidole* sp with 1,677 ants (15.41%) and *Wasmmania* sp with 1,393, (12.80%) of the total number of individuals captured. Of the 32 species collected in the RF and GF, nine (28%) were represented by a single record for the two sample areas, being respectively five individuals for RF and four for GF. The species represented by a single record amounted to almost one third of the species collected, and are probably rare in these places, thus having a lower abundance than the other ants in this study. A number of studies in neotropical regions show a high incidence of rare species of ants in one community. Of the 24 species found in the GF, 10 were found exclusively in this physiognomy, while of the 23 species collected in the RF, 8 were endemic to this area, for this experiment. For the species *Camponotus scutellaris*, 528 individuals were found only in the RF, and 59 individuals from *Camponotus pensylvanicus*, only in the GF. Despite the variation shown, there was a high degree of similarity between the ant species in the study sites, due to the structural similarity of the vegetation, such as the presence of characteristic plant litter observed in both habitats, or to the interference that the environments suffer.

ANTS ASSOCIATED WITH CROP-LIVESTOCK-FOREST INTEGRATION SYSTEM (CLFIS) IN PONTA GROSSA, PR, BRAZIL

M.F.O. MARTINS[1,2], W.R. FILHO[1,3], S.R.C. PENTEADO[1], M.A. NICKELE[4] & M.J. THOMAZINI[1]

[1]Laboratório de Entomologia, Embrapa Florestas, Estrada da Ribeira, km 111, Jardim Cristina, C. Postal 319, CEP: 83411-000, Colombo, PR, Brasil, e-mail: milafomartins@hotmail.com. [2]FUNCEMA- Fundo Nacional de Combate de Pragas Florestais. PR [3]EPAGRI- Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, SC. [4]Universidade Federal do Paraná, Curitiba, PR.

The Crop-Livestock-Forest Integration Systems (CLFIS) emerge like a sustainable form to elevate the potential of agricultural productivity and, at same time, to protect the water and soil. Besides that, CLFIS amplify the nutritional cycle of soil nutrients, supply thermal comfort to the animals and, with this, reduce the production costs. Because of a relatively new activity, few studies was realized in relation to abundance of macro, meso and microfauna and the populations dynamics in CLFIS, that are important items to an adequate pest management, because, especially the insects, can damage the forest and agricultural components, reducing the efficacy of the system. The aim of this study was to identify the ants presents in different soil strata present in the CLFIS. Samples were collected in June (2012), in the “model farm” that possess a crop-livestock-forest integration with *Eucalyptus* sp. lines, owned by IAPAR (Agronomic Institute of Paraná), in Ponta Grossa, PR (25º5′11”S; 50º9′38”W, with a characteristic vegetation like “General Fields”. The utilized method was the TSBF (“Tropical Soil Biology and Fertility”), Anderson & Ingram (1993), which is the analysis of monoliths with dimensions of 25x25x30 cm, in three layers (0-10, 10-20, 20-30cm), plus the leaf litter within a square of 25x25cm. The material was screened at Order level in the field and stored in 70% alcohol. Thirty eight morphospecies belonging to five subfamilies and 21 genera were identified: Dolichoderinae (*Conomyrma*, *Forelius*, *Hypoclinea*, *Liometopum* e *Tapinoma*), Ecitoninae (*Chelioyrmex* e *Neivamyrmex*), Formicinae (*Brachymyrmex*, *Camponotus*, *Formica* e *Prenolepis*), Myrmicinae (*Acromyrmex*, *Solenopsis* e *Trachymyrmex*) e Ponerinae (*Cylindromyrmex*, *Dyscothyrea*, *Heteroponera*, *Hypoponera*, *Odontomachus*, *Pachycondila* e *Proceratium*). The genus with largest number of species was *Brachymyrmex* (seven), followed for *Camponotus* (five), *Neivamyrmex* (four) and *Heteroponera* (three), the other genuses alternated between one and two morphospecies. The genus with the largest number of collected individuals was *Brachymyrmex* (180). The stratum with the largest number of genus was 0-10 cm, followed by litter and by stratum 10-20 cm. It was not found ants in the soil level 20-30cm. New collections are needed to further elucidate the occurrence of ant species and its correlation with the strata, at different periods of the year.

ANTS GUILDS OF THE MOUNTAIN STATE PARK HILLS HIGH, ORANGE SEBASTIAN AND CANDIBA, BA.

I.N. ROCHA[1], D.A. NEVES[2] J.T SANTOS[1], L.G.B. SORTE[1], R.C. BRITO[1] & J.S. CARDOSO[3]

[1]Discente do Curso de Ciências Biológicas, Campus VI, Universidade do Estado da Bahia (UNEB), Av. Contorno, S/N, CEP 46.4000.000 - Caetité, BA, Brasil. josieiabiologa@gmail.com [2]Discente da PPG Programa de Pós-graduação em Ciências Agrárias - Centro de Ciências Agrárias, Ambientais e Biológicas - Universidade Federal do Recôncavo da Bahia (CCAAB/UFRB). [3]Docente do Departamento de Ciências Humanas, Campus VI, Universidade do Estado da Bahia.

Guilds are groups of species that exploit the same class of environmental resources in a similar way. They are identified taking into account their taxonomy, trophic preference, nesting site, foraging strategies, recruitment methods and agility. Some studies use the ant guild concept to allow a better understanding of fauna dynamics of a particular habitat. The ant fauna of the State Park of Serra dos Montes Altos (state of Bahia – Brazil) is poorly known. This study aimed to analyze the environmental conditions of this locality, using the ant classification in guild as a tool. The study was conducted in two areas of the park located in the cities of Orange Sebastian and Candiba. Pitfall traps and Winkler extractor methods were used to sample the ant fauna. The sampled material was sorted and identified in the Laboratory of Animal Studies (LABEA/UNEB- Campus VI). Classification in guilds was performed according to Delabie et al. (2000) and Silva and Brandão (2010). Eight guilds were identified in the two areas (Sebastian Orange and Candiba). A greater number of guilds (7) was found in the Candiba area: big epigaeic predators, generalist predators, fungus cultivators, Attini fungus growing ants with huge colonies (*desfolheadoras*), dominant arboreal ants with mass recruitment system, epigaeic nomad ants and agile Pseudomyrmecinae. In the Orange Sebastian area, six guilds were found. One of them (Myrmicinae specialized predators) was found only in this area, while dominant arboreal ants with mass recruitment system and epigaeic nomadic ants were found only in the Candiba area. The two studied areas have therefore differentiated guilds that could indicate a considerable diversity of available niches. This study is ongoing.

ANTS IN THE MUNICIPALITY OF SÃO JOÃO DO OESTE, SANTA CATARINA STATE, SOUTHERN BRAZIL, IN AN AREA OF DECIDUOUS FOREST

C.L. KLUNK[1,2], F.B. ROSUMEK[1] & B.C. LOPES[1]

[1]Laboratório de Biologia de Formigas, Departamento de Ecologia e Zoologia, Centro de Ciências Biológicas, Universidade Federal de Santa Catarina (UFSC), Rua Engenheiro Agrônomo Andrey Cristian Ferreira, s/n, CEP 88040-900, Trindade, Florianópolis, SC, Brasil, e-mail: cristian_klunk@yahoo.com. [2]Programa PET Biologia UFSC.

The state of Santa Catarina (SC) is privileged because of its good information about their ant fauna, coming from works carried out since the middle of last century, thanks to the efforts of the naturalist Fritz Plaumann, and more recently of several researchers. Nevertheless, a recent review pointed out gaps in knowledge and indicated priority regions and ecosystems for surveys in the state, among which the deciduous forest. These ecosystems are included in the Atlantic Forest domain and exhibit a high degree of fragmentation in SC. Thus, this work aimed to make a rapid inventory of the ant fauna in deciduous forest fragments in the municipality of São João do Oeste, far-west of SC. The samples were taken in a fragment of 9 ha, between the months of July and August 2012 and in January 2013. For collections, sardine baits were used, which were arranged in 100 meters long transects, with 10 baits per transect, being left for about an hour on the ground. We made two transects in winter and four in summer, for a total of 60 baits in five days of collection. Furthermore, to complement the collections with baits, manual collections were made in soil and vegetation along the same transects, and manual collection in an area apart. We found a total of 47 species, being 12 exclusives of manual collection and 6 found only in the area apart. These 18 species were not considered for the analysis of frequency and species accumulation curve. The species found belong to 22 genera and 7 subfamilies, namely: Dolichoderinae (2 spp.), Ecitoninae (2), Ectatomminae (2), Formicinae (11), Myrmicinae (22), Ponerinae (5) and Pseudomyrmicinae (3). The most frequent species were *Pheidole* sp.1 (f=0,60), *Solenopsis* sp.3 (0,32), *Pachycondyla striata* (0,27), *Odontomachus chelifer* (0,23) and *Solenopsis* sp.4 (0,23). *Apterostigma* cf. *acre* and *Apterostigma* cf. *goniodes* would be new records for SC, but it still needs to be confirmed. For data relating to collections with baits, we made a random species accumulation curve. The curve did not reach an asymptote, indicating that more species can be found in the region, showing the importance of keep doing samplings in these areas. The curve in question also indicates that the sampling was low, showing that more samples should be made with baits, beyond the use of other standard methods, since the sardine baits attract a limited part of the community of ants, according to their eating habits and micro habitat ecology.

ANT RICHNESS (HYMENOPTERA: FORMICIDAE) IN REFORESTED AREAS AND AN ATLANTIC FOREST FRAGMENT IN SERGIPE STATE

G.T. RIBEIRO[1], M.E. CORREIA-OLIVEIRA[1], G.S. ROLIM[1], J.O. DANTAS[2], L.S. SOUTO[1] & E.C.F. GOMES[1]

[1]Departamento de Ciências Florestais, Universidade Federal de Sergipe (UFS), Av. Marechal Rondon, s/n, Jardim Rosa Elze, Cidade Universitária Professor José Aloísio de Campos, 49.100-000 - São Cristovão, SE, Brasil, e-mail: genesiotr@hotmail.com; [2]Instituto Federal de Sergipe, Campus de São Cristóvão, São Cristóvão, SE, Brasil

Deforestation and monoculture are the main impacting activities that negatively affect the native fauna of tropical ants. The study of ants as biological indicators is an useful tool to evaluate the state of preservation in terrestrial environments. This study aimed to evaluate the epigaeic ant fauna and the effect of reforestation on ants richness in two reforested areas comparing with an area of native forest fragment (NFF), located in the municipality of Laranjeiras, Sergipe State. One reforested area with seven years old and other with five years old, before cultivated with sugar cane. Collections were made in February (dry season) and June 2012 (rainy season). Pitfall traps were distributed in five transects (20 x 50m), distant one of the other 150 meters. In each transect was installed five traps without bait, separated from 10 meters, totaling 25 traps / area. The traps were placed in soil and remained for 48 hours. The biological material collected was sorted and separated for identification in the Laboratory of Pest Agricultural and Forestry at the Federal University of Sergipe, in Community Ecology Laboratory at the Federal University of Viçosa, and Laboratory of Myrmecology CEPEC / CEPLAC in Ilheus, Bahia State. We sampled 5,908 specimens of ants, being 82 morphospecies, distributed into 31 genera and seven subfamilies: Myrmicinae (42), Formicinae (12), Dolichoderinae (7), Pseudomyrmecineae (7), Ponerinae (5), Ectatomminae (5) and Ecitoninae (4). The ants richness did not differ between the three studied environments ($F = 1.71$, $p = 0.19$). The results suggest that five years after reforestation are enough to recover ant species richness. However, the native forest fragment (NFF) had 34 species restricted and only seven species common to the three environments. On the other hand the reforested areas 1 and 2 had a lower number of restricted species, 12 and 5, respectively. The high occurrence of the species *Pheidole* sp. 4 and *Camponotus renggeri* in NFF and species *Pheidole* (Fallax group) sp. 7, *Camponotus* (*Myrmaphaenus*) sp. 9, *Crematogaster abstinens* and *Cyphomyrmex transversus* in the reforested areas 1 and 2, is an indication that these species could be used as bioindicators of forest reforestation in Sergipe state. (CNPq, CAPES, FAPITEC/SE)

ANTS SEEK A BALANCED DIET?

F.F.S. SIQUEIRA[1,2], L.F.P. GOUVEIA[1,2] & I.R. LEAL[1,2]

[1]Programa de Pós-Graduação em Biologia Vegetal, Universidade Federal de Pernambuco. Av. Prof. Moraes Rego, s/ no, Cidade Universitária, CEP 50670-901, Recife, Pernambuco, Brasil, e-mail: felipe.uast@gmail.com. [2]Departamento de Botânica, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego, s/ no, Cidade Universitária, CEP 50670-901, Recife, Pernambuco, Brasil, e-mail: irleal@ufpe.br

Ants have very different eating habits, varying from a preference for foods rich in carbohydrate resources to almost exclusively protein. There are still ants that seem to balance their diet, feeding on different sources and acquired all the necessary nutrients. This study aimed to understand whether the ants of the species *Dorymyrmex thoracicus* (Dolychoderinae, Formicidae) are more aggressive after a diet composed by a high concentration of carbohydrate, which increases the level of sugar in the body of these ants and, consequently, leads to greater demand for protein. The study was conducted in the Parque Nacional do Catimbau (8º24"00" and 8º36"35" South and 37º09"30" and 37º14"40" West), located in Pernambuco state, Northeast Brazil. Baits of sugar and protein were offered alternatively to 18 nests of *Dorymyrmex thoracicus* in order to verify if after the sugar supply (1) the time of discovery of protein bait is shorter and (2) the number of ant discovering the bait is higher. We also use three different sugar concentrations (0.09g/mL; 0.17g/mL; 0.26g/mL) with the intention of investigate if the ant response is more intense as sugar concentration increases. Both the time of discovery of protein bait and the number of ant discovering the bait were not different before and after sugar apply. In the same way, there were no differences in the time of discovery of protein bait and in the number of ant discovering the bait among sugar baits of different concentration. These results indicate unbalanced diet of these ants. The hypothesis of the defense and dominance of the feature seems to explain best the observed pattern. It is important to emphasize the importance of further studies to elucidate ant foraging behavior of ants that facilitate the understanding of the behavior of ants in front of a unbalanced diet (C: N). (FACEPE, CNPQ)

ANTS, CATTLE GRAZING, AND THE SOUTH BRAZILIAN GRASSLANDS: PRELIMINARY RESULTS, AND PROSPECTS OF A LONG-TERM ECOLOGICAL RESEARCH

W. DRÖSE[1,2], M.Z. DAVID[1], L.R. PODGAISKI[1,3], A. CAVALLERI[1], M.S. MENDONÇA Jr.[1] & V.D. PILLAR[3]

[1]Laboratório de Ecologia de Interações, Departamento de Ecologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul (UFRGS), Av. Bento Gonçalves, 9500, CEP 91501-970 – Porto Alegre, RS, Brasil, e-mail: william_drose@hotmail.com. [2]Programa de Pós-graduação em Biologia Animal, UFRGS, Porto Alegre, RS, Brasil. [3]Laboratório de Ecologia Quantitativa, Departamento de Ecologia, Instituto de Biociências, UFRGS, Porto Alegre, RS, Brasil.

Grasslands are widespread ecosystems in Southern South America, mostly in Argentina, Uruguay and Brazil. In South Brazil grasslands overall are known as *Campos Sulinos*. Cattle grazing predominates as the traditional land use in these ecosystems, which besides the economic importance also ensures the maintenance of typical grassland vegetation physiognomy and biodiversity. There is a lack of information about terrestrial arthropod biodiversity at *Campos* grasslands, especially concerning faunal responses to disturbances and management. Here we use ants as a bioindicator group to experimentally investigate the relationship between cattle grazing and arthropod diversity in these ecosystems. This work is part of a long term ecological research network (PELD Campos Sulinos - CNPq) in which an experimental setup is distributed over six grassland sites in Rio Grande do Sul State. Each site represents a block with three 70 x 70 m plots subjected to different grazing treatments: (1) complete grazing exclusion; (2) traditional continuous grazing management, and (3) sustainable rotational grazing management. Arthropods have been sampled during summer with pitfall traps (8 *per* plot during 7 days) and sweep net. We present results of the first year of the experiment (2011), comparing only ground dwelling ant assemblages between treatments 1 and 2 in five sites. Overall, we gathered 4,132 individuals from 22 genera. The most abundant genera were *Pheidole* (52%), *Solenopsis* (19%), *Camponotus* (6%), *Brachymyrmex* (4%), *Nylanderia* (3%), and *Cyphomyrmex* (3%). On average, we found 52 individuals and five genera *per* pitfall trap. There is evidence that ant abundance and genus richness decreased under grazing exclusion. We found negative correlations between vegetation biomass (g) and both log-transformed ant abundance ($r= -0.76$; $p= 0.04$) and rarefied ant richness ($r= -0.78$; $p= 0.008$). Principal coordinates analysis (PCoA) indicated that the most important variation in genus composition was among sites, not between treatments. Ant sorting of the other experimental plots and years, and species taxonomic identification are in progress. We will also apply a functional approach to search for trait patterns in ant community responses to grazing management to infer the mechanisms behind habitat change responses. Ant species will be described by morphological and feeding behavioral traits, which may be linked to plant functional traits and microenvironmental conditions affected by the grazing treatments. Understanding the relationship between grazing management and ant taxonomic and functional diversity may enable us to better manage and conserve biodiversity of South Brazilian grasslands. (CNPq)

ARBOREAL ANT COMMUNITY ASSOCIATED WITH *Sclerolobium paniculatum* PLANTS IN CERRADO *SENSU STRICTO* IN MUNICIPALITY OF IPAMERI-GO

A.M. SILVA[1], C.A. RODRIGUES[1,2], D.A. da SILVA[1], N.M. MARTINELLI[2] & M.S. ARAÚJO[1]

[1]UEG – Universidade Estadual de Goiás, UnU Ipameri. GO 330, Km 241, Anel Viário, S/N, CEP 75780-000 - Ipameri, GO, Brasil, e-mail: arethf@yahoo.com.br. [2]Departamento de Fitossanidade, Universidade Estadual Paulista, Campus de Jaboticabal (FCAV/UNESP), Jaboticabal, SP, Brasil.

Notably, what has been observed in Brazil is the lack of entomological studies with native forest species. The *Sclerolobium paniculatum*, also known as coal and white-taxi is a plant that shows great potential for use in the Cerrado, which is considered a mosaic of biomes. We can't discuss terrestrial biodiversity without to mention the ants; in many environments they represent most of the arthropod fauna. This study aimed to identify the arboreal ants that occur associated with the *S. paniculatum* in Cerrado *sensu stricto*, in Ipameri, Goiás. This was done in a hill area, containing cerrado fragments, where we selected a fragment and in this, at random, six trees were selected along a transect 100 meters long. The collecting were made by pitfall traps (baited) which consisted of a plastic glass with capacity of 110 milliliters, and for each tree were used two traps with different baits, one containing sardine and the other containing honey, settled at a maximum of two meters high. These were settled in the morning and remained for about two hours and then were removed and sent to the Laboratory of Entomology of Universidade Estadual de Goiás (UEG), Ipameri Unit, for sorting specimens. After sorting and identification in morphospecies level, the collected ants were assembled, properly labeled and sent to the Laboratory of Myrmecology do Centro de Pesquisas do Cacau (CEPLAC) for species identification. There were two collections per month for one year, from July 2011 to June 2012. We collected 27 ant species, distributed in six subfamilies (Formicinae, Myrmicinae, Pseudomyrmicinae, Ectatomminae, Dolichoderinae, Ponerinae). Formicinae had the greatest number of species (10), followed by Myrmicinae (nine), Pseudomyrmicinae (three), Ecatomminae and Dolichoderinae (two) and Ponerinae (one). The Formicinae also had the highest number of species by genus, being, *Camponotus* (six) and *Brachymyrmex* (four). From the 24 collections, the species which showed the highest frequency were the *Crematogaster stollii*, found in all 24 samples and *Camponotus senex,* found in 21 samples. *Camponotus renggeri*, *Camponotus melanoticus* and *Cephalotes pusillus* scored the lowest frequencies being present in 4.17% of the collected samples. The number of ant species found in a single plant species shows an intense relation of ants with vegetation. Many ants use the plants as a substrate for foraging, using different foods derived from plants and in exchange they protect it from herbivores. A single tree can harbor a complex ecosystem. (CNPq)

ARE SMALL FRAGMENTS JUST EDGES? RESPONSE OF ANT SPECIES COMPOSITION TO THE COMBINED AREA AND EDGE EFFECTS

T.G. SOBRINHO[1] & J.H. SCHOEREDER[1]

[1]Departamento de Biologia Geral, Universidade Federal de Viçosa-UFV, Av. PH Rolfs, S/N 36570-000, Viçosa-MG; Brasil, e-mail: tathianasobrinho@gmail.com

Habitat fragmentation has been pointed as a main cause of changes in species richness, abundance and composition in tropical environments. This work tests an hypothesis relative to alterations of ant species composition generated by forest fragmentation due to combined area and edge effects. We tested the hypothesis that in the smaller fragments there are a more similar composition among edge and core than in larger ones. We carried out the ant sampling in ten remnants with areas ranging from 3 to 100 ha, in the region of Viçosa, MG. In each remnant we collected ten $1m^2$ samples of litter in the edge and ten in the core. We sifted litter samples and put into a Winkler extractor, to remove the ants. To test our hypothesis we conducted ten NMDS, one per each remnant, between edge and core, followed by the one-way analysis of similarity (one-way ANOSIM) to obtain the R value. R statistic, which is the measure of dissimilarity between sites, varies from zero to 1, values close to zero indicate low dissimilarity while values of R closer to 1 indicate high dissimilarity. To use R values in a new approach, in which NMDS turns into a measurable response variable, we performed a GLM using the R value as the response variable and the remnant area as the explanatory variable. According to the expected, the R value decreased with the area of the fragment, showing that in smaller fragments edge and core are more similar than in larger ones ($p<0,0001$). Concluding, forest fragmentation causes alterations on ant species composition and these changes are more pronounced in smaller remnants, which would sustain smaller populations and are more prone to invasion and to edge effects, because they present a higher relative edge. (FAPEMIG, CNPq)

AREAS RECENTLY BURNED PORTRAY A HIGHER RATE OF ANTS NESTING, MAINLY ON THE VEGETATION

R.L. CARVALHO[1], D.V. ANJOS[2], R. FAGUNDES[3] & S.P. RIBEIRO[2]

[1]Department of Biodiversity, Evolution and Environment/ICEB, , Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Federal University of Ouro Preto, Ouro Preto, Minas Gerais, 35400-000, Brazil, email: raqueluly@gmail.com. [2]Department of Biodiversity, Evolution and Environment/ICEB, Post-Graduate Program in Ecology of Tropical Biomes, Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Federal University of Ouro Preto, Ouro Preto, Minas Gerais, 35400-000, Brazil. [3]Post-Graduate Program in Ecology and Conservation of Natural Resources, Laboratory of Behavioral Ecology and Interactions, Federal University of Uberlândia, Uberlândia, MG 38400-902, Brazil.

Fire is a type of disturbance that causes alteration in habitats and decreases resources, It is more intense in small-scale and mostly affects small animals such as arthropods. On the other hand, ants are resilient and resistant to fire, they quickly recolonize disturbed environments. Thus, post-fire environment may favor the establishment of new colonies and dispersion of ants satellite nests due to the low competition for resources by species tolerant to the conditions of these environments. Thereby the objective of this study was to evaluate the ability of ants nesting in recently burned environments and in other places where have burned longer. We hypothesized that low competition environments of early succession, especially for nesting sites, favor the ants nesting. Therefore, nest traps (® 15mL Falcon tubes) were installed in Itacolomi State Park, PEIT (Minas Gerais, Brazil) at the beginning of the reproduction period (October 2012). Twenty traps were installed (spaced 10m) in two areas: burned 2 years ago (recent fire) and burned 12 years ago (late fire). Half of the traps were placed on the soil and half of them on the vegetation (2m height), totalizing 80 nests traps. Nests were found in 15 traps, with the presence of queens, workers, soldiers, eggs and pupae. There was no difference in the rate of nesting between areas (burned=22.5% and unburned=15%; GLZ nested: $X^2=0.74$, $p=0.38$). However, the number of nests built on vegetation (12) was higher than the number of nests built on the soil (3, $X^2=7.13$, $p=0.03$). Three ant species were found: *Camponotus crassus*, *C.* (*Tanaemyrmex*) sp.1 and *Cephalotes pussilus*. *C. crassus* was the most frequent, present in 75% of occupied traps. Nests of recently burned areas had a higher number of eggs, pupae and adults (GLZ nested model: $X^2=33.71$, $p<0.01$; $X^2=47.13$, $p<0.01$; $X^2=10.11$, $p<0.01$, respectively). In addition, the vegetation had nests with more eggs ($X^2=42.84$, df=2, $p<0.01$), pupae ($X^2=262.45$, $p<0.01$), and adults ($X^2 =116.87$, p<0:01). Similar to that found by other studies, *C. crassus* was also the most common specie. Furthermore, ants of the genus *Camponotus*, such as *C crassus*, have been the most dominant in these areas where were burned recently, which may have led these population of ants to expand their nests, mainly due to the large number of satellite nests. The trap was effective in capturing *Camponotus crassus*, which can facilitate the biology study of these species in the future. This technique may also be important in capturing the nests of other ant species and their manipulation in the laboratory. (FAPEMIG, CAPES, UFOP)

ASSEMBLY OF ARBOREAL ANTS IN FOREST FRAGMENTS OF THE BORDER WITH THE SEMIARID OF THE WILD OF THE BAHIA STATE

E.S. ARAUJO[1], E.S. CONCEIÇÃO[1], P.S. SANTOS[1], C.M. NASCIMENTO[1], T.S. ROCHA[1] & J.H.C. DELABIE[2].

[1]Universidade do Estado da Bahia. Departamento de Ciências Exatas e da Terra, Campus II. Km 03, Rodovia Alagoinhas-Salvador, Zona Rural, CEP: 48.040-210, c.p 59. Alagoinhas-BA, Brazil. eraraujo@hotmail.com.br. [2]UESC/CEPLAC- Laboratório de Mirmecologia. Ilhéus, Bahia, Brazil.

The North Coast Land and Wasteland of the Bahia holds ecosystems belonging to different biomes, setting up an ecotone. The vegetation characteristics, among other factors such as human disturbance and colonization of opportunistic species, can influence the structure of ant communities. The study was conducted in three forest fragments located in the Northern Territory coastline and Wasteland Baiano, quote: Forest Fragment Project Pivot, Inhambupe city/BA (11°50'56 " S, 38°29'23,792'W) and the Project Ouriçanguinhas, Ouriçangas city/BA (11°58'14" S, 38°33'7"W), with similar physiognomic characteristics and typical dense rain forest, as well as the fragment Project Biritinga in Satiro Dias city/BA (11°34'38"S, 38°42'0.5"W), considered caatinga forest. The aim of this study was to characterize the assembly of arboreal ants of forest fragments in the region bordering the semi-arid North Coast Land and Wasteland Baiano. Sampling occurred from September to December 2012, applying the method of manual collection, by 50 points, at a distance of 50 meter apart and 100 meter from the edge. The sorting and assembly of ants were performed at the Laboratory of Zoology, campus II - UNEB and Myrmecology Laboratory CEPEC. The relative frequency of the species was calculated and the most frequent choice was made based on the calculation of the 5% percentile. The program Estimates® was used to analyze diversity (Shannon Wienner) and Wealth (Chao 2) indices. Cluster analysis was performed resulting in a similarity dendrogram from the MVSP®. It was recorded a total of 20 species of arboreal ant subfamilies Ectatomminae, Formicinae, Pseudomyrmecinae and Myrmicinae. The most frequent species were *Pseudomyrmex holmgreni* and *Cephalotes pusillus*, Pseudomirmicinae and Myrmicinae respectively. The diversity index and species richness was higher in fragment Inhambupe city, 2.12 and 24.52, respectively. With regard to diversity, this was followed by the Ouriçangas city (1.99), which has the same characteristics and ecological physiognomy. However, with respect to wealth, the second highest value was observed in fragment Satiro Dias city (12.88). The cluster analysis showed the existence of similarity between both fragments Satiro Dias city and Inhambupe city. Among the ants observed in the treetops of the forest fragments studied in the border region with semiarid North Coast Land and Wasteland of the Bahia, Poneromorph occurence was low. There was similarity in relation to the myrmecofaunal composition between fragments, despite the difference in relation to their ecological characteristics and physiognomy, which are representative of different biomes. However, species diversity was higher in forest fragments typical of the Atlantic Forest Biome. (PRONEX SECTI-FAPESB/CNPq, project PNX 0011/2009; FAPESB)

AVOIDING A POSSIBLE DISTURBING EFFECT WHEN INSTALLING PITFALL TRAPS

C.J. LASMAR[1], R.G. CUISSI[1], A.C.M. QUEIROZ[1,2], A.M. RABELLO[1,2], E.O. CAÑEDO-JÚNIOR[1,2], F.A. SCHMIDT[1,2] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras, Lavras, MG, Brasil, CEP 37200-000, e-mail: chaimlasmar@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

Installation of pitfall traps can interfere in captured ant species abundance and richness. The digging-in effects when installing epigaeic pitfall traps influences ant catches, increasing them, which is supposed to be caused by the excavation to bury the pitfall, which attracts a high number of ants interested in exploring the new element available in their foraging zones. Some authors keep traps closed during some time after installation to avoid this effect on epigaeic pitfalls. Until currently, any possible effect of installation time of arboreal pitfall traps on arboreal ant catches has never been tested. The aim of this study is to detect the possible disturbing effect of installing epigaeic and arboreal pitfalls on captured ant species abundance and richness. We conducted the study in three remnants of semideciduous forest in the south of the state of Minas Gerais, Brazil. Ants were sampled in September 2011, in the dry season. We installed two grids in each remnant, separated by 50 m. Each grid was composed of a 6 x 6 m quadrant in which we installed nine epigaeic and nine arboreal pitfall traps. They were initially kept closed with their own lid, and we opened each trap at a different time (0 – opened at the moment of the installation, 1, 2, 3, 4, 5, 6, 7 and 15 days after installation). To evaluate the disturbing effect of the installation, we constructed generalized linear models with mixed effects. The abundance of epigaeic ants increased with the time spent to open the pitfall, however there was no effect on epigaeic species richness. We detected an increase in arboreal ant species abundance and richness with time spent to open the pitfall. In both cases, it seems that ants are avoiding the trap in the first instance, probably because they are running away from disturbance. Then, there is a massive attractive effect, resulting in a direct increase in abundance of both epigaiec and arboreal ants and indirect in arboreal species richness. It is common in ant ecology studies not to use the ant abundance as a parameter because it could be influenced by colony proximity and by the different ant species foraging strategies. Since we did not detect a disturbing effect on epigaiec species richness, we do not recommend that pitfalls should be kept closed after installation. For ecology studies that aim toward better sampling of the arboreal ant species richness and whether it is economically feasible, we recommend keeping the pitfall traps closed for four days, since this is the time duration before opening the pitfall after which we begin to capture higher species richness. (CAPES, CNPq, FAPEMIG)

“CABRUCA” ANTS OF THE MUNICIPALITY OF ITAMARI, BAHIA, BRASIL

A.L.B. SOUZA[1], M.A.M. NOGUEIRA[1], E.B.A. KOCH[1], L.M. CINTRA[1], L.B. SOUZA[2] & L.B. SOUZA[3]

[1]Laboratório de Biologia, Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB), Av. José Moreira Sobrinho, S/N, CEP 45206-190 – Jequié, BA, Brasil. e-mail: anabiggi@bol.com.br. [2]DILAB, Instituto do Meio Ambiente, Maceió, AL, Brasil. [3]Laboratório de Análises Clínicas, Maceió, AL, Brasil.

In southeastern Bahia, some areas of the Atlantic Forest biome are associated with forest agrosystem deployed in the form of "cabruca", where the planting of cocoa, *Theobroma cacao* L. (Malvaceae), occurs under the shade of native trees large, after thinning the forest, from the removal of wood thinner; so, the cacao trees are planted under cover shaded and thinned the original forest. Several studies show that this system has the advantage of preserving part of the regional flora and fauna, as observed previously, which showed that this agrosystem has an ant fauna richness approaching that of the Atlantic Forest, one of the highest in the world for a crop. This study aimed to survey the ant fauna occurring in an area of "cabruca" in the municipality of Itamari, Bahia, Brazil. The ants were collected on days June 11 and August 21, 2010, at De Bier Farm (13 ° 46 ' 40 " S, 39 ° 41' 20 " W). They were obtained from a total of 50 samples of 1m² of litter at intervals of 50 m, for packaging the same on Winkler sacks. The material was sieved in the field and kept in the sacs for 48 hours for sampling ants. After the screening, they were mounted, identified and deposited in the collection of the Laboratory of Biology of UESB, at Campus of Jequié. The occurrence of 81 morphospecies/species in 30 genera was recorded, belonging to subfamilies: Myrmicinae (59%), Ponerinae (20%), Formicinae (8.6%), Dolichoderinae (6%), Ectatomminae (5%) and Cerapachyinae (1.2%). The subfamilies Myrmicinae and Ponerinae had higher species richness; the predominance of Myrmicinae can be explained to be the most abundant subfamily and include a group of ants deeply adaptable to diverse ecological niches in the Neotropics. Already a representation of various species of Ponerinae reflects that "cabruca" provides ecological niches for many predator species, generalists and specialists registered, occurring in this subfamily. The Shannon diversity index (3.92), reflects the community of ants sampled, consisting of a large number of dominant morphospecies/species at the expense of rare species, as recorded for the genera *Pheidole* and *Solenopsis*, which together accounted 30,9 % of all species. The diversity of ants collected reflects part of litter myrmecofauna occurring in Itamari, since the collector curve indicated that the ant community has not been fully sampled by virtue of a representative ascent in its final portion. The results show that the composition of “cabruca” litter ants in municipality studied is representative and contributes to the regional diversity of ants in the Atlantic Forest in southern Bahia. (UESB, FAPESB, CNPq)

CANOPY ANTS OF A TROPICAL DRY FOREST: EFFECTS OF SECONDARY SUCCESSION AND HABITAT STRUCTURE AT TWO SPATIAL SCALES

F.S. NEVES[1] & R.N. GARRO[1]

[1]Laboratório de Ecologia de Insetos, Instituto de Ciências Biológicas, Departamento de Biologia Geral, Universidade Federal de Minas Gerais (UFMG), Av. Antônio Carlos, 6627, CEP 31270-901 - Belo Horizonte, MG, Brasil, e-mail: fred.neves@gmail.com.

Ants are important for the maintenance and functioning of biodiversity in the canopy. However, only a few studies investigated the patterns and mechanisms that determine the distribution of canopy ants in tropical dry forests (TDFs). The objective of the present study was to describe the community structure of ants in the canopy of a TDF and to test the following hypotheses: (i) during secondary succession richness is maintained, beta diversity among trees increases, and species composition changes; and (ii) habitat structure determines the richness and the beta diversity of ant species in the canopy at two spatial scales. Sampling was conducted in trees at dry and wet seasons (September/2010 and February/2011) using two complementary techniques: pitfalls and branch beating. We used general linear models and PERMANOVA to test these hypotheses. A total of 60 ant species were collected in the canopy. Ant species richness did not differ between successional stages ($p > 0.05$), and habitat variables did not determine ant species richness at the studied spatial scales ($p > 0.05$). Nevertheless, changes in ant species composition were observed in the course of secondary succession ($p = 0.009$). At a smaller spatial scale, beta diversity between trees was positively affected by host tree height and negatively affected by connectivity among trees ($p < 0.05$). Local interactions among ants, plants, and trophobionts, as well as the presence of dominant ant species, are probably the mechanisms that maintain ant species richness and beta diversity in the canopy during secondary succession, while habitat structure becomes more complex. (FAPEMIG, CNPq)

COMPARISON BETWEEN ANT FAUNA ON BURITI (*Mauritia flexuosa*) AND ANT FAUNA OF SOIL IN WETLAND AREAS

F.F. RIBEIRO[1], C.B. COSTA-MILANEZ[1] & S.P. RIBEIRO[1]

[1]Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Department of Biodiversity, Evolution and Environment, ICEB, Universidade Federal de Ouro Preto, CEP: 35.400-000, Ouro Preto, Minas Gerais, Brasil, e-mail: ffribeiro1@gmail.com.

Wetland areas in the Brazilian Cerrado, known as "veredas", represent ecosystems formed on sandy soils with high concentrations of peat, and are responsible for recharge of aquiferous reservoirs. These areas are ecological and socially important wetland systems, colonized by an endemic species, the buriti (*Mauritia flexuosa* L.). The buriti is a palm tree with erect stipe up to 35m, with large leaves disposed like a fan and yellowish flowers in bunches. In this study we compared the ant fauna of soil and buriti in wetlands areas, since these areas suffer direct influence of seasonality. We selected four independent veredas, two being impacted by *Eucalyptus* monoculture (one younger and one mature) and two with no surrounding plantations. Ant sampling was conducted in May 2010, February and October 2011, and March 2012 using pitfall traps (soil and buriti) with saline solution. A total of 1,706 ants were sampled, belonging to 7 subfamilies, 31 genera and 103 species. The most abundant ants in soil were *Atta sexdens* Linneaus (270), *Dorymyrmex* sp1 (191), and *Dorymyrmex spurious* Santschi (140), such *Brachymyrmex* sp2 (34) and *Pheidole* sp9 (19) for buriti. *Dolichoderus bispinosus* Olivier and *Dolichoderus lutosus* Smith were exclusive to the vereda Curral das Éguas in buriti habitat. Ant species richness and abundance did not differ between vereda locations, but did between the habitats buriti and soil (ANOVA richness: $F_{1;39} = 111.74$, $p < 0.0001$; ANOVA abundance: $F_{1;39} = 111.74$, $p < 0.0001$). The greatest richness of ants was found in the soil of wetlands, and the same pattern was observed for abundance. This result was expected, since it is considered that the ability to attract ants varies among species of plants and forage on these plants is encouraged by the occurrence of predictable and renewable resources, such as honeydew. However, the vereda São José (impacted by mature monoculture) had the highest richness (29) and abundance (110) of ants for buritis. Beyond, changes in the level of groundwater may have favored the colonization of this vereda for a greater number of species of ants and plants. The vereda São José has very diverse vegetation with 43 different species, including *Tococa cardiophilla* Naudin, plant with myrmecophytic interaction. This result suggests that the richness, abundance and species composition of ants is reflecting the spatial heterogeneity of this vereda. The same does not occur for the vereda Lagoa do Inferno, which has vegetation composed mainly by buritis, all within the lagoon and without communication canopy. Overall, the ant fauna of buritis represented a sub-sampling of the ant fauna of soil, with rare exceptions such as the genus *Dolichoderus*. (FAPEMIG)

COMPARISON OF DIFFERENT TECHNIQUES FOR SAMPLING FOR THE COMMUNITY OF ANTS IN DIFFERENT ONTOGENETIC STAGES OF *Caryocar brasiliense*

E.B.A. KOCH[1,2], F.C. CAMAROTA[1,2] & H.L. VASCONCELOS[1,2]

[1]Universidade Federal de Uberlândia. Departamento de Ciências Biológicas, Campus Umuarama, Bloco 2D, Sala 26, 38400-902, Uberlândia, MG, Brasil, e-mail: elmoborges@gmail.com; [2]Laboratório de Ecologia de Insetos Sociais – LEIS , Rua Ceará, s/n - Bloco 2D – Sala 18 – Bairro Umuarama, Uberlândia, MG, Brasil.

This study aimed to determine whether there are differences in the community of ants collected with different techniques and in different ontogenetic stages of *Caryocar brasiliense*. The study was conducted in areas of cerrado *sensu stricto* in Reserva Ecológica do Panga, localized in the southwest of Brazil. We used 81 individuals of *C. brasiliense*, which were separated into categories related to their ontogenetic stages: pre-reproductive individuals, medium-sized reproductives and large-sized reproductives. The ants were collected by mechanical beating and pitfall traps containing baits (honey and urine). The pitfall-traps were left on the plants for 48 hours. The number of branches on which were carried out the beating and the amount of pitfalls varied according to the structural complexity of the plant. On the pre-reproductive individuals we did one beating and used two baits on each tree, on the medium-sized reproductives we did two beatings and used four pitfalls and on the large-sized reproductives we did four beatings and used eight baits. To check for differences in abundance and species richness of ants collected with different techniques we performed repeated measures ANOVA. We use a PERMANOVA and a NMDS to determine differences in the community related with the plant ontogeny. We found significant differences between the two methods on the richness and abundance of ant species colected. We recorded 64 species of ants, being 54 species in the pitfalls (24 exclusive) and 41 species with the beating (11 exclusive). Ants of the genus *Gnamptogenys* were only collected with the beating, while species of the genera *Dorymyrmex*, *Nylanderia* and *Pachycondyla* only occurred in pitfall-traps. The species with the highest occurrence in both methods were *Cephalotes pusillus*, *Pseudomyrmex gracilis* and *Pseudomyrmex urbanus*. Our results suggest that the technique of Pitfall-traps are ideal to find out the richness of ant species present in the plant, because the traps samples both species of diurnal and nocturnal habits, since they remain in the trees for 48 hs. However, it overestimates the number of individuals due to the effect of attractiveness of baits and should not be used to estimate the abundance of ants. In contrast, in the beating we are not able to know all ant species present on the plant, but we have a greater reliability in the momentary abundance of ants in the plant. None of the techniques used proved to be absolute for sampling ant communities associated with *C. brasiliense*, which is clear when evaluating the number of species exclusive to each. We suggest with this study that the two techniques should be used together in a complementary manner, and whenever possible others methods must be employed for sampling the arboreal ant community of a plant.

CONTRASTING RESPONSE OF PLANT *VS.* ANT COMMUNITY TO ANTHROPOGENIC DISTURBANCES

J.D. RIBEIRO-NETO[1], F.M.P. OLIVEIRA[2] & I.R. LEAL[1]

[1]Graduate Program on Plant Biology, Department of Plant Biology, Federal University of Pernambuco, Av. Prof. Moraes Rêgo s/n, Cidade Universitária, CEP 50690-901 – Recife, PE, Brazil, camponotus2@hotmail.com. [2]Graduate Program on Animal Biology, Department of Zoology, Federal University of Pernambuco, Recife, PE, Brazil.

Anthropogenic disturbances can affect both structure and diversity of biological communities through environmental filtering. The changes can arise from modifications on extinction and colonization/recolonization rates. However, the community response to anthropogenic disturbances depends on the pattern of natural resources use by human population (if the organisms on the community are directly targeted or not) and depends on the life history traits of the organisms in the community. In this study, we examined the effects of anthropogenic disturbances on plant and ant communities from the Brazilian Caatinga. We hypothesized that anthropogenic disturbances exert a stronger effect on plant than on ant communities. We measured disturbance continuously through several descriptors in 25 (20 m X 50 m) plots. In each plot, we surveyed plant (ground diameter ≥ 3 cm) and sampled ant species with 6 pitfall traps (active for 48 h) per plot. We compared plant and ant community richness response to anthropogenic through an analysis of co-variance. Besides that, we built a presence-absence matrix to plant and ant communities, calculated the weighted nestedness and compared the observed value to a random a distribution (100 randomizations). Then, we ordered the two matrix following the maximum nestedness (plots ranked in decreasing order of species richness and species ranked by decreasing incidence) and attributed a ranking (0 – more species rich - to 1) to each plot. If anthropogenic disturbance affect plot nestedness, then there might be a positive relationship between disturbance index and the plot ranking position. Anthropogenic disturbances reduced plant species richness, but had no effect on ant community. Nestedness on plant community was higher than expected randomly, and the plot ranking was positively related to anthropogenic disturbance. Concerning ant communities, nestedness was not different from random, and ranking value was not associated to anthropogenic disturbance. Our results suggest that anthropogenic disturbance effects are stronger on plant communities than on ant communities. The nested structure in plant communities evidences a non-random loss of plant species, and the absence of this pattern relative to ant communities must be related to a higher species replacement among the plots.
(CNPq, FACEPE)

DIARY AND SEASONAL FORAGING ACTIVITY OF THE LEAF-CUTTER ANT *Acromyrmex crassispinus* (FOREL) IN A CHACO SERRANO FOREST FROM CÓRDOBA (ARGENTINA)

C.A. BARRERA[1], L.M. BUFFA[1] & G.R. VALLADARES[1]

[1]Cátedra de Entomología y Centro de Investigaciones Entomológicas de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Av. Vélez Sarsfield 299, CP 5000, Córdoba, Argentina, e-mail: corinabarrera@gmail.com

Leaf-cutter ants are widely known for their habit of cutting plant leaves and other structures and carrying them to their nests, to serve as substrate for cultivating fungus on which the colony feed. Their foraging activity may show diary and seasonal changes, being influenced by environmental conditions such as temperature and humidity. The present work aimed to characterize the diary and seasonal foraging pattern of *Acromyrmex crassispinus* (Hymenoptera: Formicidae) in a continuous (over one thousand hectares) area of Chaco Serrano in the Province of Córdoba, in Central Argentina. We randomly selected five nests at the edge (up to 5 m from the tree line) and five in the forest interior (at least 20 m from the tree line). We evaluated foraging activity on these nests by recording the number of ants carrying plant material towards the nest during a three minute period. Observations were carried out in the morning and afternoon of two consecutive days in each season (from April 2010 to February 2011). Maximum and minimum air temperature was also recorded in each opportunity. On the spring and summer samplings, we also measured nest temperature and soil temperature near the nest. Data were analyzed by means of ANCOVA, linear regressions, Wilcoxon test and Kruskal Wallis. Along the year, foraging activity was positively related to maximum air temperature ($p=0.05$, $F=4.04$, df=1.36,) and independent of minimum temperature values, at both interior and edge locations. However, under warm weather (spring-season) foraging activity was inversely related to soil temperature ($p=0.05$, $R^2=-0.19$) though independent of nest temperature ($p>0.05$). In turn, nest temperature was significantly higher than soil temperature ($p<0.0001$, $Z=3.92$) and noticeably more stable. Ants foraged with similar intensity in the morning and in the afternoon ($p>0.05$), but their activity was significantly higher in the forest interior than at the edge ($p=0.013$, $H=6.16$). Moreover, foraging activity was more stable at the interior, showing seasonal differences only at the border ($p=0.012$, $H=10.85$) where the highest activity was observed in spring and the lowest in winter. The increased and uniform nest temperature, in comparison with the surrounding ground, could be related to the mound nest structure adopted by *A. crassispinus* in the region. This type of structure has been proposed to maintain optimal temperature and humidity levels. On the other hand, the continuous foraging activity of this species in the interior (where previous studies recorded higher nest abundance) contrasting with its lower and fluctuating presence at the edges, supports the hypothesis of *A. crassispinus* representing a possible indicator of forest quality. (SECYT-UNC, CONICET)

DIFFERENCES BETWEEN FUNCTIONAL GUILDS OF ANTS (FORMICIDAE) IN FOREST FRAGMENTS AND PASTURES

D.S. ASSIS[1]; F.G.V. ESTEVES[2], I.A. DOS SANTOS[3], F.N. NUNES[2] & E.F. VILELA[1]

[1]Laboratório de Feromônios e Comportamento, Departamento de Entomologia, Universidade Federal de Viçosa (UFV), Campus de Viçosa, Av. Peter Henry Rolfs, s/n, Campus Universitário Viçosa – MG, CEP: 36570-000, Programa de Pós-Graduação em Entomologia, Universidade Federal de Viçosa; e-mail: diego.s.assis@ufv.br, [2]Instituto de Ciências da Natureza, Universidade Federal de Alfenas (UNIFAL-MG), Laboratório de ecologia de Fragmentos Florestais do Sul de Minas Gerais - ECOFRAG; [3]Centro de Formação Interdisciplinar– CFI, Universidade Federal do Oeste do Pará (UFOPA).

The environmental structure, as well as ecosystem resources and species composition, may determinate some processes, like adaptive processes on species. When two sites with different structural complexity, like forest fragments and pastures, are compared, it is expected a greater species richness of ants in forest fragments, since they have structural complexity and vegetation heterogeneity. In turn, pastures are more homogeneous environment system and, therefore, are expected to have lower species richness. These differences between local physical structures may be reflected in groups of organisms that live at these places, both in taxonomic and in functional scale. Thus, in order to seek for differences between functional groups of forest fragments and pastures, we analyzed six systems: three forest fragments and three pastures at Alfenas, southern of Minas Gerais State. We used ten pitfall traps inside of each system. Statistical data analysis included t-test and linear regression, with Poisson error distribution to evaluate the difference in ant species richness between pastures and forest fragments. We collected 89 ant species distributed amongst 30 genera shared into seven subfamilies. We arranged all the ant species in 10 functional groups, according to records of specific literature: Atine (fungus grower), Predator, Generalist, Opportunist, Arboreal, Cryptic, Invasive, dominant, dominant Dolichoderinae and Subordinated Camponotini. Our analyses showed no differences between the richness of the sampled systems ($p = 0.42$). Pastures have more generalist ant species than forest fragments (22 species). The second group with more ant species richness was the predator (17 species). Moreover, forest fragments had the same two groups as predominant species (generalist and predator), with 15 species each. Forest fragmentation is the main cause of species extinction (e.g. plants, animals). The farming expansion without regard to the importance of biodiversity is taking natural environmental to collapse. In Brazil, specifically, the absence of supervision over environmental laws has been contributing to the low achievements of sustainable management programs for farmers. And the farmer is the one who should care and maintain structural cohesion and wealth of the environment in forest fragments of their properties. (CNPq, Capes and UNIFAL-MG)

DISTURBANCE AS DETERMINANT OF ARBOREAL ANT (HYMENOPTERA: FORMICIDAE) RICHNESS, COMPOSITION AND STRATIFICATION IN MONTANE TROPICAL FOREST AREAS

R.L. ANTONIAZZI-JUNIOR[1,2]; R.B.F. CAMPOS[3] & S.P. RIBEIRO[3].

[1]Laboratório de Ecologia de Insetos, Departamento de Biologia Geral, Universidade Federal de Minas Gerais, Av. Antônio Carlos, 6627, CEP: 31270-901, Belo Horizonte, MG, Brasil, e-mail: reuberjunior@gmail.com. [2]Programa de Pós-graduação *Stricto Sensu* em Ciências Biológicas – Unimontes – MG. [3]Laboratório de Ecologia Evolutiva de Evolutiva de Insetos de Dossel e Sucessão Natural.

Tropical montane forests have been little studied, appear to have unique characteristics, and can be particularly affected by environmental changes. Because ants are important for ecosystem functioning and sensitive to anthropogenic disturbances, this study aimed to test the hypotheses that ant species richness and composition vary in sites of montane forest subjected to different past disturbance intensities and to evaluate whether disturbance intensity influences the distribution of species in the canopy and understory. We studied three montane forest sites, presently protected by a State Park, and subjected to varying disturbances patterns and recovering after more than 40 years of land conservation: natural disturbances; replacement of native vegetation by tea plantations and selective small scale logging; replacement of native vegetation by tea plantations and stone mining, respectively. In each site, we sampled ants in the canopy and understory on 15 groups of trees composed by emergent and surrounding smaller trees. Unlike what has been reported for other forests, mean species richness was higher in the canopy than in the understory, even though the mean number of species per tree did not differ among sites. Conversely, species composition differed among the three sites, but it was not possible to precisely separate canopy and understory communities based on species composition. Even though we did not find unique canopy and understory faunas, the fauna of each stratum became gradually dissimilar as disturbance intensity decreased and, as a consequence, vegetation complexity increased. The results of this study reinforce the importance of vegetation complexity for the species richness, composition, and vertical distribution of the ant fauna in montane forests.

DIVERSITY OF ANTS IN DIFFERENT VEGETATION TYPES OF CAATINGA AT CONTENDAS DO SINCORÁ NATIONAL FOREST, BA, BRAZIL

B.M. SANTOS, A.S. SOUZA, V.S. SANTOS, M.A.F. CARNEIRO, I.C. NASCIMENTO, K.S. CARVALHO

Laboratório de Invertebrados, Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB) Campus Jequié, Av. José Moreira Sobrinho s/n, CEP 45200-000 – Jequié, BA, Brasil, e-mail: biamirandasantos@hotmail.com.

The present study aimed to compare the ant fauna in three different areas of Caatinga at Contendas do Sincorá National Forest. In each area, separated from each other by at least one kilometer, the soil and vegetation ant fauna was sampled by means of pitfall traps in two sampling periods (February 2012 and November 2012). Pre-existing trails were used as transects of 200m in each area: T1-Riacho Combuca (1305510,7"S; 0,41005´53,6"W); T2-Bromelias (13055´54,4"S; 0,41006´54,8"W) and T3- Aroeira (13058´19,7"S; 0,4100,7´0,21,"W). In each transect, 20 trees, interspaced by 10m, were sampled. In each tree, randomly chosen, three pitfalls were installed in different branches and one pitfall in the soil beside the main trunk. Each tree was labeled with aluminum plate for subsequent identification of the species. In total, we collected 59 ant species. The most frequent species in both sampling periods (February 2012 and November 2012) were: *Camponotus* sp.2, *Crematogaster* sp.1, *Ectatomma* sp.1, *Pheidole* sp.1 and *Solenopsis* sp.1. The species *Camponotus rufipes*, *Camponotus* sp.1, *Camponotus* sp3, *Camponotus* sp.6, *Camponotus* sp.9, *Cephalotes* sp.1 *Crematogaster* sp.5, *Crematogaster* sp.6, *Pheidole* and *Solenopsis* sp.2, *Solenopsis* sp.4 were more frequent only in the first sampling period. In the first sampling period, the observed richness (Mao Tao) for transects T1, T2 and T3, were 30, 36 and 33 species, respectively. In this same sampling periods, the estimated richness ranged from approximately 40 to 48 (Chao1), 40 to 46 (Jacknife 1) and 34 to 41 species (Bootstrap). In the second sampling periods, the observed richness was lower compared to the first sampling period: 17 species (T1), 17 species (T2), 12 species (T3). Estimated richness estimators ranged from 17 to 23 (Chao 1), approximately 18 to 23 (Jacknife 1) and 14 to 20 (Bootstrap). The diversity of species, calculated by Simpson index in each transect were: T1 = 20.7, T2 = T3 = 24.6 and 16.6 for the first sampling period and: T1 = 10.8, T2 = 8.5 and T3 = 5.7 for the second sampling period. The analysis showed that 60% of the variation in the diversity of species between the studies Caatinga areas can be explained both by the transect ($F = 7.519$, $df = 2$, $p = 0.001$) and by the sampling periods ($F = 152.292$, $df = 1$, $p = 0.000$, $n = 120$). These data suggest the existence of effects of spatial heterogeneity (transects) and temporal (sampling period or seasonally) about the ant community of Caatinga in the Contendas do Sincorá Nacional Forest. More sampling effort must be added to this preliminary analysis as well as the identification of the species of plants that comprise the vegetation in each vegetation type, for a better comprehension of the results. (UESB, PRONEX-PNX 0011/2009)

DIVERSITY OF SOIL ANT SPECIES IN CERRADO *SENSU STRICTO* IN MUNICIPALITY OF IPAMERI-GO

C.A. RODRIGUES[1,2], D.A da SILVA[1], N.M. MARTINELLI[2], A.M. SILVA[1] & M.S. ARAÚJO[1]

[1]UEG – Universidade Estadual de Goiás, UnU Ipameri. GO 330, Km 241, Anel Viário, S/N, CEP 75780-000 - Ipameri, GO, Brasil, e-mail: camilaalvesrodrigues@hotmail.com. [2]Departamento de Fitossanidade, Universidade Estadual Paulista, Campus de Jaboticabal (FCAV/UNESP). Via de Acesso Prof. Paulo Donato Castellane, S/N, 14884-900 - Jaboticabal, SP, Brasil.

The cerrado is the second largest biome in Brazil, covering an area of 1.8 million square killometers, which corresponds to about 22% of Brazilian territory. Characterized by mosaics of vegetation types ranging from open fields to dense forest formations and it's quickly disappearing due to population growth and particularly the expansion of agricultural areas. The structural complexity of the habitat affects the diversity of formicifauna which can be influenced by the modification of the natural landscape, there is therefore a need for surveys as a way to better understand the ant species and their occurrence in such ecosystem. Thus the present study aimed to identify the soil ants that occur associated with the cerrado in Ipameri, Goiás region. This was done in a hill area, containing fragments of cerrado sensu stricto, in the municipality of Ipameri, state of Goiás. Therefore, two fragments were selected, one featuring denser cerrado sensu stricto and other with typical cerrado sensu stricto. For each fragment were randomly selected 30 sampling points distributed in a transect with about 100 metres long, totaling 60 points, and two transects. At each point was used pitfall trap type containing 50% alcohol for capturing of ant family with activity at the soil. There were two collections per month for one year, from 07 /2011 to 06/ 2012, totaling 24 samples. The traps remained open for 24 hours and subsequently were removed and sent to the Laboratory of Entomology of Universidade Estadual de Goiás (UEG), Ipameri Unit for screening specimens. After screening and identification in morphospecies level, the collected ants were assembled, properly labeled and sent to the Laboratory of Myrmecology of Centro de Pesquisa do Cacau (CEPLAC) for species identification. We collected 59 ant species, distributed in 23 genres and seven subfamilies: Myrmicinae (23 species), Formicinae (15 species), Ectatomminae (7 species), Pseudomyrmicinae (6 species), Dolichoderinae (4 species), Ponerinae (3 species) and Ecitoninae with only one species. From 59 collected species, 15 were considered frequent, being found in 50 to 100% of the 24 samples, 13 with intermediate frequency (25-50 %) and 31 species considered uncommon (equal or less than 25%). The most frequent species was *Pheidole obscurithorax*, occurring in 100% of the 24 collected samples. Perhaps for these ant species, there may be an increased availability of food and nesting locations for the ground, since the increase in the structural complexity of the habitat leads to an increase in richness. (CNPq)

DIVERSITY OF SPECIES OF THE WOODY LAYER ANTS IN CERRADO *SENSU STRICTO* IN MUNICIPALITY OF IPAMERI-GO

C.A. RODRIGUES[1,2], D.A. da SILVA[1], N.M. MARTINELLI[2], A.M. SILVA[1] & M.S. ARAÚJO[1]

[1]UEG – Universidade Estadual de Goiás, UnU Ipameri. GO 330, Km 241, Anel Viário, S/N, CEP 75780-000 - Ipameri, GO, Brasil, e-mail: camilaalvesrodrigues@hotmail.com. [2]Departamento de Fitossanidade, Universidade Estadual Paulista, Campus de Jaboticabal (FCAV/UNESP). Via de Acesso Prof. Paulo Donato Castellane, S/N, 14884-900 - Jaboticabal, SP, Brasil.

The cerrado, located mainly in the Planalto Central do Brasil, is the second largest biome in area of the country, about 1.8 million square kilometers, which corresponds to approximately 22% of the Brazilian territory. Ants are the most important group of insects of the savanna in biomass, number of individuals and ecological impact. Nevertheless, the number of ants surveys in the savannah is still unsatisfactory. Thus the present study aimed to identify the shrub and arboreal ants that occur associated with the cerrado in Ipameri, Goiás region. This was done in a hill area, containing *sensu stricto* cerrado fragments, belonging to municipality of Ipameri, Goiás state. Therefore, two fragments were selected, one featuring denser *sensu stricto* cerrado and other with typical *sensu stricto* cerrado. For each fragment, 30 plants (trees or shrubs) were randomly selected in a transect measuring about 100 meters long. Ants were sampled using plastic glass baited traps with a capacity of 110 milliliters. Two traps were used for each tree, one containing sardines and the other containing honey. They were installed, at a maximum height of two meters, in the morning, stayed for about two hours and then were removed and sent to the Laboratory of Entomology of Universidade Estadual de Goiás (UEG), Ipameri Unit, for sorting specimens. After sorting and identification in morphospecies level, the collected ants were assembled, properly labeled and sent to the Laboratory of Myrmecology do Centro de Pesquisas do Cacau (CEPLAC) for species identification. Two collections per month were made during one year, from July/2011 to June/2012, totaling 24 samples. Fifty ant species were collected, distributed in 16 genera and six subfamilies: Formicinae (17 species), Myrmicinae (15 species), Ectatomminae (seven species), Pseudomyrmicinae (four species), Dolichoderinae (four species) and Ponerinae (three species). From the 50 collected species, 17 were considered frequent, being found in 50 to 100% of the 24 collected samples. Five species showed intermediate frequency (25-50%) and 28 species were uncommon (equal or less than 25%). The most frequent species was *Camponotus blandus*, being found in 100% of 24 samples. Among the species with the lowest capture rate are *Odontomachus chelifer* and *O. bauri* (4.1%). The representatives of these species are predators and usually have underground nests, what possibly explains its low capture rate on samples. (CNPq)

DNA SEQUENCING AS AN AUXILIARY TOOL FOR IDENTIFICATION OF ALATE ANTS

A.A. de OLIVEIRA[1,3], S.M. CANTONE[2,3], A.E.C. CAMPOS[2] & R. HARAKAVA[1]

[1]Laboratório de Bioquímica Fitopatológica, Instituto Biológico (IBSP), Avenida Conselheiro Rodrigues Alves, 1.252, CEP 04014-002- São Paulo, SP, Brasil, e-mail: oliveira.amandah@gmail.com. [2]Unidade Laboratorial de Referência em Pragas Urbanas, SP,Brasil. [3]Programa de Pós-graduação em Sanidade, Segurança Alimentar e Ambiental no Agronegócio, Instituto Biológico , São Paulo, SP, Brasil

Surveys for ants in urban green areas using traditional capture techniques are not always possible due to the absence of leaf litter or bare ground to use Winkler extractors and pitfall traps, respectively. Techniques for collecting alate specimens may capture a higher diversity and abundance of species. However, the identification is compromised by the lack of keys on the reproductive caste. In this way, molecular methods are proposed in this work as an auxiliary tool for identifying this caste of ants. Samples were collected at the Instituto Biológico park and at the State Park Alberto Löfgren between June and October 2012. Both parks differ in their distances to a natural Atlantic Forest remnant. The specimens were collected through light and Malaise traps to intercept night time and day time flights. Every trap contained a receptacle with formalin 3% to preserve the specimens. After separation into morphospecies, genomic DNA was extracted and subjected to polymerase chain reaction (PCR) with primers for the mitochondrial cytochrome oxidase I and 28S ribosomal genes. Partial degradation of the DNA was observed due to formalin, allowing amplification of small products only (less than 500 bp). The sequences obtained so far confirm genetically the morphological separation of the specimens, but identification of species is hindered by the lack of corresponding sequences in the GenBank. In order to circumvent these difficulties, formalin will be replaced by propyleneglycol 10% and worker ants that occur close to the capture stations will be collected and sequenced to serve as reference in the comparisons with alates. (CAPES, CNPq)

DO LITTER BIOMASS LOSS AND ENVIRONMENTAL CONDITIONS ALTER ANT SPECIES RICHNESS AND COMPOSITION?

M.P. ANDRADE[1]; M.O. DOURADO SANNA[1]; D.C. MUSCARDI[1]; L.N. PAOLUCCI[1]; T.G. SOBRINHO[1] & J.H. SCHOEREDER[1]

[1]Departamento de Biologia Geral, Laboratório de Ecologia de Comunidades; Universidade Federal de Viçosa (UFV), Campus Universitário s/n; CEP 36570-000 –Viçosa, Minas Gerais, Brasil, e-mail: andrade.marcop@gmail.com

Litter decomposition is important for the maintenance of ecological balance. Ants may act indirectly in the decomposition of soil organic matter, acting as detritivorous and predating decomposers agents. Edge effects may result in lower biological diversity, which potentially affects ecosystem functions as litter decomposition. We aimed to test the following hypotheses: (i) litter biomass loss is higher in the forest interior than in the edge habitat; (ii) there is higher ant species richness in forest center than in the border; (iii) these possible differences are caused by different environmental conditions between these habitats types. Moreover we investigated if ant species composition differs between these two habitats. We conducted an experiment using litter bags of 20 X 20 cm and 2 mm mesh. Each litter bag initially had 10 g of dried leaves from eight different native plant species. We evenly distributed 72 litter bags between cores and edges of six forest remnants in the region of Viçosa-MG, southeastern Brazil. The dominant vegetation in most remnants is secondary seasonal semi deciduous montane forest. We made two sampling events: one 60 days and another 120 days after the experiment beginning. We measured three environmental conditions (luminous intensity, temperature and humidity) and removed the litter bags. We calculated litter biomass loss by the difference between the initial and the final weight. We found a total of 30 ant morphospecies. According to expected, litter decomposition and ant species richness were higher in forest interior than in the edge habitat. Despite we found a higher light intensity at the edge than in the core and this difference did not affect the ant species richness. Furthermore, temperature, humidity and ant species composition did not vary between the two habitats. The higher biomass loss in the core may occur due to higher decomposer diversity, such as fungi and bacteria, which are the major driver of this process. Although ant species richness was not affected by the measured environmental conditions, decomposer biota may be more sensible to them. It is possible that the habitat with higher biomass loss harbors more decomposers and detritivorous organisms such as collembolans, which are fungivorous, and may be food resource to litter-dwelling ants. We believe that ant species composition did not differ between the studied habitats because the ant fauna associated to litter biomass loss in the edge represents a subset of forest core ant fauna. We conclude that for the habitat studied ant species that occurred on litter bags were more constrained to decomposer biota than environmental conditions. (FAPEMIG, CNPq, CAPES)

DOES THE LITTER ACT LIKE A FILTER FOR ANT SEED DISPERSERS?

L.N. PAOLUCCI[1] & L.C. LEAL[2]

[1]Programa de Pós Graduação em Ecologia, Universidade Federal de Viçosa. Av. P.H. Rolfs, s/n. *campus* universitário, Laboratório de Ecologia de Comunidades. CEP 36570-000 – Viçosa, MG, Brasil, e-mail: lucaspaolucci@gmail.com; [2]Programa de Pós Graduação em Biologia Vegetal, Universidade Federal de Pernambuco, Recife, PE – Brasil.

According to the "grain-size hypothesis", the perception of environmental interstices increases as body size of terrestrial walking organisms decreases. This relationship may have important implications on patterns of seed removal by ants, for example. Smaller body-sized ants move through litter interstices with more ease than larger bodied ants, and might found diaspores easily in rich interstices sites. Nevertheless, those ant species generally have poorer seed dispersal ability than large-bodied ants. Thus we hypothesized that small-bodied ants are the main seed dispersers in rich interstices habitats, which results in a lower seed dispersal efficiency. We predict that ant disperser body size and the removal distance of sunflower seeds (*Helianthus annuus*) will decrease as local litter depth increases. Litter depth below each seed depot was used as surrogate of litter interstices availability, and naturally varied from 0 up to 15 cm. Removal distance was used as a proxy of seed dispersal quality, and was measured with a ruler until the ant got inthe nest or disappear in the litter. We established 30 seed depot at least 10 meters apart from each other in an area of Central Amazon "terra firme" near Manaus, in August' 2011. In each depot we offered 10 sunflowers seeds, which were monitored during 3:30 h. When more than one seed was removed per depot, we calculated the average removal distance. We collected, identified at genera level and measured the total length (head up to gaster) of all ant species observed removing seeds. Depots with no seed removal (six of them) were excluded from distance removal analyses. We observed 12 ant species, from four subfamilies, removing seeds. Contrary to our expectation, ant disperser body size was not related to local litter depth ($p=0.92$). Likewise, the litter depth of surrounding area did also not influence seed removal distance ($p=0.42$). Thus, both small and large bodied ants equally accessed the depots, and removed seeds for equivalent distances. Differences in ant functional traits, such as body size, are normally also correlated to differences in the way ants use the environment. Considering foraging behaviour, small-bodied ants have small foraging area and exhibit mass recruitment behaviour, while large bodied ants generally forage solitarily and have bigger foraging area. Further, large bodied ants might access resources by moving over surface obstacles, while small-bodied ants might access resources by moving through litter interstices. Therefore, although interstice availability is pointed as a constraining habitat to large bodied ants, differences in foraging behaviour should overtake it. Thus, both small and large-bodied ants are equally able to locate and use food resource on the litter surface. (FAPEMIG, CAPES, INPA, PDBFF)

ECOSYSTEM SERVICES MEDIATED BY ANTS (HYMENOPTERA: FORMICIDAE) IN THE ARID CHACO, ARGENTINA

F. CUEZZO[1] & F. CASTELLARINI[2]

[1]INSUE – CONICET, Facultad de Ciencias Naturales e IML, UNT. Miguel Lillo 205, CP: T4000JFE - San Miguel de Tucumán, Tucumán, Argentina. e-mail: cuezzof@yahoo.com.ar
[2]IMBIV, (CONICET- UNC), 5000, Córdoba, Argentina.

Despite the well-known key role of ants in almost any terrestrial environment, few studies have focused their importance as providers of ecosystem services, especially in arid or semiarid landscapes. The main objective of this work was to identify ecosystems services provided by ants, derived from its local biodiversity and its vulnerability against changes in land uses and cover changes. Our study was conducted close to Cruz del Eje, NW of Córdoba province, central Argentina. This area belongs to the Arid Chaco, with an average annual rainfall of 400 mm. Natural vegetation is represented by low, open woodland, reduced to isolated patches embedded in a predominantly agricultural matrix. We consider fourtypes of land use: 1) native forest; 2) pasture; 3) perennial crop and 4) annual crop in the studied environment. Grown dwelling ants were collected using five pit-fall traps (8 cm diameter x 10 cm deep) filled with a solution of propylene glycol diluted to 30%. Pit-falls were located at the vertices and center of a rectangle (90 mx 30 m) and were active during three consecutive days. Each replica was taken in six plotsseparate by a minimum distance of 500 m by area. The specimens in the five traps by plot were grouped into a pool. As measure of biodiversity we use Shannon-Weaver index. A cluster analysis was performed using a complement of Chao-Sorensen index as a distance measurement. We found a total of 60 ant species, with *Forelius nigriventris* as dominant, with a similar frequency between sites. Ant richness in forest, pasture and permanent crops was comparable and significantly higher than that found in seasonal(annual)crops. Cluster analysis shows a close affinity between ant communities in pasture and permanent crops. Following the nomenclature provided by the "Millennium Ecosystem Assessment", and considering all 60 ant species, 20 potential ecosystem services represented by a 33% of the ant community was clearly determined, corresponding to cultural, regulation and provision services. Ants found in pastures, perennial and annual crops provided eight services more than those in forests. The difference was probably based on the greatest number of seed dispersers species present in the three environments mentioned above. It is important to consider that the results here provided are only preliminary.Note that services provided by 67% of the species remains unknown,demonstrating the lack of knowledge still exists about this topic. (FonCyT – ANPCyT, Argentina, BID PICT-PRH 108)

EDGE EFFECTS ON ANT COMMUNITIES AS A CONTINUOUS PATCH-MATRIX GRADIENT

F.M. RIBEIRO[1,2], T.S. BARÃO[1], F. ANDRIOLLI[1] & M.C. RIBEIRO[1]

[1]Laboratório de Ecologia Espacial e Conservação, Departamento de Ecologia, Instituto de Biociências, Universidade Paulista "Júlio de Mesquita Filho" (UNESP), Av. 24A, 1515, CEP 13506-700 – Rio Claro, SP, Brasil, email: felipemartello@gmail.com. [2]Programa de Pós-Graduação em Zoologia, Universidade Paulista "Júlio de Mesquita Filho" (UNESP), Rio Claro, SP, Brasil.

Habitat edges affect local biodiversity, reducing the diversity of native species and often serving as a gateway to invasive species. In general, edges are treated as a discrete effect (i.e. habitat / matrix), but current researches have shown that some organisms respond to this process gradually (e.g. birds and mammals). Ants are good organisms to access the impact of edge effects on biodiversity, since its respond to habitat changes. However, until now there is a lack of studies that focus on understanding if the response of ant assemblage to edge effects occurs as a discrete (habitat-matrix) or as a gradient way. On this study, we evaluated the response of ants to edge effects within Brazilian savanna landscapes (a.k.a. Cerrado), aiming to understand if the ant assemblage responds discretely (i.e. habitat-matrix) or to a gradient of distance to the edge. Ants were collected in 15 fragmented landscapes of Cerrado. Two transects of 200 m (using interior-edge-matrix direction) were sampled and eight pitfalls (four inside and four outside of the fragment) were placed 25 meters apart on each transect. Species richness was estimated for each landscape and for each distance in relation to the edge. Two competing models were compared using Akaike Information Criterion (AIC): 1) habitat-matrix model; 2) gradient model, where the distance in relation to the edge was used as a continuous variable. Species richness (total and for functional groups) was analyzed using Generalized Linear Model (GLM), and the weight of AIC (wAIC) was estimated for each model. Functional groups that did not differ between matrix and patches were discarded. The total richness for habitat (Cerrado fragment) was higher than for matrix ($F=6.34$, $p=0.01$) and the gradient model best explained ($wAIC=0.80$) ant richness. The aggressive Dolichoderinae was the only functional group with higher richness in matrix than in habitat and the discrete model (habitat-matrix) best explained the outcome ($F=72.61$, $p<0.001$, $wAIC=0.99$). The gradient model best fitted on predators ($F=29.48$, $p<0.001$, $wAIC=0.84$), and habitat-matrix model best fitted for Cephalotinae ($F=19.57$, $p<0.001$) and patrol ants ($F=26.41$, $p<0.001$) since we found the difference between AICs < 2 for both groups. We concluded that the response of the total richness of ants to the edge effect did not reflect the responses of each functional group, which suggests that the impact of edge effects on ant assemblages should be assessed through functional groups. Furthermore, the fact that gradient model better fit the total ant richness, as well as for some functional groups, demonstrated the importance of understanding edge effects as a gradient and not as a discrete process. (CNPq/PIBIC)

EDGE EFFECTS ON ANT COMMUNITY IN PRIMARY FOREST OF NORTH-EAST AMAZON

L.F. ZURLO[1], R.G. CUISSI[1], C.J. LASMAR[1], T.S. MORETTI[1], F.T. TANURE[1], E.O. CANEDO-JÚNIOR[1,2], R.M. FEITOSA[3], C.R. RIBAS[1] & C.J. MARSH[4]

[1]Universidade Federal de Lavras, Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Minas Gerais, Brasil, CEP:37200-000, email: luana_zurlos2@hotmail.com; [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil; [3]Universidade Federal do Paraná, Laboratório de Biologia e Sistemática de Formigas, Departamento de Zoologia, Curitiba, Paraná, Brasil; [4]Imperial College London, Silwood Park Campus, Buckhurst Road, Ascot, Berkshire, SL5 7PY, United Kingdom.

Edge effects are caused by forest fragmentation and have many impacts on biota, altering species richness and composition and consequently changing the existent ecological processes. This study aimed to investigate if edge effects result in a modification of species richness and species composition in an ant community in the north-east Amazon. For this investigation we propose to determine which environmental variable(s) directly influences this change throughout the forest. We selected one primary forest site bordering a *Eucalyptus* forest and sampled along four 1km long transects at four distances running parallel to the edge: 0m, 100m, 316m and 1km from the forest edge. To sample ants, pitfall traps containing sardine and honey bait were placed at each sampling point (six per transect) and remained in the field for 48hours. The traps were installed 18m high for the arboreal stratum, at ground level for the epigaeic stratum and buried 13cm deep for the hypogaeic stratum. After collection, ants were sorted and mounted at the UFLA Ant Ecology Laboratory and taken to the Zoology Museum of the University of São Paulo for identification. Furthermore, we measured the following environmental variables at each sampling point: understory density (UD), canopy density (CD) and average canopy height (ACH). As an initial analysis, we correlated the environmental variables measured with distance from the forest edge to test if there is a variation in them going to the center of the forest. We used hierarchical partitioning in each stratum to assess the independent environmental variable effects, as well as distance from the edge effect, on ant species richness. We used multivariate analyses based on linear models (DISTLM) to verify the influence of environmental variables and distance from the edge on ant species composition in each stratum. The correlation between the environmental variables and the distance from the edge was positive for ACH and CD and negative for UD. None of the environmental variables influenced ant species richness. However, we found changes in the hypogaeic ant composition with distance from the forest edge ($p=0.048$). Our results show that edge effects may modify edaphic ant communities. This could be explained by the possible modification in quantity and quality of organic matter and humidity from the edge to the centre of the forest, as these ecological factors are considered extremely important for soil fauna maintenance. Therefore, future studies should collect environmental variables related to the dynamics of the hypogaeic stratum, such as soil humidity and temperature and leaf litter characteristics. Our results show that edge effects may impair ecological integrity, by modifying ant fauna, and that the comprehension of how this modification causes changes in ecological patterns is, therefore, the key to understand the impacts caused by forest fragmentation.(FAPEMIG, CNPq, CAPES)

EFFECT OF CONTROLLED BURNING OF SAVANNA (CERRADO) ON INITIAL ESTABLISHMENT OF *Atta sexdens rubropilosa* COLONIES

D.A. da SILVA[1], C.A. RODRIGUES[1,2] , A.M. SILVA[1] & M.S. ARAÚJO[1]

[1]Universidade Estadual de Goiás (UEG), UnU Ipameri, GO 330, Ipameri, GO, Brasil, CEP: 75780-000, e-mail: denise_florestal@hotmail.com. [2]Universidade Estadual Paulista (FCAV/UNESP), Jaboticabal, SP, Brasil, CEP: 14884-900P.

A critical moment of the leaf-cutting ants is the initial establishment of their colonies. The failure to establish is connected to biotic and abiotic factors and mortality of colonies may be associated with changes in physical, chemical and microbiological properties of soil. It is known that fire changes these properties and, consequently, may affect the establishment of initial colonies. The present study aimed to evaluate the impact of prescribed burning in vegetation of cerrado at the initial establishment of *Atta sexdens rubropilosa* colonies. The study was conducted at the Experimental Farm of Universidade Estadual de Goiás (UEG), Unit of Ipameri. We selected two plots of 60 square meters, one with and one without controlled burning. These soils with the burned and unburned area, on the day of the flight, samples were taken for microbiological and chemical analyzes. For our experiment, were collected during flight nuptial, 220 females. Of this total, 20 were placed in the field to pierce the burned area (10) and unburned (10). The other females collected were taken to the laboratory and placed to pierce the same soils collected in the field. In the field, 70% of females pierced the ground in unburned area, and 20% established colonies. In the burned area, 40% pierced and none of them established colonies. At the laboratory, 98% of females placed in unburned soil drilled and built its nests and 91% of those placed in the area of burned soil drilled and built its nests. When the establishment of colonies, after 120 days of punched the ground, only 2% avenged in burned area and 8% in unburned area. Although there was little survival of initial colonies in different situations investigated, our study indicated that controlled burning alters the chemical and microbiological properties of the soil, which in turn influence the survival rate of colonies of *A. sexdens rubropilosa*.

EFFECT OF HABITAT COMPLEXITY ON ANT (HYMENOPTERA: FORMICIDAE) COMMUNITY IN CAATINGA

F.F.S. SIQUEIRA[1,2] & I.R. LEAL[1,2]

[1]Programa de Pós-Graduação em Biologia Vegetal, Universidade Federal de Pernambuco. Av. Prof. Moraes Rego, s/ no, Cidade Universitária, CEP 50670-901, Recife, Pernambuco, Brasil, e-mail: felipe.uast@gmail.com. [2]Departamento de Botânica, Universidade Federal de Pernambuco, Av. Prof. Moraes Rego, s/ no, Cidade Universitária, CEP 50670-901, Recife, Pernambuco, Brasil, e-mail: irleal@ufpe.br

Habitat complexity has a positive effect on ecological communities because the more heterogeneous is an environment the more niche as available for species reducing competition and increasing species coexistence. Vegetation complexity is highly variable in Caatinga, ranging from xerophytic scrub to seasonally dry forest. However, information on how this habitat complexity affects insect community is still poorly known. In this study we investigate the effects of habitat complexity (i.e. litter thickness, vegetation stratification and tree richness) on ant richness and species composition. We expected that ant species richness increases and species composition change as litter thickness, vegetation stratification and tree richness increase. This study was carried out at the Parque Nacional do Catimbau (8º24”00” and 8º36”35” South and 37º09”30” and 37º14”40” West), located in Pernambuco state, Northeast Brazil. Ants were surveyed in 14 sites, seven composed by scrub vegetation and seven by dry forest, using a set of four pitfall traps per site, which were operating for 24 h. Habitat complexity was measured by (1) litter thickness, (2) vegetation stratification and (3) tree richness. We recorded only seven species of ants, from three subfamilies (Dolichoderinae, Myrmicinae, and Ponerinae). Habitat complexity metrics did not explain both ant species richness and composition. Both the lack of a relationship between habitat complexity metrics and the low richness of ants could be explained by the low precipitation of the last two years in the semiarid region of NE Brazil, which has been considered one of the worst droughts in the last 50 years. Then, further studies that utilize different sampling methodologies should be conducted to further understand the relationship between ant species richness and composition and habitat complexity. (FACEPE)

EFFECT OF SAMPLING TECHNIQUES AND ENVIRONMENTAL ATTRIBUTES ON THE ANT FAUNA OF ILHA GRANDE, SOUTHEASTERN BRASIL

A.B. VARGAS[1]; F.S. ALMEIDA[2], J.M. QUEIROZ[3], A.J. MAYHÉ-NUNES[4], D.S. GOMES[3]; L.X.T. CHEVALIER[3] & R.C.S. COELHO[3]

[1]Centro Universitário de Volta Redonda, UniFOA, e-mail: andrebvargas@yahoo.com.br. [2]Departamento de Ciências Administrativas e do Ambiente, ITR, UFRuralRJ. [3]Departamento de Ciências Ambientais, IF, UFRuralRJ. [4]Departamento de Biologia Animal, IB, UFRuralRJ.

Complementarity of sampling techniques is often used to proper describe leaf litter ant fauna. Environment structure also influences sampling success, so it may be an important variable. In the present study, we assessed the effect of sampling techniques and environmental attributes on the leaf litter ant fauna of Ilha Grande, Angra dos Reis, state of Rio de Janeiro, southeastern Brazil. We sampled ants in two rainforest areas, with a sampling effort of 15 Winkler extractors and 15 pitfalls per area. We placed the 1-m^2 leaf litter plots and the pitfalls at a minimum distance of 10 m from each other. The extractors and pitfalls remained active for 48 h; extractors at laboratory conditions and pitfalls in the field. The environmental attributes measured were: leaf litter depth, temperature, humidity, luminosity, and dry weight of the sieved material obtained with the Winkler extractor in each plot. We collected 81 ant species of eight subfamilies and 33 genera. The Winkler extractors had a higher capture success (36 and 35 species) (Mann-Whitney, P=0.08) than the pitfalls (16 and 22 species). Only pitfalls detected a significant difference between areas (Mann-Whitney P=0.02). Both methods detected significant difference in species composition between areas (NMDS stress=0,033; ANOSIM R=0,53; P=0,0001) (NMDS stress=0,29; ANOSIM R=0,20 P=0,0015). The environmental attributes pointed to structural differences between areas (NMDS stress=0,013; ANOSIM R=0,11 P=0,025). Hence, we highlight the importance of using complementary sampling techniques to study the leaf litter. (FAPERJ/CNPq)

EFFECT OF URBAN GRADIENT ON AN ASSEMBLAGE OF ANTS (HYMENOPTERA: FORMICIDAE) IN THE METROPOLITAN REGION OF SALVADOR, BRAZIL

T.S. MELO[1,2], M.C.L. PERES[2,3] & J.H.C. DELABIE[4]

[1]Programa de Pós-graduação em Ecologia e Biomonitoramento, Universidade Federal da Bahia, Salvador, BA, Brasilm, e-mail: terciosilvamelo@hotmail.com. [2]Centro de Ecologia e Conservação Animal, Universidade Católica do Salvador (UCSal), Av. Professor Pinto de Aguiar, 2589, CEP 41740-090, Salvador-BA, Brasil. [3]Programa de Pós-Graduação em Planejamento Territorial e Desenvolvimento Social, Universidade Católica do Salvador (UCSal), Av. Professor Pinto de Aguiar, 2589, CEP 41740-090, Salvador-BA, Brasil. [4]Laboratório de Mirmecologia, Convênio UESC/CEPLAC, CEPEC-CEPLAC, Caixa Postal 7, CEP 45600-000, Itabuna-BA, Brasil.

Several researches approaches the urbanization gradient, however it is not yet clear how ants respond to these gradients, mainly on tropical regions. We aimed evaluate how ants' assemblages distribute on urban environments, regarding: (I) forest fragments along a city-countryside gradient; (II) Test if the observed richness of alien/sinantropic species differ among the fragments; (III) evaluate if the composition of assemblages and guilds of ants vary according to the factors that can characterize this gradient. We conducted the study in five cities within the Metropolitan Region of Salvador (RMS), Bahia. We defined the urbanization gradient according to the cities' population density. On each municipality, we surveyed two forested areas within the urban matrix, on 10 sample points (SP) each. On each point, we sampled the animals with Winkler trap, entomological umbrella and manual sampling. Ants were deposited in the collection of the Mirmecology Laboratory at CEPLAC. To compare richness of observed species and alien/sinantropic species among habitats, we performed a Variance Test (ANOVA). To compare the composition of assemblages and guilds among habitat categories, we applied the Multiple Response Permutation Procedure (MRPP). We measured cartographically the distance from the fragments to the south portion of Salvador to test if a correlation (Pearson) exists between the observed richness and alien/sinantropic species regarding the urbanization gradient. We collected 157 ant species (with three alien/sinantropic), distributed in 40 genus and eight subfamilies. Myrmicinae was the richer subfamily, with 87 species. Species were classified into 15 guilds, with ''Generalist Myrmicinae'' as the richer guild (28 spp). We found significative difference comparing the observed species richness ($p=0.0476$), alien/sinantropic species ($p=0.0072$), assemblage composition ($p= 0.0000$, $A= 0.0699$, $T= -12.5730$) and guilds composition ($p= 0.0000$, $A= 0.0789$, $T= -6.4640$). The distance of the fragments to the south of Salvador was not correlated with the observed richness ($p=0.5191$) and alien/sinantropic ant species ($p=0.7203$). Despite ants show differences on richness (observed and alien/sinantropic) and composition (assemblage/guilds) among the fragments, which was possibly occasioned due urbanization processes, the species distribution and the composition of ants community along RMS do not show any relation to the population density gradient. (CAPES, Pronex SECTI-FAPESB/CNPq projeto PNX0011/2009)

EFFECT OF URBAN HABITATS ON ANT ASSEMBLAGE (HYMENOPTERA: FORMICIDAE) IN SALVADOR, BRAZIL

T.S. MELO[1,2], M.C.L. PERES[2,3] & J.H.C. DELABIE[4]

[1]Programa de Pós-graduação em Ecologia e Biomonitoramento, Universidade Federal da Bahia, Salvador, BA, Brasil, e-mail: terciosilvamelo@hotmail.com. [2]Centro de Ecologia e Conservação Animal, Universidade Católica do Salvador (UCSal), Av. Professor Pinto de Aguiar, 2589, CEP 41740-090, Salvador-BA, Brasil. [3]Programa de Pós-Graduação em Planejamento Territorial e Desenvolvimento Social, Universidade Católica do Salvador (UCSal), Av. Professor Pinto de Aguiar, 2589, CEP 41740-090, Salvador-BA, Brasil. [4]Laboratório de Mirmecologia, Convênio UESC/CEPLAC, CEPEC-CEPLAC, Caixa Postal 7, CEP 45600-000, Itabuna-BA, Brasil.

The formation of urban environments creates several types of habitats among different complexity levels. Among them, green areas have shown a highly importance to biological diversity management. Here we aimed to compare the ant assemblages among different types of green areas located in a Brazilian metropolis called Salvador (Brazilian northeastern region). For these we set up two hypothesis: (I) the ant species composition is different in different habitats and (II) the observed richness of the alien/sinantropic species is differed among habitats. We conducted the surveys in the city of Salvador – Bahia, the third largest city of Brazil. We sampled four habitat types: residential gardens/backyards, wastelands, small forest fragments and large forest fragments. On each habitat type we established 20 sample points (SP), totaling 80 points. In each point, we sampled the ants with Winkler trap, entomological umbrella and manual sampling. Ants were deposited in the ant collection of the Mirmecology Laboratory at CEPLAC. We performed a Variance Test (ANOVA) to compare richness of the observed species and also the alien/sinantropic species among the sampled habitats. We applied the Multiple Response Permutation Procedure (MRPP) test to compare the composition of assemblages and guilds of ants among all sampled habitat categories. We collected 149 ant species distributed in 39 genus and seven subfamilies. The richest subfamily was Myrmicinae (87 spp) representing 58.3% of the sampled species. Species were classified into 15 guilds, with ‘‘Generalist Myrmicinae’’ as the richest (30 spp), representing 20.1% of all species. We recorded eight ant alien/sinantropic species in Salvador. We did not found difference among habitats regarding species richness ($p=0.7310$, $F=0.4316$). However we found significative difference on the alien/sinantropic species ($p < 0.0001$), the comparison of the composition of ants' assemblages ($p= 0.0000$, $A= 0.0846$, $T= -19.6250$) and guilds ($p= 0.0000$, $A= 0.1020$, $T= -11.1610$) among all sampled habitat categories. Ants showed no difference in species richness among habitats, but urban environments (backyards, gardens and wastelands) showed a higher frequency of alien/sinantropic species than the forest fragments. Differences on the composition of ant assemblages and guilds highlight the importance to maintain different types of green areas within urban environments to conserve biological diversity and ecosystem functions. (CAPES, Pronex SECTI-FAPESB/CNPq projeto PNX0011/2009)

EVOLUTION OF THE ASSOCIATION OF ATTINI ANTS WITH NITROGEN-FIXING AND ANTIBIOTIC PRODUCING BACTERIA

A.C. MARCHIORI[1], M. FERRO[1], S. KAKAZU[1] & M. BACCI JR[1,2]

[1]Laboratório de Evolução Molecular, CEIS - Centro de Estudos de Insetos Sociais, Instituto de Biociências, UNESP - Universidade Estadual Paulista, Avenida 24A, n 1515, Bela Vista, CEP: 13506-900 Rio Claro, SP, Brasil, e-mail: marchioriac@gmail.com. [2]Departamento de Bioquímica e Microbiologia, Instituto de Biociências, UNESP, Rio Claro, SP, Brasil

Ants of Attini tribe are known for the habit of cultivating mutualistic fungi (Basidiomycota) on a variety of harvested materials to form what is called the fungus garden. This habit originated approximately 50 million years ago in South America and gave rise to five agricultural systems. Attine ants utilize the fungus gardens as a source of nutrients and enzymes Therefore, to access these nutrients, fungus and ants must be associated with other microorganisms. Studies of microbial community associated with attine ants are mostly related to the fungus gardens and aim to explore the mechanisms of plant biomass degradation. Information on the microbiota associated with the body of ants and its function are still lacking. Attine ants rely on microbial symbionts for nutrition and protection against parasites. On the other hand, some microbes threaten these ants and others appear to be only commensals. In this work, the bacteria associated with *Atta laevigata*, *Trachymyrmex urichi* and *Mycocepurus goeldii* were identified by cultivation independent methods and a scenario in which the evolution of attine ants is shaped by the interaction with these microorganisms has been proposed. A washing protocol was developed to remove external bacteria, and used to sample microorganisms living inside the ants. The results showed differences between the bacterial communities harbored by the attine ants studied. It was discovered that the intestines of most basal attine *M. goeldii* are dominated by a single species of *Spiroplasma*. However, during the attine ants' evolution, this bacterium was progressively replaced by two Rhizobiales species in the gut of the phylogenetically intermediate *T. urichi*, and finally a single species of Rhizobiales prevailed as the unique bacterial species in the gut of the most derived leaf-cutter ant *A. laevigata*. Leaf-cutters also harbor on their cuticles considerable amounts of *Acetobacter*. Both Rhizobiales and Acetobacter species are in the group of nitrogen-fixing bacteria. Thus, it is conceivable that specialization in nitrogen-fixing mutualists may have played a role in increasing population and body size during Attini evolution. A larger population is thought to be associated with increases in infection rates, but this tendency was apparently counterbalanced by high social complexity of leaf-cutters and by the maintenance of Burkholderiales and Actinomycetales species, which we only found in ants' cuticle. These antibiotics producing bacteria may have assumed the protective role that is currently attributed to Pseudonocardiaceae in the remaining Attini species. We also detected an association with *Wolbachia* mutualists, which may have begun in the more primitive Attini, then specialized in the intermediate ones, and finally being lost in the more derived leaf-cutters. Mutualistic associations appear to be recent and originated from a single acquisition of nitrogen-fixing bacteria and multiple acquisitions of antibiotic producing microbes. (FAPESP)

EXTERNAL DENSITY AND CHARACTERIZATION OF *Dinoponera quadriceps* NESTS IN AN AREA IN FLONA CONTENDAS DO SINCORÁ, BAHIA

J.S. GUIMARÃES[1], C.S. RODRIGUES[1], A.S. SOUZA[1], M.A.F. CARNEIRO[1], I.C. NASCIMENTO[1] & K.S. CARVALHO[1]

[1]Laboratory of Invertebrate Zoology, Department of Biological Sciences, Universidade Estadual do Sudoeste da Bahia (UESB) Campus Jequié, Av. José Moreira Sobrinho s/n, CEP 45200-000 – Jequié, BA, Brasil, e-mail: jeu_234@hotmail.com

The aim of the present study was to determine the density of nests and their external characterization in an area of Caatinga National Forest Contendas Sincorá, Bahia. Four incursions were carried out in the field from June 2012 to June 2013. The trail Rio Combuca (13055'14 .4 "S; 041006'54 .9" W) was previously selected for the research, due to the abundance of individuals of *D. quadriceps* this area. At first, it was designed a transect at 20 meters from the entrance of the trail (distance from the edge), and from that point demarcated an area of 100m x 100m (1 hectare), with the assistance of a measuring tape. After the establishment of the area, the active search was performed by nests of *D. quadriceps*. 70 nests of *D. quadriceps* have been located within the demarcated area; amongst those, 61 had active workflow, i.e., there were workers returning from foraging activity. Most of the nests (n = 44) were located in the base of a tree, 15 nests near the base of the tree and 11 at least 1 away meter from the nearest tree. The distance between the nests varied from 2 to 5 meters. Most of them presented a molehill shape, with small sticks in their surroundings. The number of entries varied from (53 nests), two inputs (13 nests) and only four nests were three or more entries. On two occasions (September and November 2012) were sighted workers of *D. quadriceps* foraging over the trees, a fact that had not been reported for this species. The year 2012 was marked by a long period of drought in the Contendas do Sincorá which certainly made decrease the availability of potential prey used by *D. quadriceps*. The shortage of food resources at ground level may have led to foraging in the trees. After the onset of the rains (May 2103), workers were no longer detected foraging in trees. More field inspection will be carried out to verify the dynamic distribution of the nests in the area that has been studied over time and evaluate the relationship between the drier periods of foraging and *D. quadriceps* in the trees. (UESB, PRONEX-PNX 0011/2009)

GRAZING IMPACTS ON SAVANNA ANT COMMUNITIES IN THE AUSTRALIAN SEASONAL TROPICS

G.B. ARCOVERDE[1,2], A.N. ANDERSEN[2] & S. SETTERFIELD[1]

[1]Faculty of Engineering, Health, Science & the Environment, Charles Darwin University, Darwin, NT, 0909, Australia, email: gabriela.burlearcoverde@csiro.au. [2]CSIRO Tropical Ecosystems Research Centre, Darwin, Australia

Globally, grazing is one of the most widespread forms of disturbance, and it is especially important in tropical savannas, which hold much of the world's livestock. High levels of grazing can markedly change vegetation structure, plant species composition, ecosystem structure and function, and the abundance and composition of fauna. Ants have been widely used as bioindicators of the ecological impacts of grazing. In a recent review, four general ant response patterns were identified: (1) soil and vegetation type have a far bigger impact on ant community composition than does grazing; (2) grazing modifies species composition but often not total ant richness and abundance; (3) a species' response often varies between habitats; and (4) between 25-50% of the species that can be statistically analysed are significantly affected by grazing. Here we describe the impacts of grazing on ant communities in the semi-arid tropics of Australia, testing the extent to which they conform to the four identified global patterns. The work was conducted at Lakefield Station (1000 mm mean annual rainfall) located 460 km south of Darwin, using cross-fence comparisons of areas of different grazing intensities and covering two land systems. We found the ants to be remarkably resilient in relation to grazing, with inherent spatial variation being greater than cross-fence differences in areas of contrasting grazing intensity. We attribute this resilience to the effects of habitat and evolutionary history on the functional composition of the fauna, which is dominated by arid-adapted taxa and habitat generalists. The work is part of a broader project comparing ant responses to grazing along rainfall gradients in Australia and Brazil. (CNPq, CSIRO)

HABITAT HETEROGENEITY AND ANT ASSEMBLAGES DIVERSITY IN CAATINGA BIOME

F.A. NUNES[1,2], Y.B. VASCONCELOS[1], L.R. SÁ[1] & Y. QUINET[1,2]

[1]Laboratório de Entomologia, Unidade de Mirmecologia, Instituto Superior de Ciências Biomédicas, Universidade Estadual do Ceará (UECE), Av. Paranjana, 1700, CEP 60714-903 – Fortaleza, CE, Brasil, e-mail: francyregis@yahoo.com.br. [2]Programa de Pós-graduação em Ecologia e Recursos Naturais, Universidade Federal do Ceará, Fortaleza, CE, Brasil.

The semi-arid region of northeastern Brazil is a highly heterogeneous environment where the dominant vegetation type (*caatinga*) is a mosaic of physiognomies from seasonally dry thorn forests to open shrubby vegetation. It also comprises other vegetation types like seasonal deciduous submontane dry forests (*mata seca*), closed and xerophyllous shrubby montane vegetation (*carrasco*), and patches of rainforest (*brejos*) on the top of small mountain ranges or on the windward slopes of plateaus. Although vegetation heterogeneity is known to promote biodiversity both at local and landscape scale, very little is known about between-habitat diversity in the Caatinga region. In this work, we present the first results of a study whose goal is to compare ant assemblages diversity and guilds in the three main vegetation types (arboreal *caatinga, mata seca* and *carrasco*) found in the Reserva Serra das Almas, a 6146 ha protected area of Caatinga biome located in center-west region of Ceará state. In each vegetation type, two 1-ha plots (one with undisturbed vegetation - UV, the other with intermediate stage of vegetation regeneration - RF) were chosen and in each plot, two neighboring 90 meters transect lines were established, each with 10 sampling points at 10-m intervals. At each point, several methods were used to sample both soil and arboreal ants: Winkler extraction (48 hours) of a 1-m^2 leaf litter, a soil pitfall trap (4 days), soil sardine (or honey) baits (90 minutes) (one at morning, one at night), two subterranean traps (24 hours) with sardine (or honey) bait, two arboreal traps (one in canopy, the other on trunk) (4 days) with sardine (or honey) bait, arboreal sardine (or honey) baits (90 minutes) (one at morning, one at night), hand sampling (4 hours per transect). In total, 126 species representing nine subfamilies and 36 genera were found in all of the six plots. The more speciose subfamilies were Myrmicinae (68 species) and Formicinae (21 species), while the most diverse genera were *Pheidole* (19 species), *Camponotus* (16 species), *Solenopsis* (12 species) and *Crematogaster* (10 species). The vegetation with highest species richness was *mata seca* (95 species; 61 in UV - 82 in RF), followed by *carrasco* (88 species; 69 in UV -77 in RF), and arboreal *caatinga* (49 species; 42 in UV – 30 in RF). Jaccard similarity index was higher between *mata seca* and *carrasco* (0.56) than between *caatinga* and *mata seca* (0.35) or *caatinga* and *carrasco* (0.33). Although still preliminary and without habitat structural heterogeneity analysis, our results show strong differences in species richness and composition between different habitats of Caatinga region, even at small geographic scale. It stresses the need for much more sampling effort in the whole Caatinga region and in all habitats of it. (CAPES, CNPq, FUNCAP)

HAVE PONEROMORPHS ANY INFLUENCE ON THE STRUCTURE OF THE ANT ASSEMBLAGES IN FOREST REMNANTS OF “CAATINGA” AND “AGRESTE” REGIONS IN THE STATE OF THE BAHIA, BRAZIL?

E.S. CONCEICAO[1], J.A.A. CARVALHO[1], E.S. ARAUJO[1], U.S. ESTRELA[1], P.S. SANTOS[1], P.T.B. SÁ & J.H.C. DELABIE[2],

[1]Universidade do Estado da Bahia (UNEB), Departamento de Ciências Exatas e da Terra, Campus II, Rodovia Alagoinhas-Salvador - BR 110 - Km 03, CEP: 48040-210, c.p 59. Alagoinhas, BA, Brazil. elta_mara@yahoo.com.br. [2]UESC/CEPLAC- Laboratório de Mirmecologia. Ilhéus, Bahia, Brazil.

Poneromorph corresponds to a polyphyletic group of ants (formerly, Ponerinae *sensu* Kempf, 1972) that are considered baseline for their habits and morphological characteristics. In the Neotropical Region, they are currently constituted by 24 ant genera in six sub-families. These ants present a range of habits and most of them are epigeic or hypogeaic. The aim of the study was to verify the influence of Poneromorph on the structure of the ant assemblages in the transition areas between the semiarid vegetation (“caatinga”) of the north of the state of Bahia and the region known as “Agreste Baiano”, Brazilian Nordeste. Ants were sampled from September to December 2012 in a forest remnant of the Pivot Project at Inhambupe (11°50'56.6"S 38°29'23” W), in another one of the Ouriçanguinhas Project at Ouriçangas (11°58'14"S 38°33'7"W) and in a caatinga forest remnant of the Biritinga Project at Sátiro Dias (11°34'38"S 38°42'0.5"W). In each of these areas 150 samples were collected as follows: 50 Winkler, 50 "Pitfall" and 50 hand collections. An interval of 50 meters was maintained between two successive sampling points and the samplings began at 100 meters from the edge. Statistics was performed using Excel 2007® and niche overlap and co-occurrence analyses using EcoSim® v1.2d. Between epigeic ants, the most frequent Poneromorph was *Dinoponera quadriceps* (72%) especially at Sátiro Dias, while *Ectatomma opaciventre* showed a very high frequency (78%) in the whole fragments. *Dinoponera quadriceps* is a typical species in the Nordeste Region of Brazil characteristic of the caatinga biome. Between the arboreal ants, the Poneromorph showed no significant frequency, being *Ectatomma tuberculatum* (2%) the only representative of the group recorded in that stratum, and was found exclusively in the Sátiro Dias remnant. This low frequency of Poneromorphs seems due to their habits, as these ants are solitary foragers, have few opportunities to nest on trees and have their colonies with low population. The rates of co-occurrences in the Inhambupe and Ouriçangas forest remnants suggest competition between soil species. At Sátiro Dias none co-occurrence was yet detected. We were thus unable to detect niche overlap for Poneromorphs in any of the sampled fragments and with any other common ant. However, it was observed that a tendency of interaction occurs on the ground between these species. In all the forest remnants, members of the Poneromorphs were always the most frequent species in the ground. Although this is a group of ants considered dominant not only for its biomass and population, it certainly influences the ant assemblages on and in the soil in the forest fragments, through competition for prey selection. Further studies tentatively will make that clearer. (PRONEX SECTI-FAPESB/CNPq, project PNX 0011/2009; FAPESB).

INFLUENCE OF HABITAT IN COMPETITIVE STRATEGY FOR FOOD RESOURCES BY ANTS

G.B. MARTINS SEGUNDO[1]; D.M.T. SANTOS[1]; F.K.G. SILVA[1]; J.C.A. MACÊDO[1] & J.V.L. LIMA[1]

[1]Post Graduate Program in Ecology and Natural Resources (PPGERN), Federal University of Ceará (UFC), Avenida Humberto Monte, s / n, CEP 60455-760 - Fortaleza, CE, Brazil, e-mail: glaucobmsegundo@hotmail.com.

Competition is considered one of the most important mechanisms by which the activities of an individual can affect the well-being of other individuals, from the same species or not. Ants, especially in tropical environments, are great competitors by presenting outstanding numerical dominance with respect to biomass. When resources are scarce, greater foraging efficiency is expected to be favored. Here, we tested this hypothesis by experimental field observations at the Ecological Station (ESEC) of Aiuaba (06º36'01" S and 40º07'15" W). Two types of habitats were considered: one with high food resource availability (MR - inside the woods and near a river) and a second one with low resource availability (SR - open field with some trees and buildings). In each site (MR and SR), we mark six areas, with four points in each area. At each point, we distributed four baits made of bananas and sardines (total of 48 baits). The observations (45 minutes spent in each bait) were performed in the morning, afternoon and evening (two areas of each environment per turn). We measured the following variables: the arrival time of the first ant (AT) and number of ants (NA) at the end of 45 minutes. We also collect ants in areas for later identification at genus level. We performed ANOVA and GLM's in the program R. We identified 12 morphotypes belonging to seven genera, eight of them being common to both habitats, while four were found only in the SR habitat. The arrival time at baits was lower ($p = 0.002$) in the MR site and in the afternoon ($p = 1.81$ e-07). Also, the number of ants was superior at MR site ($p = 0.006$). We conclude that in places with more resources availability, the ants were more agile and more active in searching for food in the afternoon.

INFLUENCE OF *Prosopis juliflora* (Sw.) DC. (FABACEAE) ON ANT ASSEMBLAGE IN A CAATINGA AREA

C.B. COSTA-MILANEZ[3], B.C. BARBOSA[1], D. VENTURA[2], F.F.S. SIQUEIRA[2], L.F.P. GOUVEIA[2] & V. LONDE[3]

[1]Programa de Pós-Graduação em Ecologia, Manejo e Conservação da Vida Silvestre, Departamento de Biologia Geral, Universidade Federal de Minas Gerais, [2] Programa de Pós-Graduação em Biologia Vegetal, Departamento de Botânica, Universidade Federal de Pernambuco, [3] Programa de Pós-Graduação em Ecologia de Biomas Tropicais, Departamento de Biodiversidade, Evolução e Meio Ambiente, Universidade Federal de Ouro Preto. cborgesdacosta@gmail.com

Prosopis juliflora, the “algaroba”, is an invasive species better adapted to areas of Caatinga for being undemanding to ground water availability. Due the excellent adaptation to arid regions, spread quickly through the Northeast of Brazil and reduced drastically the plant species richness compromising the natural regeneration in some areas of the Caatinga. This study evaluated whether the ants species richness is altered in areas with algaroba dominance. The study was conducted in the National Park Catimbau (Pernambuco) in two areas: one area dominated by algaroba and other with caatinga formed by shrub and tree. Ants sampling was in May 2013 using two types of bait, carbohydrate and protein. In each area were established three sampling units, with directions and distances established arbitrator by lottery from random numbers. Each sample unit had two sub-samples. The sub-samples were far from each other 10 meters and contained two types of baits. The baits were 50 cm apart from each other within the sub-sample. The baits were observed every 10 minutes during two hours and all specimens were collected. In algaroba area we recorded two species of ants *Dorymyrmex thoracicus* and *Pheidole* sp. In caatinga area we founded ten ants species: *D. thoracicus*, *Pheidole* sp., *Solenopsis* sp. and *Ectatomma* sp., plus six morphotypes. Mean ants richness per bait was lower in the area dominated by algaroba (1,16±0,41) compared to caatinga area (3,16±0,75, t=5,7; p<0,01; gl=10). In the algaroba and caatinga area, *D. thoracicus* was the dominant species, being found only in protein bait while *Pheidole* sp. in carbohydrate bait. As expected, the dominance of algaroba affected the ants’ community reducing species richness. Although some ant species might have your abundance affected by the occurrence algaroba monodominance, on the other hand, some ant species generalists are favored, as *D. thoracicus*. In the algaroba area, *D. thoracicus*, was the species dominant. This ant specie has aggressive foraging behavior favoring its high abundance in this area. Our study showed that algaroba monodominance in an area of Caatinga affected the richness of ants in the area, so that the species *D. thoracicus* became the dominant species. We suggest from these results that the loss of plant diversity caused by invasive species can alter the ecosystem as a whole, including invertebrate fauna, also affecting the diversity of this group. (FAPEMIG, UFPE)

INSECT FAUNA SUCCESSION ON PIG CARCASSES AND THE ROLE OF ANTS DURING THE DECOMPOSITION PROCESS

M.C. PAULA[1,2], G.M. MORISHITA[4], C.H. CAVARSON[3], C.R. GONÇALVES[3], J.A. ESPINDOLA[3] & W.F. ANTONIALLI-JUNIOR[1]

[1]Laboratório de Ecologia, Centro Integrado de Análise e Monitoramento Ambiental (CInAM), Rodovia Dourados – Itahum, Km 12, CEP 79804-970 – Dourados, MS, Brasil, e-mail: michelecastro.ufgd@gmail.com. [2]Programa de Pós Graduação em Entomologia e Conservação da Biodiversidade, Universidade Federal da Grande Dourados, Dourados, MS, Brasil. [3]Universidade Federal da Grande Dourados, (UFGD), Dourados, MS, Brasil. [4]Universidade Estadual de Mato Grosso do Sul, (UEMS), Dourados, MS, Brasil.

Forensic Entomology is applied to several legal issues as a tool in criminal investigations. Several species are associated with the decomposition process, being replaced or added on the carcass, creating an entomological succession. According to the literature the groups that stand out are the Diptera, Coleoptera and Hymenoptera (wasps and ants). Although the most studied insects are the Diptera and Coleoptera, because of their already proved important role, ants are present at all stages of decomposition, and may act as predators or sarcosaprophagous. Therefore, the aim of this study was to investigate the role of ants in ecological succession during the different stages of carcasses decomposition. Three experiments were conducted from October 2012 to June 2013 in a forest fragment in the municipality of Dourados, MS. We used six carcasses of pigs (*Sus scrofa* Linnaeus, 1758), two each quarter, simultaneously at different points of the same forest. Immediately after placing the carcass, we started the data collection, from 06:00 to 7:30 a.m.; 12:00 to 13:30 p.m.; and 18:00 to 19:30 p.m., every day until the end of the decomposition process. The stages of decomposition were Fresh, Bloated, Active Decomposition, Advanced Decomposition and Dry Stage. Six orders of insects occurred colonizing the carcass during all the collection phase, especially Diptera with 42% of the occurrences, Coleoptera with 26% and Hymenoptera with 24%, the other orders had 8% of occurrences. The first group to visit was the Diptera taking on average 10 minutes (± 1.13), and we collected specimens of the families Calliphoridae, Muscidae, Sarcophagidae and Faniidae, Phoridae, Piophidae, Anthomyiidae, Ulidiidae, Stratyomiidae, Lauxanidae, Pteromalidae, Sirphidae, Bombylidade and Tabanidae. On the other hand, Coleoptera were the most diverse and abundant in the Advanced Decomposition and Dry stages, occuring individuals of the families Staphilinidae, Histeridae, Scarabaeidae, Silphidae, Bostrichidae and Trogidae. Ants occurred during all stages of decomposition. In the presence of sarcosaprophagous ants the carcass was faster decomposed. The t-test ($p < 0.074$), the acceleration was 40% with a mean of 8.67 ± 1.76 days compared with the carcass without the presence of the ants which in this situation decomposed 14.67 ± 1.76 days. This fact is probably associated with the holes produced by these species that act consuming the carcass which will produce new entries to larvae placed on the outside of the carcass. Therefore, ants have indeed demonstrated an important role, working directly or indirectly in the decomposition process of the carcass. (CNPq, CAPES)

LAND USE CHANGE AFFECTS THE ABUNDANCE, SPECIES RICHNESS, AND THE PREDATORY ACTIVITY OF GROUND-DWELLING ANTS

R. PACHECO[1], H.L. VASCONCELOS[1], G.P. CAMACHO[2] & T.L.M. FRIZZO[3]

[1]Laboratório de Ecologia de Insetos Sociais, Instituto de Biologia, Universidade Federal de Uberlândia (UFU), Rua Ceará, s/nº, CEP 38408-000, Uberlândia, MG, Brasil, email: rpneco@yahoo.com.br; [2]Universidade Federal de Viçosa, Viçosa, MG, Brasil; [3]Universidade de Brasília, Brasília, DF, Brasil.

The loss of insect diversity within agricultural landscapes is of particular concern since many insect species provide ecosystem services of importance to farming. Ants, for instance, are important generalist predators and therefore can help to suppress pest outbreaks. However, little is known about how changes in the diversity and composition of ant assemblages, following the transformation of natural habitats into crops, may affect the role of ants as predators. Here we provide comparative information about the structure of ant assemblages in adjacent crop (soybean plantations) and non-crop (woodland savannas) habitats in southeastern Brazil. We also estimated rates of predation by ants in crop and non-crop habitats and evaluated how rates of predation by ants change as a function of variations in the density of ant species. This allowed us to test the hypothesis that the predatory effects of ants on prey assemblages are enhanced when multiple ant species are present. Ants foraging above or belowground were collected in six different sites at varying distances from the border between crop and non-crop habitats. Epigaeic ants were collected with traditional pitfall traps and hypogaeic ants with subterranean pitfall traps. Rates of predation by ants belowground were estimated using *Tenebrio molitor* larvae buried inside plastic containers that allowed ant access but prevented the larvae to escape. Aboveground predation rates were estimated using artificial caterpillars made with modeling clay. Distance from the non-crop habitat did not significantly affect the structure of ant assemblages or the rate of predation by ants within crops. Aboveground predation rates did not differ between crop and non-crop habitats despite the fact that aboveground ant species density was much greater in the non-crop habitat. In contrast, rates of predation by ants belowground were nearly two times greater in the non-crop habitat even though ant species density belowground did not differ significantly between crop and non-crop habitats. Ant abundance aboveground (all species combined) was only slightly greater in the non-crop habitat, whereas ant abundance belowground was more than two times greater in the non-crop than in the crop habitat. These results suggest that inter-habitat differences in predation rates are mediated mainly by changes in overall ant activity and not by changes in the number of ant species. (CNPq, CAPES)

LEAF-CUTTING ANTS (*Atta robusta* BORGMEIER, 1939) DO NOT ALTER PLANT COMMUNITY IN BRAZILIAN RESTINGA.

T.G. SOBRINHO[1], M.S. MADUREIRA[1,2], J.H.SCHOEREDER[1] & M.C. TEIXEIRA[3]

[1]Departamento de Biologia Geral, Universidade Federal de Viçosa-UFV, Av. PH Rolfs, S/N 36570-000, Viçosa-MG; Brasil. [2]Universidade do Estado da Bahia-UNEB, Teixeira de Freitas-BA; Brasil; [3]Centro Universitário do Norte do Espírito Santo-CEUNES, São Mateus-ES; Brasil, e-mail: tathianasobrinho@gmail.com

Atta robusta is a leaf-cutting ant species that acts as seed disperser in Brazilian Restingas. We verified if these ants alter plant community analyzing the effect of distance from their nests on sapling communities. We hypothesized that near the nests (i): there is a lower abundance and species richness of sapling species, (ii) there is a higher abundance and species richness of plant species dispersed by *A. robusta* and (iii) there is a typical sapling species composition on nests. We obtained sapling species richness and abundance from 10 x 10 m plots disposed at 0, 10, 20, 30, 40 and 50 m away from the *A. robusta* nests. We performed linear regression analyses to verify the effect of nest distance on sapling abundance and species richness. Bray-Curtis dissimilarity index was used to detect differences in sapling species composition among nests (0m) and other plots (10-50m). None of our hypotheses were accepted. We suggest a preferential foraging on adult plants located at sunny sites to explain the absence of negative effects on saplings communities. Seedling predation was proposed as main mechanism to explain the absence of association among plants dispersed by *A. robusta* and ant nests. Contrary to other leaf-cutting ants, *A. robusta* does not reduce plant recruitment and according to seed dispersal effectiveness concept this species is not an efficient disperser. (FAPEMIG, FAPESB, CNPq)

LITTER ANT ASSEMBLAGES IN REMNANTS OF THE ATLANTIC RAIN FOREST OF SOUTHERN BAHIA, BRAZIL

A.F.R. CARMO[1], M.S. PASSOS[2], I.C. NASCIMENTO[3], J.H.C. DELABIE[2] & S. CAMPIOLO[2]

[1]U.P.A. Laboratório de Mirmecologia, CEPLAC/UESC agreement, Centro de Pesquisa do Cacau, Cx.P. 7, CEP: 45600-970 – Ilhéus, BA, Brazil, e-mail: afrcarmo@hotmail.com; [2]Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz (UESC), Ilhéus, BA, Brazil; [3]Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB), Jequié, BA, Brazil.

The Brazilian Atlantic Forest stands out with the highest diversity indices found in tropical forests, and due to its high level of endemism, is considered as one of the most threatened hotspots and with the higher conservation priorities. The aim of this study was to analyze the richness and composition of ant species in different remnants of the Atlantic Forest in southern Bahia. We used a database generated from the research conducted by the Dríades Institute during the Flora and Fauna Monitoring Program (Campaign 2006/2007 - Veracel Celulose SA) in the counties of Porto Seguro, Eunápolis, Belmonte and Santa Cruz Cabrália, state of Bahia, Brazil, in 16 Atlantic forest remnants, two of them being conservation units. In each area, 40 $1m^2$ squares samples of litter were collected. Each sample was put in mini-Winkler traps, where it remained for 48 hours for ant extraction. The material was carried to the Myrmecology Laboratory, where it was sorted, mounted and identified. 272 ant morphospecies/species were identified, distributed into 11 subfamilies, 29 tribes and 49 genera. The subfamily with the highest number of species was Myrmicinae (n=173), followed by Ponerinae (37) and Formicinae (28). The genus represented by the greatest number of species was the megadiverse *Pheidole* (n=38). It was followed by *Hypoponera* (n=14), *Solenopsis* (n=13) and *Pachycondyla* (n=12). Species richness is quite similar among areas, despite differences in their assemblage composition. However, nearly 50% of the species occurred in only one type of environment. The ant richness per area varied from 54 (areas “Sucupira A” and “Peroba A”) to 73 species (“Ceplac/ESPAB”), with an estimated number varying from 72.14±8.62 (“Liberdade B”) to 168.41±33.3 (“Ceplac/ESPAB”). Berger & Parker’s Dominance Index varied between 7 (“Juerana”) and 9.7 (“Sucupira A”). Coincidentally, this last area was also that one with the smaller species diversity. We recorded the occurrence of the threatened ant species, *Dinoponera lucida* Emery, the giant ant of the Central Corridor of the Brazilian Atlantic rain forest, as well in conservation units (PNBP: “Parque Nacional do Pau Brasil” and “Ceplac/ESPAB”), as in other forest remnants. One of the most significant results of our study was the discovery and description of a species of Myrmicinae belonging to a new genus: *Diaphoromyrma sofiae* Fernandez, Delabie & Nascimento in seven of the 16 areas that were sampled. This information shows the importance of preservation of such forested areas in southern Bahia where new other species certainly await to be uncovered. (VERACEL, CNPq, FAPESB-PNX0011/2009)

NEIGHBOURS SHAPE THE EPIPHYTIC COMPOSITION OF NEOTROPICAL ANT GARDENS

L.N. PAOLUCCI[1], J.P.C. MENEZES[2], F.M. RESENDE[3], F.P. PEIXOTO[4] & L.C. LEAL[5].

[1]Programa de Pós Graduação em Ecologia, Universidade Federal de Viçosa. Av. PH Rolfs, s/n. *campus* universitário, Laboratório de Ecologia de Comunidades. CEP 36570-000 – Viçosa, MG, Brasil, e-mail: lucaspaolucci@gmail.com. [2]Programa de Pós Graduação em Recursos Hídricos em Sistemas Agrícolas, Universidade Federal de Lavras, Lavras, MG – Brasil. [3]Programa de Pós Graduação em Ecologia, Conservação e Manejo da Vida Silvestre, Universidade Federal de Minas Gerais, Belo Horizonte, MG – Brasil. [4]Programa de Pós Graduação em Ecologia e Evolução, Universidade Federal de Goiás, Goiânia, GO – Brasil. [5]Programa de Pós Graduação em Biologia Vegetal, Universidade Federal de Pernambuco, Recife, PE – Brasil.

Ant garden (AG) is a complex ant-epiphyte plant association, in which plants benefit from dispersion, nutrition and protection from herbivores, while ants use different food resources from epiphytes and their roots as support for the nest. Ants initiate AGs by adding seeds into a carton nest from plant fibres. Those seeds are continuously added to the nests throughout ant colony lifetime. Epiphytic composition of Neotropical AGs is highly variable, even among different nests of the same ant species. Despite of the knowledge of plant species potentially occurring on AGs, the processes responsible for such variable epiphytic composition is still misunderstood. We investigated which processes structure epiphytes composition on AGs formed by *Crematogaster levior* and *Camponotus femoratus* in Amazon forest. In this region, a parabiotic association between these ant species comprises most of the AGs, and 16 epiphytes species were yet registered in association with these ants. We hypothesized that AGs' epiphytes composition are structured by i) plant succession, ii) environmental filters or iii) seed dispersion limitations. If so, i) AGs with equivalent age, ii) under similar environmental conditions or iii) closer to each other will have a more similar epiphytic composition. We sampled 18 AGs in Central Amazon "terra firme" near to Manaus-AM, Brazil, in August' 2011. On each AG, we calculated nest area using ellipse formulae and used it as a surrogate of AG successional stage. Light availability, number of branches supporting the garden and AG height in relation to the ground were considered as environmental variables. Finally, we measured the distance between sampled AGs. For testing our hypotheses, we made individual comparisons between similarity matrix of epiphytic composition and similarity matrix of AGs area, standardized environmental variables and distance among sampled AGs. Epiphytic composition was not related to AGs area or similarity of environmental conditions. On the other hand, closer AGs showed a more similar composition of epiphytes in comparison to more distant gardens. We concluded that there is not an assembly rule driving AGs epiphytic composition. The composition of AGs epiphytes seems to be determined by the surrounding seed composition, simply due to probabilistic issues. As AGs epiphytes do not occur outside the AG, neighbor AGs may act as the main source of seeds for new ant gardens. (FAPEMIG, CAPES, INPA, PDBFF).

OCCURENCE AND RICHNESS OF GROUND-DWELLING ANTS ALONG A TOPOGRAPHIC GRADIENT IN BRAZILIAN AMAZON

C.B. GOMES[1], J.L.P. SOUZA[1] & E. FRANKLIN[1]

[1]Laboratório de Sistemática e Invertebrados do Solo, Coordenação de Pesquisa em Entomologia, Instituto Nacional de Pesquisa da Amazônia – INPA, Av: André Araújo 2936 CEP 69067-375 - Manaus, AM, Brasil, e-mail: cbg.mila@hotmail.com.

Due to their biological and ecological characteristics ants have an important role in most terrestrial ecosystems. Therefore, studies using protocols defined sampling effort as well with certain groups that are taxonomically well resolved as ants can produce significant results to answer some ecological questions. We conducted a study in August 2011 at the experimental farm of the Federal University of Amazonas (UFAM). Samplings follow standardized protocols (RAPELD) to allow uniform measurement of environmental variables on local and regional scale as well as comparisons of results between locations. The ant samples were taken in a permanent grid with plots was distributed over 25 km2 of trails, and each plot was at least 1 km distant from any other. Plots were 250 m long and positioned to follow altitudinal contour lines, and thus minimize altitudinal and soil variation within each plot. Three sampling techniques were used: Winkler extractor, pitfall traps and sardine baits. We collected 300 samples by each technique, amounting 900 for every grid. Sorting and identification of ant species and morphospecies were made in the laboratory. The study sites were ranked according to the records of the presence/absence by the technique of non-metric Multidimensional Scaling (NMDS). We used the first two axes of the NMDS for multivariate analysis of variance (MANOVA) with environmental variables. We compare our results with previous studies in the Ducke Reserve in Amazonas, Viruá National Park and Maraca Ecological Station in Roraima. In the four study sites were identified 79,955 specimen classified in 115 species and 268 morphospecies. When comparing the four sites, the lowest number of taxon was recorded in Viruá and the largest number of taxon was recorded in Ducke. The sardine bait was effective in sampling more taxon than the Winkler in Maracá and Viruá, but the same pattern was not detected in Ducke and UFAM where Winkler was more efficient than bait. In Ducke, where information available with the combination of the three sampling techniques revealed a high correlation with the clay content, volume of litter and the slope of terrain. In Viruá this correlation was found with clay content and volume of litter. In Maraca, the combination of the three sampling methods demonstrated a high correlation between taxon number (211) and canopy openness. On the farm UFAM combination of three sampling techniques, also evidenced correlations of taxon number (178) with altitude. From this study the four biological reserves located in the state of Amazonas and Roraima, we assume that standardized protocols (RAPELD) can be applied in other similar environments for detection of ecological information about ground-dwelling ants. (CNPq, CEBAM, PPBio)

PONEROMORPH ANTS IN THE LIANA FORMATION OF THE BRAZILIAN ATLANTIC FOREST BIOME IN THE BOA NOVA NATIONAL PARK, STATE OF BAHIA

C.S. RODRIGUES[1], A.S. SOUZA[1], M.A.F. CARNEIRO[1], J.H.C. DELABIE[2], K.S. CARVALHO[1] & I.C. NASCIMENTO[1]

[1]Laboratório de Zoologia de Invertebrados, Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB) Campus Jequié, Av. José Moreira Sobrinho s/n, CEP 45200-000 – Jequié, BA, Brasil, e-mail: cyntira_13@hotmail.com; [2]U.P.A. Laboratório de Mirmecologia, convênio CEPLAC/UESC, Centro de Pesquisa do Cacau, Cx.P. 7, CEP: 45600-970 – Ilhéus, BA, Brasil

This study aimed to evaluate the Poneromorph ant composition and diversity in a liana formation of the Brazilian Atlantic forest biome at Boa Nova, southwest of the state of Bahia. Samples were taken in four campaigns between 2010 and 2012, two during the rainy season and two during the dry season. In each one, 50 samples of 1 m² litter were extracted for the ants in Mini-Winklers during 48 hours. In the same sampling points we also installed pitfall traps which were maintained in the field for 24 hours. Seventeen species of Poneromorph ants were sampled represented by six genus: *Anochetus* (one species), *Hypoponera* (two), *Ectatomma* and *Gnamptogenys* (three each one); *Odontomachus* and *Pachycondyla* (four each one). The number of Poneromorphs corresponds to 24% of the ant species which were collected (n=86). The most frequent species was *Ectatomma muticum* present in 54.5% of samples, followed by *Odontomachus chelifer* (19.6%). The species accumulation curve shows that the sampling effort was sufficient, as the total richness (estimated using Chao2) was 17±0.08 species, which is the same number that the observed. If one considers separately the curves of accumulated richness for each collecting methods (pitfall and Winkler), is also evident that both methods reach an asymptote. However, the total observed species number is different for both (pitfall: n=8; Winkler: n=12). This reinforces the argument that complementary collection methods are strongly needed when sampling ant communities. A similarity analysis shows that species composition is distinct according to seasonality: two clusters are clearly formed, one for the dry season and the other for the rainy season, with a similarity of 0.516 (Jaccard index). These data are still preliminary, since more samples are planned for the next two years. In addition, new parameters, such as litter accumulation and vegetation structure, will be included in further analyses. (UESB, PRONEX-PNX 0011/2009)

PREDATORS AND PARASITOIDS SHARING A LEAF-CUTTING ANT PREY (*Acromyrmex lobicornis*): PRELIMINARY RESULTS OF COMPLEX INTERACTIONS

L. ELIZALDE[1] & D. MEIER[2]

[1]Laboratorio Ecotono, Universidad Nacional del Comahue, Pasaje Gutiérrez Nº 1125, Bariloche, 8400, Argentina, e-mail: luelizalde@gmail.com; [2]Unidad de Gestión Provincial de Bosques, Villa la Angostura, Argentina, e-mail: diemeier@yahoo.com.ar

Predators and parasitoids that share the same prey can interact negatively trough intraguild predation or competition for the resource. But they can also interact positively, by increasing prey availability for the other. Leaf-cutting ants are preyed upon by various vertebrates and invertebrates, but one of the most important are armadillo mammals. These ants are also attacked by a group of phorid parasitoids, which form a guild in the sense that they only use leaf-cutting ants as hosts to oviposit in. Armadillos, phorid parasitoids and leaf-cutting ants overlap in much of their distribution range and constitute a good study system to research predator–parasitoid–prey trophic interactions. Here, we present preliminary results evaluating whether these predators and parasitoids interact through their common prey, the leaf-cutting ant *Acromyrmex lobicornis* in Patagonia (Argentina). Since the system is unknown, we also describe basic aspects of these interactions as a necessary first step. Along transects we 1) counted the number of nests with signs of attack by the armadillo *Chaetophractus villosus*, 2) collected their feces to later identify ants in them, and 3) collected ants to rear phorids from them in some of these nests. A 48% of the nests suffered armadillo attack (N = 65 nests), and the feces analysis allowed to determine that these mammals feed on ants with high frequency (67% of the feces had *A. lobicornis*), and that ants represented the dominant insect food resource (although armadillos also fed on vegetables). We found that 80% of nests were parasitized by the phorid species *Myrmosicarius catharinensis* (N = 10 nests). In nests with phorids, 3 ± 2.1% (mean ± SD) forager ants were parasitized. This mean parasitism is similar to values found in other localities by this phorid species. However, we found no significant differences in the percentage of ants parasitized by phorids between nests with and without armadillo attacks (U = 10, P = 0.57, N = 8 nests). These preliminary results suggest that predators and parasitoids are not interacting through their shared prey. However, we are conducting field experiments to determine the potential for interactions mediated by their common prey in this predator-parasitoid system. These results may be important for integrated biological control of these ants when they have become pests, and also to avoid them to become pests. (Fundación Bunge y Born, Argentina)

RESOURCE AVAILABILITY AND AGGRESSIVE BEHAVIOUR AMONG ANTS: A PROXY FOR INTER-SPECIFIC COMPETITION ROLE ON ANT COMMUNITY STRUCTURE

F.A. SCHMIDT[1,2,3], R.S. JESUS[1], F.M. REZENDE[1], R.R.C. SOLAR[4] C.R. RIBAS[2] & J.H. SCHOEREDER[1]

[1]Departamento de Biologia Geral. Universidade Federal de Viçosa, Viçosa, MG, Brasil, e-mail: schmidt.fa@gmail.com. [2]Setor de Ecologia, Departamento. Biologia, UFLA, Lavras-MG, Brasil. [3]Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre, Rio Branco, AC, Brasil. [4]Departamento de Entomologia. Programa de Pós Graduação em Entomologia, Universidade Federal de Viçosa, Viçosa-MG, Brasil.

Inter-specific competition is considered a hallmark of ant community ecology. Therefore, sites with high abundance and variety of resources would support more species diverse ant communities. In this study, we verified the assumption different ant species sharing the same resource would be less aggressive against each other when they inhabit sites with higher abundance and variety of resources. We tested the hypothesis (1) that sites with more varied and abundant resources have a smaller proportion of ant species found at attractive baits relative to those collected by non-interactive methods (pitfall traps) and (2) the higher is the number of species present at the baits, the more often aggressive interactions should be. We developed our study in savannah and forest habitats, which made up a gradient of resource abundance and variety for ants. In each site we distributed ten pitfall traps and five observational stations, that consisted of a piece of paper – 4 cm^2 with a portion of sardine – 1 cm^3. In each observational station, we counted all the aggressive interactions among the ants within 1 hour period. We considered as aggressive interactions actions such as attacking other ants with open mandibles to bite the other ant, gaster flexions aiming to sting the other ant or bearing some secretion and to actually sting other ant. To verify the assumption, we carried out a linear regression between the number of aggressive behaviours observed in the attractive baits (response variable) and the resource quantity and heterogeneity (explanatory variables). We also carried out linear regressions to test the following hypotheses: (i) the ratio (number of ant species on the baits)/ (number of ant species sampled in pitfall traps) was the response variable and the resource quantity and heterogeneity were the explanatory variables; (ii) the number of aggressive behaviours observed in the attractive baits was the response variable and the number of ant species on the observational station was the explanatory variable. We found no relationship between ant aggressiveness and resource availability. Moreover, the resource availability of sites had no influence on the number of ant species found at attractive baits. However, the higher is the number of species present at the baits, the more aggressive interactions were observed ($p < 0.05$). These results indicate that aggressiveness among ants could be more due to their behaviour traits than to sites resource availability. Considering that behaviour dominance hierarchy does not necessarily have an effect on ant abundance or competition, measures of ant aggressiveness could not be directly interpreted as a proxy of the role inter-specific competition on ant community structure. (CAPES, CNPq, FAPEMIG)

RESPONSE OF ANT FUNCTIONAL GROUPS RELATED TO TIME AFTER FIRE IN CAMPOS RUPESTRES

M.C. ANJOS[1], T.C. LANA[1,2], H.S. BRANT[1], L.D. BRAGA[1], G.W. FERNANDES[2] & F.S. NEVES[1,2]

[1]Laboratório de Ecologia de Insetos, Departamento de Biologia Geral, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais (UFMG), Av. Antônio Carlos, 6627, CEP 31270-901 – Belo Horizonte, MG, Brasil, e-mail: mcatao87@gmail.com [2]Programa de Pós-graduação em Ecologia, Conservação e Manejo da Vida Silvestre, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brasil

The *Campos Rupestres* is a biodiverse mountain ecosystem included inside the Brazilian Cerrado. Although studies demonstrate the presence of fire in the history of the Cerrado biome over 32 thousand years, the understanding of how it affects the fauna´s community is recent. Despite the studies on plants of *Campos Rupestres* reveal patterns related to fire, there is still no information on how this disturbance affects ant community in this ecosystem. For this study, ant´s genera was assigned to functional groups, based on their eating habits and behavior assuming that these groups would respond differently to the fire disturbance. Thereby, the aim of this study was to detect how ant functional groups are affected by fire in an area of *Campo Rupestre* in Serra do Cipó, Minas Gerais. The hypothesis was that different functional groups exhibit different responses throughout time after a fire episode, since the fire causes momentary changes in the environment, such as vegetation structure and plant species richness. We selected a recent burned area and an adjacent unburned one to compare distinct patterns on the distribution of the functional groups. The ant samples were taken one, four and ten months after the fire event. The samples consisted in 15 epigeic pitfall traps distributed in 3 transects of 200 m long, in each area, totaling 30 pitfalls. Each pitfall was 50m distant from one another and each transect was 200m apart, at least. The local functional groups detected were: dominants (D), epigeic omnivorous (not dominant) (EO), pollen consumers (PC), epigeic generalist predadors (EGP) and fungus growers (FG). We sampled 61 ant species belonging to seven subfamilies and 23 genera. The significant difference among functional groups between the burned and unburned areas was detected only four months after fire, with the increase on species richness of the pollen consumers and the epigeic omnivores ants, and the decrease on species richness of the epigeic generalist predators. Throughout the period of ten months the fire effect was not detected in none of the groups. Thus, we corroborate the hypothesis that changes induced by fire in *Campos Rupestres* promote a dynamic and biodiverse ecosystem. The pattern of rapid recovery of *Campo Rupestre*´s grasses must be exerting a fundamental role in the dynamics of these specific functional groups. Therefore we believe the presence of fire in this ecosystem is important for the biota´s dynamic, but we suggest the continuity of researches about the effect of different regimes of fire over the local biota, once repeated fire events could prejudice the recovery of the vegetation, even in an ecosystem that has evolved with the fire presence. (FAPEMIG, CNPq)

RESPONSE OF ANTS' COMMUNITIES TO DIFFERENT PLANTATION SYSTEMS AND SOIL COVERING ON CASSAVA CULTIVATION IN THE CERRADO, MS STATE, BRAZIL

M.L.F. TEIXEIRA[1], R.A.C. CREPALDI[2,3], E.S.V. DE CASTRO[1], A.B. VARGAS[4], R.F. DA SILVA[5] & F.M. MERCANTE[3]

[1]Laboratório de Fitossanidade, Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, JBRJ. Rua Jardim Botânico, 1008, Jardim Botânico, CEP 22460-000, Rio de Janeiro, RJ, Brasil, e-mail: malu@jbrj.gov.br. [2]Programa de Pós-graduação em Entomologia e Conservação da Biodiversidade, Faculdade de Ciências Biológicas e Ambientais, Universidade Federal da Grande Dourados. Dourados, MS, Brasil. [3]Embrapa Agropecuária Oeste, Dourados, MS, Brasil. [4]Programa de Pós-graduação em Ciências Ambientais e Florestais, Universidade Federal Rural do Rio de Janeiro, Departamento de Ciências Ambientais, IF, Seropédica, RJ, Brasil. [5]Universidade Estadual de Mato Grosso do Sul, Dourados, MS, Brasil.

The study aimed to estimate richness, composition and similarity of the ant fauna between cassava cultivated areas (*Manihot esculenta* Crantz 1766) under different planting methods and soil coverings. The planting systems were conventional drilling and no-tillage under mucuna (*Stizolobium cinereum* Piper & Tracy 1910), sorghum (*Sorghum bicolor* (L.) Moench 1794) and pearl millet (*Pennisetum americanum* (L.) K.Schum. 1895) mulching. An area of Cerrado native vegetation was also evaluated. Samples were taken before sowing, then six and eleven months after it. A total of 34 ant species distributed in 21 genera and six subfamilies were registered. The ant community complexity increased from the conventional plantation system towards the area with natural vegetation, which had the most dissimilar environment in relation to the cultivated areas. The conventional and no-tillage systems didn`t affect the species distribution. The no-tillage system under sorghum mulching showed the greatest richness of ant species among the plantation areas. In contrast, the no-tillage system under mucuna mulching showed the lowest richness, probably because of its fast degradation rate. The greatest richness of ant species occurred on the area with Cerrado native vegetation. Even though the distribution of the ant community was only slightly affected by the adopted plantation systems, the mulching favored the establishment of colonies during the initial period, especially opportunist predators' species. **(**PROBIO II, FUNDECT, CNPq, FAPERJ)

RICHNESS AND ABUNDANCE OF ANTS (HYMENOPTERA, FORMICIDAE) IN A REMAINING AREA OF ATLANTIC RAINFOREST IN SERGIPE, BRAZIL

G.T. RIBEIRO[1], J.O. DANTAS[2], L.N.A. DANTAS[1], A.M.S. GUIMARÃES[1], M.E. CORREIA-OLIVEIRA[1] & M.C. MENDONÇA[3]

[1]Universidade Federal de Sergipe, Av Marechal Rondon, s/n, Elze Rose, CEP 49.100-000, São Cristóvão, SE, Brazil, e.mail: genesiotr@hotmail.com; [2]Instituto Federal de Educação, Ciência e Tecnologia de Sergipe, São Cristóvão, SE, Brazil, [3]Universidade Tiradentes, ITP, Aracaju, SE, Brasil

There are about 2,500 described species of ants in Brazil, distributed into 15 subfamilies. Ants play important roles in the dynamics of terrestrial ecossystems, such as seed dispersal, predation and herbivory, nutrient cycling, carbon sequestration, soil aeration and interactions with other organisms. The objective of this work was to study richness and abundance of ants in three Atlantic Rainforest fragments, located in Laranjeiras/SE: Point 1 (S 10°46'16,6", W 37°07'44,8"), a forest fragment located on the banks of the River Sergipe; Point 2 (S 10°46'17,6", W 37°08'56,4"), a forest fragment adjacent to an ammonia plant and; Point 3 (S 10°45'50,9", W 37°09'44,1"), a forest fragment located in the settlement Bom Jesus/SE. The collection of insects was conducted monthly, between May 2009 and March 2010, with a total of 11 samples by the end of the study. To capture the insects, 3 pitfall traps and a Malaise net trap were set in each area. The pitfall traps consist of plastic containers of 20cm height and 14cm in diameter containing water, salt and detergent, buried ground level. The traps remained in the field for a period of 3 days in each collection. The captured insects were placed in 70% alcohol, then assembled and identified at subfamilies level with a stereoscopic microscope and the aid of literature. We collected 679 ants divided into four subfamilies: Myrmicinae showed higher abundance with 397 individuals, followed by Formicinae (188), Ponerinae (92) and Pseudomyrmecinae (2). Points 01 and 02 are disturbed areas and showed close richness and abundance, in point 01 occurred four subfamilies, Myrmicinae being the most abundant subfamily (145 individuals), followed by Formicinae (16), Ponerinae (12), Pseudomyrmecinae (1). In point 02 occurred Formicinae (92), Myrmicinae (51) and Ponerinae (40). Point 03 showed equal richness to the other points (4 subfamilies) and greater abundance of ants (322), mostly Myrmicinae with 201 individuals, followed by Formicinae (80), Ponerinae (40) and Pseudomyrmecinae (1). The area studied showed low richness with only four subfamilies, there was no difference between the assessed points. Abundance in points 1 and 2 were close and point 3 showed to be the most conserved area with higher abundance. The subfamily Myrmicinae was the most abundant in the area. This work contributes to the knowledge of the ant fauna of the Sergipe state. (FAFEN/SE, CNPq, CAPES, FAPITEC/SE)

RICHNESS OF ANT FAUNA IN A SWAMP GALLERY FOREST

F.A. SANTANA[1], D.M. SILVA[1]. & J.A.V. OLIVEIRA[1]

[1]Universidade Estadual de Goiás (UEG), Unu Quirinópolis; Av. Brasil, Qd 3 Conjunto Hélio Leão II, CEP 75860-000 Quirinópolis, GO,Brasil, e-mail: fassantana@yahoo.com.br

Swamp gallery forests are formations typical of the Cerrado biome. They are evergreen forests of Central Brazil, located in areas where the water courses are not clearly defined. They present a rather heterogeneous environment, with high species counts, reflecting a diversity index higher than that found in other forest types. The aim of this study was to inventory the richness of ant fauna in a swanp gallery forest. The gallery forest is located on the *Inhumas Córrego Fundo* farm, near the city of Quirinópolis-GO (Brazil), an area where the surrounding vegetation is predominantly pasture lands. To carry out the work, collections were taken in five transects located one hundred meters apart. In each transect, sardine baits were placed 20 meters apart, and were left exposed for one hour. Active collections were also carried out in each transect. In total, 2,443 individuals were collected, distributed among 49 taxa, including five subfamilies and nineteen genera *Azteca*, *Brachymyrmex*, *Camponotus Crematogaster, Cardiocondyla, Cephalotes, Dolichoderus, Dorymyrmex Leptogenys, Megalomyrmex Monomorium, Nylanderia, Pachycondyla, Pheidole, Pseudomyrmex, Solenopsis, Tapinoma Wasmania,* and *Zacryptocerus*. As for abundance, the most representative taxon was *Solenopsis* sp3, with 43% of the total individuals collected. *Solenopsis* has a cosmopolitan distribution, characterized by the presence of predominantly arboreal species that establish interactions with plants for obtaining food.

RICHNESS OF ARBOREAL ANTS ALONG A HETEROGENEITY GRADIENT OF WOODY VEGETATION AT BRAZILIAN SAVANNAH

V.C. CARRASCOSA[1], K.C.F. NEVES[1], J.C.H. DELABIE[2], C. MORENO[1], M.V. CIANCIARUSO[1] & V.G. FERRO[1]

[1]Laboratório de Ecologia de Insetos, Instituto de Ciências Biológicas, Departamento de Ecologia. Universidade Federal de Goiás (UFG), Campus Samambaia, Prédio ICB 1, sala 222 CP 131, CEP 74001-970– Goiânia, GO, Brasil, e-mail: vidalcobos@gmail.com. [2]Laboratório de Mirmecologia, CEPEC-CEPLAC & Universidade Estadual de Santa Cruz, Rod. Jorge Amado, Ilhéus-BA

Structurally more heterogeneous habitats generally have higher species richness; they provide a biggest variety of niches and allow more species to coexist per unit of area. Because of their importance in ecosystems, their high diversity and the direct interaction with plants, we selected arboreal ants as object of study to test whether an increase in habitat heterogeneity is related to an increase in ant diversity. Samples were collected in December 2012 at Emas National Park, southwest of the state of Goiás , Brazil . Were demarcated 42 plots of 100 m^2, which represent a richness gradient of woody vegetation between 2 and 27 woody species/plot. The richness of plants was used as an estimate of the environmental heterogeneity. In each plot were sampled four trees higher than one meter. Four arboreal traps were placed in each tree, two with protein bait (urine) and two baited with carbohydrates (honey), which remained exposed during 48h.Were taken 672 samples at all (16 per plot). The collected ants were identified at the laboratory until species level. We found 16,057 ants distributed in 74 species and 22 genera. The ants' richness of the plots ranged from 7 to 19 species. The most abundant genus, present in all plots, was *Camponotus* (n = 23), followed by *Pseudomyrmex* (9) and *Pheidole* (8). The results show that there is a positive correlation between the richness of trees and the richness of ants (F = 4.87, R2 = 0.10, p = 0.03). The richness of trees is important to explain these results, but the regression only explains 10 % of the variation. There must be other factors influencing the ants' richness variation along the gradient vegetation gradient that were not measured in the field. Some of these factors, such as functional diversity of woody vegetation, are now being investigated. (UFG, PELD sítio 13 – CNPq 403833/2012-4, Capes e CEPLAC)

SHRUB ANTS COMMUNITY ASSOCIATED WITH *Byrsonima* SP. PLANTS SENSU STRICTO CERRADO IN IPAMERI-GO

A.M. SILVA[1], D.A da SILVA[1], C.A. RODRIGUES[1,2], N.M. MARTINELLI[2] & M.S. ARAÚJO[1]

[1]UEG – Universidade Estadual de Goiás, UnU Ipameri. GO 330, Km 241, Anel Viário, S/N, CEP 75780-000 - Ipameri, GO, Brasil, e-mail: arethf@yahoo.com.br. [2]Departamento de Fitossanidade, Universidade Estadual Paulista, Campus de Jaboticabal (FCAV/UNESP). Via de Acesso Prof. Paulo Donato Castellane, S/N, 14884-900 - Jaboticabal, SP, Brasil.

The *Byrsonima* genre, whose species are popularly known as “murici”, it has 160 species, with about 70 in Brazil, which are important components of the cerrado flora. This is due to the great ornamentation potential and recovery of degraded areas, presented by these plants. However, few are the studies of ant families lifting in such plants. Thus, this study aimed to identify the shrub ant species which occur associated with *Byrsonima* sp., in sensu stricto cerrado. This was done in a hill area, containing fragments of cerrado, belonging to the municipality of Ipameri, state of Goiás. So, we selected a fragment showing sensu stricto cerrado and in this, at random way, we selected five shrubs of the referred to the genre along a transect about 100 metres long. Samples were collected using traps (bait) which consisted of a plastic glass with a capacity of 110 milliliters, and for each tree were used two traps, one containing sardines and other containing honey put at a maximum of 2 metres high. These were put in the morning, remained for about two hours and then were removed and sent to the Laboratory of Entomology of Universidade Estadual de Goiás (UEG), Ipameri Unit for specimens screening. After screening and identification in morphospecies level, the collected ants were assembled, properly labeled and sent to the Laboratory of Myrmecology of Centro de Pesquisa do Cacau (CEPLAC) for species identification. There were two collections per month for one year, from 07 /2011 to 06/ 2012, totaling 24 samples. We collected 20 ant species, distributed in 9 genres and 5 subfamilies: Formicinae (8 species), Myrmicinae (7 species), Pseudomyrmicinae (3 species), Ectatomminae (1 species) and Dolichoderinae (1 species). The most captured subfmília (Formicinae), also had the highest number of species in the same genre: *Camponotus* (5). From the 20 collected species, only *Camponotus senex* was considered common, being found in 79.2 % of the 24 collected samples. With intermediate frequency, were considered five species (25 to 50%) and the majority, 13 species were infrequent (equal to or less than 25%). The Formicinae, Dolichoderinae and Pseudomyrmicinae subfamilies are characterized by maintaining associations with certain plants, which collect food such as sugary liquids found in extrafloral nectaries, or any phytophagous. Also, these ants from these subfamilies generally protect plants from other phytophagous, such as small arthropods. (CNPq)

SODIUM LIMITATION IN ANT ASSEMBLAGES IN THE BRAZILIAN CERRADO

J. VIEIRA[1,2], F.C. CAMAROTA[1,2] & H.L. VASCONCELOS[1]

[1]Laboratório de Insetos Sociais, Instituto de Biologia, Universidade Federal de Uberlândia (UFU), Rua Ceará, Campus Umuarama, Bloco 2D, CEP: 38400-902- Uberlândia, MG, Brasil, e-mail: jesicavieiracb@gmail.com. [2]Programa de Pós-graduação em Ecologia e Conservação de Recursos Naturais, Universidade Federal de Uberlândia, MG, Brasil.

Despite sodium being an essential nutrient for life and the fact that its availability may impact populations of organisms and ecosystem processes, little is known about how this nutrient is distributed among different habitats. In ants, recent studies on the recruitment of workers to baits with salt have showed controversial results. This study was conducted in four different cerrado physiognomies: open cerrado, cerrado *sensu strictu*, dense cerrado and cerradão. These four physiognomies represent a gradient of increasing tree density and leaf-litter cover and decreasing grass cover. The goal of this work was to evaluate if there are differences on the ant preferences for salt or another nutrient (sugar) according to the 4 different cerrado physiognomies and between the ground layer and the vegetation canopy. We also experimentally investigated if nutrient supplementation affects the development of colonies of a common species of arboreal ant (*Cephalotes pusillus)*. Ant communities were sampled along transects on the ground and on the vegetation, being 14 transects on each physiognomy. On each transect we placed 4 ml Vacutainer vials on every 3 m. The vials were half-stuffed with cotton saturated with sucrose or NaCl solution with a series of three concentrations, plus a distilled water treatment. After 2 hours, we collected the vials. For the nutritional supplementation experiment we collected 40 small colonies of *C. pusillus* and transferred them to artificial nests located on 40 different plants, being one nest per plant. The nests were placed on the same tree species (*Qualea grandiflora*), and each contained one queen, 20 workers and 2 soldiers. We divided the experimental trees on four treatments: 10 nests were fed sucrose solution, 10 nests with salt solution, 10 nests with sucrose and salt and other 10 nests with distilled water to control. Our results of our first approach showed a higher preference for baits with salt by the canopy ants, while on the ground, we showed a preference for sugar baits. This pattern was the same in all physionomies. There was interaction between the different concentrations of sucrose and stratum. On the ground, concentrations of 10% were more used by ants. Genera such as *Camponotus*, *Azteca* and *Cephalotes* had significant preference for salt baits and *Pheidole* and *Ectatomma* to sucrose baits. Preliminary analyzes of the experiment with *C. pusillus* showed greater development of the colonies fed with sucrose. Treatment colonies (salt and salt + sucrose) developed less than control ones. We still have to wait to have a clearer picture of the experimental results, which are going to show in novel ways the influence of nutrition limitation of arboreal ants. For now, the salt nutrition is showing us two different facets: an important limitation nutrient but sometimes, also a toxic one. (CAPES)

SPATIAL DISTRIBUTION AND ABUNDANCE OF FIVE SPECIES OF ANTS IN AREAS SUBJECT TO FIRE

I.P. REIS, D.V. ANJOS, R.B.F. CAMPOS & S.P. RIBEIRO

Laboratório de Ecologia Evolutiva de Insetos de Dossel e Sucessão Natural, Departamento de Biodiversidade, Evolução e Meio Ambiente/ICEB, Universidade Federal de Ouro Preto, MG, Brasil. igor_pires_r@hotmail.com

Natural or anthropogenic fire causes changes in natural environments that can alter the ecosystems functioning. Ants are considered resistant arthropods, resilient to fire, and re-colonizers of disturbed environments performing many ecological services within ecosystems. Thus, this project followed monthly changes in the abundance and spatial distribution of five species of ants along a year, in two areas subject to different historical impact by fire. We selected two sites, one burned recently (four months before the start of the study) and an adjacent area burned about ten years ago , here called FR (impact by Recent Fire), FT (impact by Late Fire), respectively. In this work, we tested the hypothesis that variations in the abundance and spatial distribution of ants in areas disturbed by fire are larger in areas recently under fire. For this end we plotted one grid per area, with four 20 m transects five meters apart in which 20 pitfall traps were placed five meters distant from each other. The ants were collected monthly in each of the areas and the distribution of species that contributed most to the distinction between the two areas was mapped to do the comparison between them. *Pheidole radoskowskii (reflexans), Camponotus crassus* and *Camponostus rufipes* were the most frequent species in the FR, while *Pachycondyla striata*, *Camponotus rufipes* and *Solenopsis invicta* were the most frequent in the FT. Together, these five species account for more than half of the total abundance of ants collected. *P. radoszkowskii* recognized to typically occur in disturbed sites, was significantly more frequent in the FR, corroborating previous studies. *P. striata* were collected in the FT in all campaigns and in the FR only after the fourth month, suggesting that the recent fire does not favour this predator species. On the other hand *S. invicta* was collected in both areas, although most abundant in the FT especially by the fourth study month. The lower frequency of this species in the FR may relate to the lower availability of resources and consequent lower investment in foraging in this environment. *C. crassus* was common in both areas, being collected in all months of the study corroborating the statement that this species tolerates disturbances. Likewise *C. rufipes* appears indistinctly in both areas, which reflects the general habit of this species and may also result from the fact that their nests are easily rebuilt and they can forage long distances. The results of this study reinforce the importance of ants as colonizers of disturbed habitats and species composition of these communities as an indication of the occurrence of fire, depending on the biology of different species. (CAPES, CNPQ e FAPEMIG)

SPATIAL-TEMPORAL DYNAMICS OF LITTER-DWELLING ANTS (HYMENOPTERA, FORMICIDAE) IN A TROPICAL DRY FOREST (TDF).

F.T.P. SOUZA-JÚNIOR[1,2]; R.L. ANTONIAZZI-JUNIOR[1,3]; L.M. BATISTA[1] & F.S. NEVES[1]

[1]Universidade Federal de Minas Gerais, Departamento de Biologia Geral, Laboratório de Ecologia de Insetos, Avenida Antônio Carlos, 6627, CEP 31.270-901 - Belo Horizonte, MG, Brasil, email: fabiotulio.bio@gmail.com; [2]Centro Universitário UNA, Belo Horizonte, MG, Brasil; [3]Universidade Estadual de Montes Claros, Programa de Pós-Graduação *stricto sensu* em Ciências Biológicas, Montes Claros, MG, Brasil.

In tropical environments, the habitat heterogeneity and resource availability determines ant species richness. However little is known about the patterns and mechanisms that determine the ant community in Tropical Dry Forests (TDF's), especially about ants in leaf-litter. The aim of this study is to test the following hypotheses (*i*) the species richness and composition of litter-dwelling ants differ between secondary and primary forest, (*ii*) the richness and species composition of ground-dwelling ants are affected for seasonality, varying between wet and dry season. This work was developed in Mata Seca State Park, north of Minas Gerais, southeast Brazil. Samples were collected in 10 plots along 5 km transects, five of them at an early stage (ten years on regeneration) and five at a primary forest. In each plot four samples were taken using the Winkler extractor between the years 2010 and 2012, two in each season (wet and dry). We found 75 ant species, distributed in 26 genera of 7 subfamilies. Myrmicinae and Formicinae were the richest subfamilies, twelve and five genera, respectively. We found no differences in species richness between secondary forest and primary forest, but the species compositions have significantly statistical difference between the two forests. In relation to the seasonality, the ant species richness was lower in dry season comparing with the wet season, considering only in the primary forest, whereas the species composition not differs in either secondary or primary forests. The decrease in species richness of litter-dwelling ants from wet season to dry season only in the primary forest studied can be explained as result of the high leaf losses, which is an outstanding feature of the TDF in dry season In the other hand, in the secondary forest, despite of being also TDF and consequently have the same pattern of foliage loose, in the two seasons the soil is more exposed to light and for this reason it is expected a higher humidity loose. In primary forests, at the dry season, the leaf litter is occupied by species typically generalists and opportunists, like the genera *Solenopsis* e *Pheidole*, influenced by high luminosity and high temperature, and consequently, less humidity. Finally, we concluded that there was change in species composition between the secondary forest and the primary forest studied, in the last one, litter-dwelling ants are affected by the seasonality, which is not seen in the secondary forest fauna. This study shows the importance of maintain primary forests environments, because the simplification of vegetation suppresses the diversity of fauna and ecosystems services**.** (FAPEMIG)

SUCESSION OF GROUND-DWELLING ANTS AFTER FIRE IN MONTANA FOREST, MINAS GERAIS, BRAZIL

D.V. ANJOS[1], I.P. REIS[1], E. ANTUNES[1], B.G. ROBERTO[1], R.B.F. CAMPOS[1], R. FAGUNDES[2] & S.P. RIBEIRO[1]

[1]Department of Biodiversity, Evolution and Environment/ICEB, Laboratory of Evolutionary Ecology of Canopy Insects and Natural Succession, Federal University of Ouro Preto, Campus Morro do Cruzeiro, CEP 35400-000 – Ouro Preto, Minas Gerais, Brazil, email: diegoanjosufop@gmail.com. [2]Post-Graduate Program in Ecology and Conservation of Natural Resources, Laboratory of Behavioral Ecology and Interactions, Federal University of Uberlândia, Uberlândia, MG, Brazil.

Fire is a natural disturbance component of Savannas (Brazilian Cerrado), but it may cause reduction in biomass and diversity of arthropods and compromise the functionality of ecosystems that have not evolved with this pressure of selection, such as Montana Forests. Ants are arthropods resistant and resilient to fire, and are able to recolonize several environments. Thus, we evaluate how myrmecofauna behaves in post-fire succession, through the analysis of richness, abundance and species composition in two areas impacted by fire in different recovery times, one recent and one old. The following hypotheses were tested: (i) ant richness and abundance increase with time after fire in the area recently burned; (ii) the difference in composition between the areas decreases over time. Thus, we selected two areas in Itacolomi State Park, one burned and one adjacent unburned area (during this period), here called RF (recent fire) and LF (late fire). The RF area was affected by fire in the same year of the sampling and the LF area did not suffer burnings for at least 12 years. In each area, we established a 300 m² grid with four 20 m parallel lines, spaced 5 m between each other. Along each line, we disposed a pitfall trap every five meters, resulting in 20 pitfalls in each area. We sampled monthly from October 2010 to October 2011. A total of 1705 individuals distributed in 58 morphospecies were collected. The ant abundance was higher in RF area compared to LF area, and also varies over time. In both areas, the abundance was higher in the first months of the study (October-November 2010), with higher amplitude oscillations in the RF during the study (ANOVA area: $F_{1,11}=10.145$, $p<0.01$; ANOVA month: $F_{11,11}=6.557$, $p<0.01$). The ant species richness varied significantly between months, but there was no significant difference between the areas (ANOVA area: $F_{1,11}=1.073$, $p=0.322$), (ANOVA month: $F_{11,11}=7.844$, $p<0.01$). The species composition was different between areas (ANOSIM $R=0.319$, $p<0.01$). The species *Pheidole radoskowskii* (*reflexans*), *Pheidole* sp.2 and *Camponotus rufipes* were the most abundant in the RF area, and *Pheidole radoskowskii* (*reflexans*), *Pachycondyla striata* and *Solenopsis invicta* in the LF area (SIMPER). There was a negative relationship between the dissimilarity and time post-fire (Test F: $F_{1,10}=8.23$, $p=0.01$), indicating that the species composition in the two areas become more similar over time. The results support the hypothesis that each species respond the impact of fire in a particular way over time. In the short term, the fire causes habitat changes that may have important effects on local ant foraging, food availability, microclimate and predation rates. The species *Pheidole radoszkowskii (reflexans),* commonly found in open areas and pastures, was favored by fire, being very opportunistic. (FAPEMIG, CAPES, UFOP)

SURVEY OF ANTS IN URBAN AREA OF PARNAÍBA, PIAUÍ, BRAZIL

E.L. BRITO[1], L.M.S. CARDOSO[1] & C. MARTINS[1]

[1]Universidade Federal do Piauí (UFPI) Campus Parnaíba, Av. São Sebastião, 2819, CEP-64.202-020, Parnaíba, PI, Brasil, e-mail: edson_limaphb@hotmail.com.

Surveys of ant species are of great relevance to gather data on a particular region, being of paramount importance the achievement in the most varied regions. In Piauí State there is a paucity of studies on urban ant surveys since records on the scientific production of research on the subject are scarce. In this sense the aim of this study was to survey data on ant species associated with households in the city of Parnaíba, Piauí. The study area is next to the cost and to the Parnaíba River, with about 145 thousand habitants, with a tropical hot and humid climate and two defined seasons (dry and rainy). The collections were performed in four neighborhoods (Pindorama: B.01, Rodoviária: B.02, Piauí: B.03 and São Francisco: B.04) in five houses per neighborhood, randomly chosen, with bimonthly surveys from January to November 2012. Baits placed in plastic straws were used and fixed with adhesive tape in three rooms (two baits in the living room and in the kitchen and one bait in the bathroom). After two hours of exposure baits were placed into tubes containing 70% ethanol and then brought to the laboratory and morphologically identified using a magnifying glass and specific keys. 10,234 specimens were collected allocated among the species *Tapinoma melanocephalum* (73%), *Pheidole megacephala* (10%), *Solenopsis* sp. (10%), *Paratrechina longicornis* (4%), *Monomorium pharaonis* (1%), *Camponotus arboreus* (0,4%), *Crematogaster* sp. (0,08%). The frequencies remained constant even between dry and rainy seasons with the occurrence of *Tapinoma melanocephalum* as the most prevalent in all collections. In all sampled neighborhoods, there was the presence of the species *Tapinoma melanocephalum*, *Pheidole megacephala*, *Solenopsis* sp. and *Paratrechina longicornis*, but in neighborhood B.04 we found higher incidence of *Pheidole megacephala* (25%) and *Paratrechina longicornis* (20%) and lower incidence of *Tapinoma melanocephalum* (40%) when compared with another neighborhoods. The species *Monomorium pharaonis* and *Crematogaster* sp. was intrinsic to the B.02, and *Camponotus arboreus* was ausent in B.01. Our results corroborate data from other surveys from various regions of the country done by other authors, which highlights the frequent presence of some species also listed here.

SURVEY OF FIRE-ANTS SPECIES GROUP *Solenopsis saevissima* IN PUBLIC SQUARES IN THE CITY OF GUARULHOS - SP, BRAZIL.

A.A de OLIVEIRA[1,3], R.R CABRERA[2] & R. HARAKAVA[3]

[1]Laboratório de Bioquímica Fitopatológica, Instituto Biológico (IBSP), Avenida Conselheiro Rodrigues Alves, 1.252, CEP 04014-002- São Paulo, SP, Brasil, e-mail: oliveira.amandah@gmail.com. [2]FIG-UNIMESP Centro Universitário Metropolitano de São Paulo, SP, Brasil. [3] Programa de Pós-graduação em Sanidade, Segurança Alimentar e Ambiental no Agronegócio, Instituto Biológico , São Paulo, SP, Brasil.

Ants of the genus Solenopsis, popularly known as fire-ants, are difficult to identify when using dichotomous keys because many morphological characters are reduced or absent. Therefore, molecular tools have been used with the purpose of minimizing errors in the identification of species. The present study had the objective to identify fire-ants collected in public squares in the city of Guarulhos – SP, between the months of March and April 2012. Thirty-six squares were selected, each being the largest in the neighborhood, where the specimens were actively collected and stored in 70% alcohol for identification. Variables such as soil temperature and nest density for each square were also verified. Genomic DNA was extracted from about ten specimens of each sample and subjected to polymerase chain reaction (PCR) for a fragment of the mitochondrial cytochrome oxidase I (COI) gene. The amplified products were sequenced and compared with sequences deposited in GenBank using the software Blast-n. Haplotype 1 was observed in seven squares and haplotype 2 in thirteen squares, both haplotypes corresponding to *Solenopsis saevissima*. Three squares had haplotype 3 and ten squares had haplotype 4, both corresponding to *Solenopsis invicta*. Overall, the presence of *Solenopsis saevissima* was detected in 56% of the squares, *Solenopsis invicta* in 36% and in 8% of the squares neither species were present. We obtained a mean of 26.5 °C for soil temperature and nests density was 0.04/m². Statistical analysis did not show significant correlation between the density of nests and soil temperature. Our results confirm previous studies in public squares in the city of São Paulo, where both species were also detected, indicating that these species are well adapted to the urban environment.

TEMPORAL VARIATION IN EPIGEIC ANTS ASSEMBLY OF A DECIDUOS FOREST AREA (ATLANTIC FOREST BIOME) IN THE BOA NOVA NACIONAL PARK, BA, BRAZIL

T.O. SILVA, V.S. SANTOS, M.A.F. CARNEIRO, I.C. NASCIMENTO & K.S. CARVALHO

Laboratório de Invertebrados, Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB) Campus Jequié, Av. José Moreira Sobrinho s/n, CEP45200-000 – Jequié, BA, Brasil, e-mail: milyolivier@hotmail.com.br.

The general purpose of the study was to evaluate whether the epigeic ants assembly ofa deciduous forest (Atlantic Forest biome), varies temporally. For this, we collected four samples in different times: July 2010, April 2011, 2012 and December 2012 at 50 points (20m of distance) in a deciduous forest area ($14^0$19'41.0"S; $04^0$012'27.8"W) located in the Boa Nova National Park, Bahia, Brazil. At each sample point we extracted $1m^2$litter and installed a pitfall trap for 24 hours. The extracted was sifted and hanging in winklerbags for 48 hours (All Protocol: Ants of the Leaf Litter). Wemeasurewith a caliper rule three times the height of the litter before the extraction. For statistical analyzes, we used the average value of the three measures.In total, we sampled 83 species of ants on the soil and in the litter. Even with a reasonable sample size recommended for this type of study, the species accumulation curves did not stabilize in any of the four collections. Nevertheless, the richness estimators (Chao1, Jacknife1 and Bootstrap) showed values relatively close to the values of the observed richness (Mao Tao) presenting respectively: July 2010: 39 to 43.8 (observed richness = 35), April 2011: 49.9 to 61.6 (observed richness = 40), April 2012: 57.6 to 65.6 (observed richness = 48) and December 2012: 49 to 54.7 (observed richness = 44). The values for the Simpson diversity indices were more variable: July 2010 = 20.3; April 2011: = 15.4, April 2012 = 18.1; and December 2012 = 21.3). These indices were significantly different from each other (F = 6, 91, n = 200, p <0.001), specificallybetween December 2012 and July 2010 (p = 0.003) and December 2012 and April 2011 (p = 0.001). The height of the litter, which was highly variable between time of sampling: July 2010: 29.4 mm (± 11.0); April 2011: 16.9 mm (±10.4); April 2012: 17.2 mm (9.9); December 2012: 1.71 mm (2.8), explained more than 80% of the variation in species diversity (r^2 = 0.87, p = 0.000, n = 200). The ant species composition is very dissimilar among samples, varying between 33 to 44% (Jaccard coefficient). The results of this study indicate a temporal variation, or perhaps seasonal, in the epigeic ants assembly of the deciduous forest. Apparently the volume of litter is determining species diversity in time and space. In fact, the litter is a limiting resource for ants that live and/or nest on the floor of tropical forests. (UESB, PRONEX-PNX 0011/2009)

TEMPORAL VARIATION IN EPIGEIC ANT ASSEMBLAGE ON CAATINGA AREAS OF CONTENDAS DO SINCORÁ NATIONAL FOREST, BA, BRAZIL

A. VIEIRA[1], A.S. SOUZA[1], V.S. SANTOS[1], M.A.F. CARNEIRO[1], I.C. NASCIMENTO[1] & K.S. CARVALHO[1]

[1]Laboratório de Invertebrados, Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB) Campus Jequié, Av. José Moreira Sobrinho s/n, CEP 45200-000 – Jequié, BA, Brasil, e-mail: adriele23@hotmail.com.br.

In order to verify that the ant assemblage of the Caatinga is affected by seasonality, we conducted two collections of epigaeic ants: one in dry season (August 2010) and another in the rainy season (February 2011), using pitfall trap distributed in 50 sampling points, 20m distant from one another, in an area of Caatinga ($13^{0}55'14.4$”S; $0.41^{0}0.6'54.9$”W) located within the Contendas do Sincorá National Forest. At each sampling point, three measurements of the layer height litter were taken random by a caliper ruler. In total, we identified 34 species of ants foraging in the soil of the Caatinga studied. The number of species recorded in the dry season was 20, while during the rainy season, the number of species was 24. The Simpson diversity index calculated, respectively, for the dry and wet seasons were 1.17 and 1.16. The analysis of variance revealed statistically significant differences in the values of these indices between the two stations ($t = 7.013$, $p = 0.000$, $n = 50$). The composition of species also differed between seasons, showing only 29% similarity, revealed by calculating the Jaccard similarity coefficient. In fact, of the species of ant recorded in the sample, only 10 species were common to both seasons: 2 morphospecies of the genus *Camponotus*, 2 morphospecies of the genus *Pheidole*, *Solenopsis* sp, *Ectatomma* sp, *Linepithema* sp, *Neivamyrmex* sp, *Cephalotes* sp. and *Dinoponera quadriceps*, the latter being the most frequent species in the study area, occurring in 86% of samples. Furthermore, this ant species, *D. quadriceps*, presented an abundance average of more than 2 individuals (2.26 ± 1.3) per sample. The average cover of litter on the soil of the Caatinga in the dry season was 13.8 (± 12.0) mm and the rainy season was 16.2 (± 10.0) mm, but this difference was not statistically significant ($t = 1.907$ $p = 0.056$, $n = 150$). Other facts, such as percentage of vegetation cover, reflected by the number of leaves that fall or remain on the plants in this type of biome may be influencing the assemblage of the epigeic ants in the sampled environment. (UESB, PRONEX-PNX 0011/2009)

THE IMPACTS OF LAND-USE CHANGE ON AMAZONIAN ANT COMMUNITIES: A LARGE-SCALE ASSESSMENT AT THE AGRICULTURAL FRONTIER

R.R.C. SOLAR[1,2], J.C.M. CHAUL[1], J. BARLOW[2], J.H. SCHOEREDER[1], C.R. RIBAS[3], E. BERENGUER[2], J. FERREIRA[4] & T.A. GARDNER[5].

1. Universidade Federal de Viçosa, Departamento de Entomologia, Av. PH Rolfs s/n. Viçosa, MG, Brasil. CEP 36570-000; rrsolar@gmail.com 2. Lancaster Environment Centre, Lancaster University, UK 3. Universidade Federal de Lavras, Lavras MG 4. EMBRAPA Amazônia Oriental, Belém, PA 5. Zoology Department, University of Cambridge, UK.

Tropical forests are being rapidly degraded by fragmentation, logging, fire, and hunting. Quantifying and understanding how biodiversity responds to such disturbances is key to designing more effective conservation strategies for human-modified landscapes. The aim of the present study is to i) quantify the main responses of the ant community to land-use and forest change in the Brazilian Amazon, and ii) identify the relative importance of different natural and anthropogenic factors in determining observed responses at multiple spatial scales. We sampled 201 sites (transects) distributed across 18 catchments (5000ha each) in the municipality of Paragominas (Eastern Brazilian Amazon), encompassing a full gradient of land-cover intensification from undisturbed primary forest through varyingly disturbed primary forests, old and young secondary forests, mechanised agriculture and pastures. Ants were sampled using baited pitfall traps. Variables measured to capture natural patterns of environmental heterogeneity included tree species richness, forest canopy cover, aboveground biomass (total, leaf-litter, fine roots and fine-woody debris) and soil chemical and physical characteristics. Variables used to measure anthropogenic disturbances included the percent of primary forest in the surrounding landscape, the trajectory of forest loss in the last two decades, and time since the last logging or fire event. We sampled 289 ant species and used AICc based model selection and model averaging to examine determinants of total species richness at both site and catchment scales. At the site scale, null-model was the most likely for species richness in primary and secondary forests or in mechanised agricultural areas. However, within pastures, an increase in duff and fine-woody debris promoted an increase in ant species richness, whereas an increase in soil pH was associated with fewer ant species. At the catchment scale, gamma diversity of ants is positively associated with increases in aboveground biomass and fine roots mass. We found that β-diversity per catchment increases with an increase in the area of primary forest and soil density and decreases with time since last fire event. We assessed changes in species composition across land-uses using NMDS and tested variables that may influence species composition using PERMANOVA and dbRDA. Ant communities became markedly more dissimilar when moving from undisturbed primary forests to agriculture and pastures. Land use type, area of surrounding primary forest, tree species richness, duff mass, soil density, phosphorous and percentage of clay had significant influences on species composition shifts at the site scale. We conclude that variables regulating ant diversity relate to both differences in land use and the scale of the study. Our results suggest that variables describing both the current state of land-use and forest condition, as well as wider landscape context, can both have a strong influence on patterns of ant species composition. (CNPq, INCT, CAPES, FAPEMIG, EMBRAPA, The Nature Conservancy, Darwin Initiative, NERC)

USING ANTS TO ESTIMATE THE RELATIVE CONSERVATION VALUE OF DISTURBED HABITATS

D.L. BRAGA[1], V.H.F. OLIVEIRA[1], F. FRAZÃO[1], C.R. RIBAS[1], F.A. SCHMIDT[2,3], R. ZANETTI[4] & T. GARDNER[5]

[1]Universidade Federal de Lavras, Setor de Ecologia e Conservação, Departamento de Biologia, Lavras, MG, CEP: 37200-000, Lavras, Brasil, e-mail: braga.dl@gmail.com. [2] Departamento de Biologia Geral. Universidade Federal de Viçosa, Viçosa, MG, Brasil. [3]Centro de Ciências Biológicas e da Natureza, Universidade Federal do Acre, Rio Branco, AC, Brasil. [4] Universidade Federal de Lavras, Departamento de Entomologia, Lavras, MG, CEP: 37200-000, Lavras, Brasil. [5]Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK.

The aim of this study was to assess the relative conservation value of modified habitats in the eastern Brazilian Amazon using ants as a model group. The ants were sampled with pitfall traps in 18 catchments which together encompass seven characteristic land-uses in the region of Santarém-Belterra, state of Pará: mechanized agriculture, pastures, secondary forest, undisturbed primary forest, burned primary forest, selectively logged primary forest and selectively logged and burned primary forest. The relative conservation values of each landscape using were evaluated using the *Shared-S* package for the R environment. In this analysis we assumed that (i) the higher the number of species shared between the modified and the undisturbed habitat, the higher the relative conservation value of the former, and that (ii) the conservation value of the undisturbed habitat is high when the ratio between species unique to this habitat and the total number of species is elevated. Confidence intervals were calculated from 1,000 bootstraped matrices. Mechanized agricultural crops presented the lower conservation values, followed by pasture. Secondary forest presented a conservation value comparable with disturbed primary forest. The conservation values of different types of disturbed primary forest were similar and the highest among the landscape use analyzed. The singularity index of pristine primary forest were higher when compared with mechanized agricultural crops and there was no difference between pasture and burned primary forest (intermediate values) and even between secondary forest, logged and burnt primary forest (lower values). Our results indicate that the singularity index seems to be influenced by the total number of species in the systems analyzed. Habitats with lower levels of diversity increase the singularity index of the reference system. In this way, the implementation of modified habitats in pristine landscapes must take into account the most adequate management, because structurally simple habitats lead to lower relative conservation values and higher singularity index to the original habitat remnants. Moreover, our results highlight the importance of secondary forest to conservation and management of forest landscapes, as this system has markedly higher conservation values than non-forest systems and quite closed to primary forest. Therefore, considering the data from ants, disturbed primary forest and secondary forest have a high conservation value and are deserving of increased conservation investment. (CNPq)

WATER TABLE LEVEL DRIVES ANT FUNCTIONAL DIVERSITY CHANGES IN AN AMAZONIAN *TERRA FIRME* FOREST

F.B. BACCARO[1], I.F. ROCHA[2], B.E.G. DEL AGUILA[2], J. SCHIETTI[3], T. EMILIO[3], J.L.P.V. PINTO[4], A.P. LIMA[5] & W.E. MAGNUSSON[5]

[1]Departamento de Biologia, Universidade Federal do Amazonas (UFAM), Av. General Rodrigo Octávio, 6200, CEP: 69077-070 - Manaus, Amazonas, Brazil, e-mail: fabricera@gmail.com. [2]Programa Institucional de Bolsas de Iniciação Científica (PIBIC), Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, AM, Brasil. [3]Programa de Pós-Graduação em Ecologia, INPA, Manaus, AM, Brasil. [4]Programa de Capacitação Institucional, Rede GEOMA – LBA, INPA, Manaus, AM, Brasil. [5]Coordenação de Pesquisas em Ecologia, INPA, Manaus, AM, Brasil

Seasonal changes in rainfall, topography and soil properties create gradients of soil moisture, and determine forest structure and plant species distributions. Areas with shallow water tables comprise a significant portion of tropical forests, and have distinct forest structure and plant-assemblage composition. Like plants, ants are relatively sessile organisms and may experience stress caused by local changes in soil–water availability. Here, we evaluated the influence of water-table level on ant- assemblage richness, abundance and composition in a *terra firme* forest, in Central Amazonia. We sampled ants in ten 250 m-long transects, regularly distributed over 5 km^2 (distant 1 km from each other) by extracting ants from 100 1-m^2 litter samples, 100 pitfall traps and 100 sardine baits. During one year, the water-table level in each transect was monitored every 15 days with a 6-m deep dipwell. We collected 177 ant species/morphospecies representing 42 genera in nine subfamilies. The water table level showed marked variation between seasons, following the rainfall regime of the field site. The number of 15-day periods when the water table was ≤ 1 m ranged from zero to 11 (approximately 5.5 months) among transects. Overall the abundance of individuals and occurrence of species were lower in areas where the water table was closer to the surface (≤ 1 m depth) for longer periods. However, the number of ant species was higher in transects with shallow water table. Changes in number of species were mainly a result of an increase in generalist species associated with a decrease in the number of specialist predators and small hypogaeic generalist foragers. However, in contrast to other functional groups which had more consistent results, 33 percent of the generalist species analyzed were less abundant in transects with shallow water table and 33 percent showed the opposite pattern. These results suggest that there is a greater compartmentalized structure in relation to the water table gradient among generalist species than for the other functional groups. Overall, disturbance mediated by the water table appears to increase species richness, but with proportionally fewer specialists and hypogaeic species than generalist species. The functional classification approach seems to be useful for sets of species with relative narrow ecological niches. For generalist species, however, this classification needs to be complemented with more information about natural history to improve our understanding of the process behind these compositional changes.

WHAT ARE THE EFFECTS OF DIFFERENT FOREST TYPES IN DIFFERENT LANDSCAPES ON LEAF LITTER ANT ASSEMBLAGES?

A.B. VARGAS[1] & T.A. MIRANDA[1]

[1]Centro Universitário de Volta Redonda UniFOA Campus Olezio Galotti, CEP 27240-560, Volta Redonda, Rio de Janeiro, Brazil, e-mail: andrebvargas@yahoo.com.br

Species richness and composition are related to the structural complexity of ecosystems. In more complex ecosystems (natural) the fauna is richer and more diverse than in the simpler ecosystems (degraded). This structure varies naturally or in response to humans through the use of natural resources. In the present study, we assessed ant species richness and composition in different forest types located in different landscapes. We collected ants with pitfall traps at three localities (A, B, and C), in 90 sampling units per locality in two periods of the year. We placed traps 10 m apart from each other, distributed in six transects that were 300 to 400 m apart from each other. We measured the following environmental parameters: leaf litter depth, percentage of ground cover, temperature, humidity, circumference at breast height, number of trees, and leaf morphotype, and correlated them with ant species richness and composition. We collected 120 ant species of 37 genera and eight subfamilies. The subfamily Myrmicinae was the richest in genera (23) and species (72), corresponding to 60% of all species sampled. It was followed by the subfamily Ponerinae with 16 species, Formicinae with 15, Ectatomminae with 6, Dolichoderinae with 4, Heteroponerinae with 3, Ecitoninae and Pseudomyrmecinae with only 2 species each. We recorded 77 species in locality A (53 in the first campaign and 58 in the second); 66 species in locality B (37 species in the first campaign and 55 in the second; 74 species in locality C (42 in the first campaign and 60 in the second). Species richness varied significantly among localities in the first campaign, but not in the second. Species composition varied significantly among localities in both campaigns, which shows that the sampling localities have different characteristics, even if they occur in the same type of vegetation, which may be related to factors such as relief, climate, and history. Despite habitat fragmentation, the sampling localities showed a good representativeness of the ant fauna characteristic of the Atlantic Forest. The preservation and conservation of these fragments is very important, aiming at a higher connectivity among them and the other forest remnants of the region. (UniFOA)

INTERACTIONS BETWEEN ANTS AND PLANTS, AND BETWEEN ANTS AND OTHER ARTHROPODS

ALTITUDE AND DENSITY OF APHIDS DETERMINING THE RICHNESS AND ABUNDANCE OF ANTS ASSOCIATED WITH *Baccharis dracunculifolia* (ASTERACEAE).

R.M. SOUZA[1], G.F. MONTEIRO[1,2], L.E.M. REIS[1,3], L.F. SILVA[1,2], S.M.A. NOVAIS[1,3] & F.S. NEVES[1,3]

[1]Laboratório de Ecologia de Insetos, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais – UFMG, Av. Antônio Carlos, 6627, Pampulha, CEP 31270-901 – Belo Horizonte, MG, Brasil, e-mail: mello.rayana@yahoo.com.br. [2]Programa de Pós-Graduação em Ciências Biológicas, Universidade Estadual de Montes Claros, Montes Claros, MG, Brasil. [3]Programa de Pós-Graduação em Ecologia, Conservação e Manejo de Vida Silvestre, Universidade Federal de Minas Gerais – Belo Horizonte, MG, Brasil.

Many studies have shown that species richness tend to decrease when the altitudinal gradient increases. Ant communities are expected to follow the same altitudinal gradient pattern. However, some ant species have trophobiosis interaction with aphids. In this interaction, aphids secrete an energy-rich substance (honeydew) that ants use like resource and, in return, they offer protection. Aphids are obligated guests of their host plant, where they feed from the sap of the leaves. Thus, these organisms have a close relationship with host plants and probably follow their distribution. Therefore, on one hand, the ant-aphid interaction may be maintained along the altitudinal gradient but on the other, the density of aphids may influences the ant community. We hypothesized that the richness and abundance of ants increase with the density of aphids independent of the altitudinal gradient. The study was conducted at Serra do Cipó National Park, at Minas Gerais State. Ants and aphids were collected on *Baccharis dracunculifolia*, a common shrub found in all elevations. Samples were taken at 800, 1100, and 1300 meters of elevation using the tree beating method, followed by capture with an entomological umbrella at 60 shrubs per altitude. The most rich and abundant ant community was found at the intermediate level (1100m), followed by 800 and 1300m, respectively. Aphid abundance did not differ among elevations. A positive relationship between ants and aphids was detected in all elevations, corroborating our hypothesis. The high ant species richness and abundance at intermediate level (1100m) may be encouraged by better abiotic conditions (e.g. temperature and humidity), providing a greater resource variety to them. The altitudinal gradient may determine ant species probably due to the atmospheric conditions and soil contents. However, aphids´ presence is mainly dependent upon their host-plant presence, and seems to be the main mechanism that operates on ant diversity found on *B. dracunculifolia* shrub, throughout the elevations studied.

ANT-APHID INTERACTION AND THEIR INFLUENCE ON ARTHROPOD COMMUNITY

R.P. CARVALHO[1], E.O. CANEDO-JÚNIOR[1,2], A.M. RABELLO[1,2], R.G. CUISSI[1] & C.R. RIBAS[1]

[1]Universidade Federal de Lavras, Departamento de Agronomia, Setor de Ecologia e Conservação, Lavras, Minas Gerais, Brazil, CEP: 37200-000, e-mail: rcarvalho@agronomia.ufla.br. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

We evaluated the arthropod richness, abundance and composition associated to *Bidens pilosa* ("Spanish Needle") in plant individuals with and without ant-aphid interactions and point out if there is dominance of arthropod species/genus in these plants. The species involved in the interaction are aphids of the genus *Aphis* and ants of the genera *Dorymyrmex, Wasmannia, Linepithema, Camponotus, Crematogaster, Pseudomyrmex, Pheidole, Acromyrmex, Atta, Nylanderia, Solenopsis*, *Cephalotes* and *Brachymyrmex*. We tested the hypotheses that there are (1) a reduction of arthropod richness and abundance and (2) the consequent change in the composition; with the presence of ant-aphid interactions. We carried out the study at the Federal University of Lavras, Lavras, Minas Gerais, southeast Brazil, during five days between April and May 2013, through active collecting, in a 35m transect, containing 20 sampling points (plants). There is no difference in the richness (F_{19-1} = 2.862; p = 0.1) and abundance (F_{19-1} = 0,127 p = 0.7) of arthropod species in plants with and without ant-aphid interactions. Nevertheless, the species composition among the treatments was different (R=0.205; p=0.003). Among the arthropod groups sampled, the genera *Astylus* (Coleopter) and *Camponotus* (ant) were those that most contributed to the dissimilarity. *Astylus* (Coleoptera) contributed with 3.7% to the dissimilarity in the species composition, and its abundance was higher in the absence of ant-aphid interaction. *Camponotus* genus contributed with 3.4% of dissimilarity among treatments, and its abundance was higher in plants with the interaction. Our results indicate that the ant-aphid interaction does not affect the arthropod richness and abundance in *Bidens pilosa*, but affects species composition. This pattern was not found in others works, indicating that the species richness is not a good parameter for verifying the effect of this interaction. However, there was variation in the arthropod composition, confirming our hypotheses. With the presence of the interaction there is a reduction in the presence of herbivorous organisms (*Astylus Atromaculatus*), and the consequent increase in the presence of organisms which use resources like extrafloral nectaries and/or honeydew secreted by aphids (*Camponotus* genus). Therefore, our study shows that ant-aphid interactions can potentially improve the health of the infested plants. (CNPq, CAPES, FAPEMIG)

ANT-PLANT INTERACTIONS MEDIATED BY EXTRAFLORAL NECTARIES: A CASE STUDY IN BIGNONIACEAE

A. NOGUEIRA[1], P.J. REY[2] & L.G. LOHMANN[1]

[1]Universidade de São Paulo, Instituto de Biociências, Departamento de Botânica, Rua do Matão, 277, São Paulo-SP, 05508-900, Brazil, e-mail: anselmoeco@yahoo.com.br. [2]Universidad de Jaén, Facultad de Ciencias Experimentales, Departamento de Biología Animal, Biología Vegetal y Ecología, Paraje Las Lagunillas s/n 23071 Jaén, Spain.

Mutualistic ant-plant interactions are mediated by morphological structures that are generally concentrated in more costly plant parts. For example, extrafloral nectaries (EFNs) produce resources that attract ants that in turn are thought to protect various plant parts against herbivores, increasing plant performance. Nectar-secreting glandular trichomes are found in representatives of the Bignoniaceae in various shapes, location, and sizes. This plant group occurs in contrasting environments that range from wet forests (e.g., Amazon forests) to drier habitats (e.g., cerrado and caatinga). Here, we integrate data on the quantitative variation of EFNs, with data on ant visitation and phylogenetic relationships in order to understand the general role of ant-plant interactions in this group. In particular, we addressed whether extrafloral nectaries were really effective against herbivores based on the defensive hypothesis. We identified a positive association between ant visitation and the abundance of EFNs among plant species, and rejected phylogenetic conservatism hypothesis due to a high lability of EFNs during the diversification of this plant group. A static-optimum model showed a better fit to our data than a purely drift model, suggesting an adaptive evolution of EFNs. The EFN abundance was also associated with habitat shifts, with a decrease in the EFN abundance from forests to savannas. These evolutionary associations suggest divergent selection on EFNs after the transition between contrasting habitats. Furthermore, data on ant-plant interactions from 10 populations of *Anemopaegma album* in a savanna environment indicated that ant visitation is positively correlated with the relative production of leaves and proportion of flowering plants across populations, suggesting that local variation in ant visits is fundamental for variation in plant defense and performance. However, EFN trait variation was not related to ant visitation, herbivory and performance variables across populations. These findings indicated a complex geographic pattern with a mosaic of EFN evolution associated with the local variation of ant and herbivore assemblages among populations. Information on the relationship between ant functional traits (size and recruitment) and EFNs visited by each ant species allowed us to classify all populations of *A. album* as local situations of phenotypic “matching” and “mismatching”. Eight populations emerged as matched populations in two distinct groups, as follows: (1) a population ‘Mirangaba’ occupied by smaller ants matched with lower abundances of EFNs, composed mostly of *Crematogaster crinosa* with high recruiting behavior that is able to feed on nectar from scattered and low productive EFNs; (2) seven populations occupied by larger ants matched with higher EFN abundances, mostly composed of *Camponotus* spp. with lower recruiting ability and favored by highly productive, abundant and clustered EFNs. However, only three of these eight matched populations had higher values of the plant performance descriptors. These three populations also had lower variance of EFN abundance, in accordance with the adaptive hypothesis of EFN evolution, and were considered plant-evolutionary hotspot of these interactions. Concluding, the evolutionary pattern among species and the ecological-evolutionary pattern among populations in species of Bignoniaceae seem to be going in the same direction, suggesting additional avenues and questions for future studies of ant-EFN interactions on plant groups occupying contrasting habitats. In addition, comparative

phylogenetic methods and geographic mosaic theory of coevolution/evolution might illuminate other exciting questions related to animal-plant interactions throughout several distinct environments on Earth (CAPES, CNPq, FAPESP)

ANTS (HYMENOPTERA: FORMICIDAE) ASSOCIATED TO *Myrtillocactus geometrizans* (CACTACEA) IN HUICHAPAN, HIDALGO STATE, MEXICO

G. CASTAÑO-MENESES[1,2], D. MARTÍNEZ[3], A. CALLEJAS-CHAVERO[2,3] & D. PÉREZ-VELÁZQUEZ[2,3]

[1]Unidad Multidisciplinaria de Docencia e Investigación, Facultad de Ciencias, Universidad Nacional Autónoma de México, *Campus* Juriquilla, Querétaro, México, e-mail: gabycast99@hotmail.com. [2]Ecología y Sistemática de Microartrópodos, Depto. Ecología y Recursos Naturales, Facultad de Ciencias, Universidad Nacional Autónoma de México, Ciudad Universitaria, México, D. F., México. [3]Laboratorio de Ecología Vegetal, Depto. de Botánica, Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, México, D. F., México.

The cactus *Myrtillocatus geometrizans*, common named "garambullo", is an endemic species from Mexico, with a wide distribution in the arid and semiarid regions of the country. This species have economic importance, due their fresh fruits are used to made jams, liqueurs, ice cream, jellies; and dry fruits are used to extract pigments to dyeing textiles. In addition, the latex produced by plant is used in veterinary, and the snags are used for handicrafts, firewood and fodder for livestock. From biological point of view is very important to prevent soil erosion, increases the water infiltration and the organic matter in soils and CO_2 capture, and is used as feeding, mating, oviposition and shelter sites for many organisms, including ants. In an area of 0.75 km^2 in Huichapan, Hidalgo State, Mexico (20°16'-20°31'N – 99°52'-99°29' W, at 2,100 m asl), we reviewed a total of 73 specimens of garambullo once a month during May 2011 to May 2012, and in 22 of them were recorded the presence of ants, which were sampling directly by brushes and aspirators. The ant specimens were preserved in 80% alcohol, and identified under stereoscopic microscope. A total of 14 ant species were recorded in the branches of *M. geometrizans*, belonging to four subfamilies and seven genera. The subfamily Dolichoderinae was the most abundant and constant during the study, with *Liometopum apiculatum* and *L. luctuosum* as dominant species, that in previous studies have been recorded also nesting in the base of different garambullos species. The other species recorded of subfamily were *Dorymyrmex grandulus* and *Forelius pruinosus*. The most species richness genus was *Camponotus* with six species associated to garambullos, including *C. atriceps*. Two species of *Pseudomyrmex* (*P. major* and P. *pallidus*) were recorded. Myrmicinae was represented only by *Pogonomyrmex barbatus* and *Crematogaster* sp. *P. barbatus* is a common consumer and dispersor of garambullo's seeds in arid and semiarid areas in Mexico. The garambullo specimens in the study recorded the presence of coccids of *Toumeyella* genus attended by *L. apiculatum* and *Crematogaster* ants in some plants. The ant community associated to garambullo plants shown a great complexity, with a high species richness that included different feeding habits, as well different association degree to the cactus. The prevalence of ant in the garambullos in the studied area was about 30%, and the mainly use that ants made of the plants is for food resources in direct or indirect form, as well to nesting. This is the first report of the ants associated at garambullo plants in the Huichapan area. (PASPA program - DGAPA-UNAM)

ANTS PROTECT *Stachytarpheta glabra* (VERBENACEAE) AGAINST HERBIVORES AND THE NECTAR PRODUCTION IS IMPROVED BY HERBIVORY RESULTING IN HIGHER REPRODUCTIVE OUTPUT

R. FAGUNDES[1,2], A.L. DUTRA[2] & Y. ANTONINI[2]

[1]Programa de Pós-Graduação em Ecologia e Conservação dos Recursos Naturais, Universidade Federal de Uberlândia, Uberlândia, MG, Brasil, roberthfagundes@gmail.com.
[2]Departamento de Biodiversidade, Evolução e Meio Ambiente, Universidade Federal de Ouro Preto, Ouro Preto, MG, Brasil.

Plants evolved numerous defense strategies against herbivores. In biotic defenses, plants invest in extrafloral nectary (EFN), domatia and volatile compounds. In the first case, ants protect plants in exchange of nectar. However, this strategy can be energetically costly. Thus, some plants may regulate investment in protection according to the degree of sustained herbivory. The present study test the hypothesis that ants protect *Stachytarpheta glabra* against herbivores and the investment in nectar production is regulate by herbivory. We selected 40 shrubs of *S. glabra* (5m distant) with similar height and phenological stage in a 4ha area of Rupestrian Field (Ouro Preto, MG). Randomly, ten was used as control, ten was blocked to ant access by applying Tangleffot ®, ten had eighteen leaves damages by 2cm line cuts, and ten had both manipulations. We selected three recently sprout branches with six leafs each and no herbivory for measure nectar quality, herbivory damage and reproduction output three months later. Ants and herbivores were counted in the whole plant. Manipulations was apllied fortnightly. *S. glabra* interact with seven ant species (217 individuals) and *Camponotus crassus* was more abundant (60%). We found that the EFN number is a constitutive defense of *S. glabra* and did not respond to leaf damage. But nectar production was induced and increased in the absence of ants (mean±IC95%: Nectar volume: with ants=0.01±0.003µL and without ants=0.015±0.005µL; Sugar concentration: with ants=73.0±0.7% and without ants=75.15±1.0%) and even more so with prior damage (0.016±0.008µL; 75.7±0.8%; MANOVA: $F_{3,34}$=2.79; p=0.05). High nectar quality causes higher number of individuals and species of patrolling ants (Individuals: without damage=1.06±1.25 and with damage=3.47±1.2; Species: 0.8±0.5 and 1.67±0.53). The number of herbivores and leaf damage was higher in the absence of ants (herbivores: with ants=0.53±0.36individuals/plant and without ants=1.16±0.54; GLZ Poisson with log-link: T=2.46; df=36; p=0.02; leaf damage: with ants=0.02±0.01% of leaf area lost and without ants=0.17±0.07%; LSD: p<0.01) but not so much when applied prior damage (with damage: 0.07±0.05; without damage: 0.13±0.07; $F_{1,36}$=4.59, p=0.03). Consequently, plants without ants had lower fitness (inflorescences: with ants=6.15±1.06 and without ants=4.75±1.21; flowers: 18.70±3.15 and 13.76±1.82; seeds: 8.85±1.46 and 6.97±1.0; MANOVA: $F_{3,36}$=4.04, p=0.01), but especially those without prior damage (Inflorescences=6.5±1.66; Flowers=18.53±4.12; Seeds=9.3±2.81; LSD: p<0,05). We conclude that ants play an important role by protecting *S. glabra* but investment in attraction of ants is directly regulated by herbivory. The production costs of nectar is reduced when there is little need for defense and probably allowing relocation of plant nutrients in other activities, such as reproduction. Moreover, the better performance of plants with prior damage compare to those without damage, both without ants, may indicate a trade-off with alternative defenses (not measured) produced when the ants are not present or are not effective. (CAPES, CNPq, FAPEMIG, UFOP)

ANT SPECIES IN ASSOCIATIONS WITH *Copaifera langsdorffii* IN BRAZILIAN SAVANNA

A.S. MARTINS[1] & K. DEL-CLARO[1]

[1]Laboratório de Ecologia Comportamental e Interações (LECI), Instituto de Biologia (INBIO), Universidade Federal de Uberlândia, UFU, Uberlândia -MG. Rua Ceará, Campus Umuarama, Bloco 2D, CEP: 38400-902- Uberlândia, MG, Brasil, e-mail: antonio.martins@bio.ufu.br.

Considering the force of selective pressure caused by herbivory, plants have developed a range of defenses through evolutionary time. This study examined the effects of the presence of extrafloral nectaries (EFN) on *Copaifera langsdorffii* (Fabaceae, Caesalpinioideae) on the interactions in which this plant is involved in cerrado vegetation. The activity of these glands was confirmed through histochemical studies. We also conducted an experiment to exclude ants in which, for each of the 15 trees sampled we monitored: a treatment branch, with ants isolated by a resin and a control branch, maintained in natural conditions (with ants). The rates of leaf area loss at the end of six months were significantly higher in the branches without ants, indicating that their presence confers protection against foliar herbivores. The main ants found were *Camponotus*, confirming the characteristic dominance of this genus in nectary plants. *Cephalotes*, *Pseudomyrmex*, *Crematogaster*, *Pachycondyla villosa* and *Ectatomma tuberculatum*, were also frequent. Hemiptera and Lepidoptera larvae were the most common herbivores on the plants. It is known that *C. langsdorffii* produces secondary compounds as chemical defenses and since the recruitment of guardian-ants appeared as an effective biotic defense, this study suggests the use of diverse strategies against herbivory for this plant species including phenological variation over time. The arboreal ant diversity was striking and thus, it is included here another savannah tree in the group of extrafloral-nectar producing plants, highlighting the importance of this resource to ant-plant interactions.

***Camponotus femoratus* (FABRICIUS, 1804) RECRUITMENT IN RESPONSE TO HERBIVORY IN ANTS-GARDENS EPIPHYTES**

R.E. VICENTE[1], W. DÁTTILO[2] & T.J. IZZO[1]

[1]Department of Ecology and Botany, Community Ecology Laboratory, Universidade Federal de Mato Grosso, Cuiabá, MT, CEP 78060-900, Brazil, email: ricardomyrmex@gmail.com.
[2]Institute of Neuroethology, Universidad Veracruzana, Xalapa, VZ, CP 91190, Mexico.

Several studies have shown that ants can recognize chemical clues of their host plants in ant-plant system, nevertheless it's poorly demonstrated in Ants-gardens systems. In these mutualistic interaction, ants species constantly interact with various epiphyte species, suggesting a convergence on the chemical signal released could be acting to ensure that ants be able to recognize and defends all epiphytes species. We hypothesize that ants recognize and differentiate among chemical stimuli released by AG-epiphytes and non Ag-epiphytes. We studied the ant *Camponotus femoratus* ants and three AG-restricted epiphytes on those we experimentally simulate leaf herbivore damage and quantify the number of ants recruited. When exposed to the AG-epiphytes *P. macrostachya* or *Codonanthe* sp. leaves we observed that the recruitment of *C. femoratus* workers was respectively 555% and 245% higher on average the non AG-epiphyte *Piper* sp. However, the number of ants recruited by the AG-epiphyte *Markea* sp. or *Piper* sp. did not differ from paper pieces (manipulative control). It indicate that ants can discern among chemicals released by different plants, suggesting that ants can select plants that offer better resource. This results can be explained by a evolutionary process acting on both: ants capability in discern and plants chemicals compounds; or by ant´s learning based on the frequency epiphytes in AGs. Disentangle an innate behavior, a product of a classical coevolutionary process, from an ant´s learned behavior is complicated but important subject to understand the evolution of ant-plant mutualisms. (We thank Office National des Forêts Brazil for logistical financial support. REV thanks CAPES for doctoral fellowship WD is grateful for financial support by the CNPq and CONACYT)

COMPARISON OF THE QUANTITY OF NUTRIENTS IN AREAS OF FOREST PLANTATIONS WITH AND WITHOUT LEAF CUTTER (*Atta sexdens rubropilosa*) ANTHILLS

D. UKAN[1], M.Z. FERRONATO[2], R. VOLTAN[2] & N.J SOUSA[2]

[1]Professor, Dr., Department of Forest Engineering (Departamento de Engenharia Florestal), Universidade Estadual do Centro-oeste, PR 153 - Km 7 - Bairro Riozinho, Cx. Postal, 21, Fone (42) 3421-3000, CEP: 84500-000, Irati, Paraná, Brasil, HYPERLINK "mailto:daniukan@yahoo.com.br" daniukan@yahoo.com.br; [2]Universidade Federal do Paraná (UFPR), Curitiba, PR, Brasil.

Leaf cutter ants, which include ants and quenquéns, are considered the most significant of plantation pests in Brazil, due to the considerable damage and intense attack on plants in all stages of development. However, it is believed that these insects can contribute positively to the chemical modification of soil. The data collected from this work was completed in plantations of flooded gum *(Eucalyptus grandis*), with the goal of evaluating the increase percentage in nutrient material in areas with and without leaf cutter anthills (*Atta sexdens rubropilosa*). The collected soil samples were taken from Fazenda Santa Fé, in the city of Capão Bonito/ São Paulo, Brazil, which belongs to the company Fibria S.A. The effect of anthill residuals in the soil was measured by comparing differences between a determined area with the presence of anthills, specifically, four adult colonies, with approximately 45 square meters of loose soil each, and the other without anthills, as the control; both belonging to the cited plantation. From each anthill a soil sample was taken from the center of the anthill at depths of 0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm and 80-100 cm and the same procedure was repeated in the areas without the presence of anthill residual. In total, through a Dutch process, 40 soil samples were taken: 20 in areas with anthills and 20 in areas without anthills. The statistical design used for the analysis was entirely random, with four repetitions and arrangements of treatments, using subdivided plots, with each anthill being its own experimental unit. The processing of this data was completed via Software Assistant 7.5 Beta, following Bartlett testing, ANOVA and comparing the average Tukey levels of 5% probability. Through the chemical analysis of the soil, it was verified that the quantity of nutrients was superior in areas with anthills. Considering that the soil samples in areas without anthills were set at a control, or rather, 100% of the total nutrients found in the soil samples, it is noted that there was a percent increase of diverse amounts, from 9.5% in content of P, 13% of K, 43% of Ca and 11% of Mg, the content of MO (organic material) in 4.2%, as well as other important indicators of the soil quality, as the sum of the bases (SB), which presented an increase of 23%, a reduction of pH of 0.5%, CTC (cationic exchange capacity) reduction of 10%, a base saturation (V%) increase of 39% in areas with anthills. In conclusion, the residual generated by the presence of leaf cutter anthills plays an important role in the improvement of the quality of soil and the cycling of nutrients where they occur. (CNPq)

CONTEXT DEPENDENT OUTCOME OF THE INTERACTION BETWEEN THE ANT *Camponotus punctulatus* MAYR (HYMENOPTERA: FORMICIDAE) AND THE BROWN CITRUS APHID *Toxoptera citricidus* (KIRKALDY) (HEMIPTERA: APHIDIDAE)

E. DIEHL-FLEIG[1,2]

[1]Part of the PhD thesis conducted at the Programa de Pós-graduação em Fitotecnia, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves 7712, Porto Alegre, RS, Brasil, e-mail: edf.formiga@gmail.com. [2]Programa de Pós-graduação em Neurociências, Universidade Federal do Rio Grande do Norte, Natal, RN, Brasil.

In this study, we evaluated the observed and estimated effect of the attending ant *Camponotus punctulatus* Mayr 1868 on the life history of the brown citrus aphid *Toxoptera citricidus* (Kirkaldy 1907) growing in *Citrus sinensis* (L.) Osbeck under free enemy lab conditions. For that, an experimental procedure was repeated under similar conditions separated in time, hereafter called E1 and E2. For each experiment a different queenless colony was given access to potted citrus plants (n = 13/experiment) bearing a pair of similar branches (age and size) colonized by aphids from a stock population. A single branch per plant was freely accessed by ants, while the other served as control and aphids developed without any attendance from ants. Aphids were followed up since their first day of emergence (E1, 12.6 ± 2.83 nymphs/branch; E2, 10 ± 0.0 nymphs/branch) growing up as a colony until the adult stage, when all adults were removed except for one, that was observed until its death. During aphid adult stage, daily offspring was quantified and removed. Aphid data was recorded on a daily basis, including survival, fecundity and the number of attending ants. In E1, ants had no effect on the aphid life history parameters. However, in E2, attended aphids had increased mean and daily fecundity and reduced longevity which had a statistically significant impact on all the estimated population parameters (net reproductive rate, intrinsic rate of increase, finite rate of increase, mean generation time and doubling time). Minor methodological differences and uncontrolled factors cannot be ruled out for the contrasting outcomes observed between these two experiments. But, one major difference was the average daily number of ants attending the aphids, which was significantly higher in E2 during both nymph stage (E1, 0.13 ± 0.08 ants/aphid; E2, 2.32 ± 0.09 ants/aphid) and adult stage (E1, 0.48 ± 0.09 ants/aphid; E2, 1.07 ± 0.11 ants/aphid). There seems to be an indication that not just ant attendance *per se*, but the intensity of this attendance, is important in altering the aphid life history. This could be the case, as other studies have been pointing out, that the mutualistic interactions are dynamic and context dependent, with costs and benefits varying according to the ecological context, as the density of the partners interacting. (CNPq)

DISTRIBUITION AND PREVALENCE OF *Wolbachia* INFECTION IN FIVE ANT SUBFAMILIES IN CENTRAL AMAZONIA, BRAZIL

C.A. NOGUEIRA[1,2], F.B. BACCARO[3], J.L.P. SOUZA[1] & I.P. FARIAS[2]

[1]Laboratório de Sistemática e Ecologia de Invertebrados do Solo, Coordenação de Biodiversidade, Instituto Nacional de Pesquisas da Amazônia (INPA), Av. André Araújo, 2936, CEP 69067-375, Manaus, AM, Brasil, e-mail: ca.nogueira@yahoo.com.br; [2]Laboratório de Evolução e Genética Animal, Departamento de Biologia, Universidade Federal do Amazonas (UFAM), Manaus, AM, Brasil. [3]Laboratório de Zoologia, Departamento de Biologia, Universidade Federal do Amazonas (UFAM), Manaus, AM, Brasil.

Wolbachia are intracellular parasite bacteria found in many species of arthropods and nematodes. They are mainly maternally inherited although horizontal transmission can occur. The paths used by *Wolbachia* to pass horizontally from one individual or species to another are not well understood, but one path may be via predation. The New World army ants (Formicidae: Ecitoninae) are top predators in the ground-litter tropical forests, preying upon a diversity of other arthropods. The main goal of this study was to evaluate whether army ants are more susceptible than others ants to *Wolbachia* infection. We used PCR assay to determine the prevalence of *Wolbachia* infections in workers of 67 native ant species from four sites in Brazilian Amazon. We dissected the gaster from each individual ant and then extracted DNA by grinding it in a 300 µL of 10% Chelex 100 resin (Bio-Rad), centrifuging for 2 min at 10.000 r.p.m., vortexing for 30s, incubating at 95°C for 20min, vortexing for 30s, and centrifuging for 20 min at 10.000 r.p.m. PCR was carried out with *Wolbachia*-specific primers for the *ftsZ* and *wsp* (A and B strain) bacterial gene. Primers designed from a highly conserved region of the arthropods 28S rRNA gene were used as control for the PCR. The confirmation of the amplification was visualized in 1% agarose gel. The *Wolbachia* infection rate among these species was greater than normally reported in previous studies for ants, which is around 30%. However, there was no significant ant subfamily-related bias in susceptibility to *Wolbachia* infection (χ^2 = 3.16, d.f. = 4, p = 0.57). Thirty seven out of 67 ant species screened in five subfamilies (55.2%) were infected by an A or B-group *Wolbachia*, 7/16 in Ecitoninae (43.8%), 2/5 in Ectatomminae (40%), 4/7 in Formicinae (57.1%), 21/32 in Myrmicinae (65.6%), and 3/7 in Ponerinae (55.2%). In addition, susceptibility to infection seems to be independent of ant guild as well (χ^2 = 2.78, df = 1, p=0.12). Out of 31 generalist ant species, 11 were infected (64.5%) versus 16 out of 28 for predator species (42.9%). Although phylogenetic evidence indicates high rates of *Wolbachia* horizontal transmission between hosts, some groups of ants that almost exclusively rely on prey do not increase their susceptibility to infection. Furthermore, although these ants (army ants among them) frequently consume *Wolbachia*-infected preys, bacteria transmitted can be restricted to the digestive tract of the host or even not survive the digestive process. Thus, the probability of successful infection of a new host depends not only on the characteristics of the host species but also on physiological ability of *Wolbachia* to colonize the germ line of an individual and to invade and maintain itself in host populations. (CNPq, FAPEAM)

EVALUATION OF *Atta sexdens* PREFERENCE FOR *Brassica oleracea* (BRASSICACEAE) LEAVES CULTIVATED IN CONVENTIONAL OR ORGANIC SYSTEMS

G.C. HERMÓGENES, F.G. LACERDA & G.R. MOREIRA

Universidade Federal do Espírito Santo, Alto Universitário S/N – Cx Postal 16, CEP 29500-000, Alegre, ES, Brasil, gabriellahermogenes@hotmail.com.

Leaf-cutting ants are important pests to several cultivated plants including several fruit trees, *Eucalyptus* species, and sugar cane. The use of synthetic pesticides in agriculture is the most widespread method for pest control. Organic farming is a form of agriculture that relies on techniques such as crop rotation, green manure and excludes synthetic chemicals to control insect pests. This system improves soil fertility with the presence of a richer microbial population. The aim of this study was to compare the preference of *Atta sexdens* for *Brassica oleracea* leaves (cabbage) originated from organic or conventional farming system. It was quantified the mean time to begin cutting the leaves and we analyzed the behavior of forager workers in contact with the two types of leaves. Four field colonies were used in this study. Fresh leaves of *B. oleracea*, 15 g originated from organic and 15 g from non-organic system were offered at the same time to each colony during 30 minutes. This procedure was repeated twelve times. At the end of each experiment leftovers were collected and weighed to evaluate leaf consumption. Leaf water loss was controlled by placing the same quantity of leaves in an inaccessible place to ants. The value of water loss was used to correct the weight of the leaves transported by the ants. Foraging behavior was measured by using scan sampling method. Means were compared by Tukey test at 5% significance level. It was verified a preference of the workers for leaves of the conventional system. Average consumption of non-organic cabbage (4.1 ± 1.4 g) and organic cabbage (2.5 ± 1.2 g) differed significantly ($p<0.01$). The mean time to begin cutting the leaves in both systems did not differ statistically ($p=0.26$). There was no difference in allogroming behavior ($p=0.12$) and workers average that cleaned the leaves ($p=0.20$) when in contact with organic vegetables and non-organic. Self-grooming behavior was more frequent in workers in contact with organic leaves ($p=0.03$). It is possible that organic cabbage have more micro-organisms and/or impurities on leaf surface. If so, this could trigger self-grooming or other hygienic behavior. Thus, the use of organic farming system could minimize the attack of leaf-cutting ants.

FAUNA ASSOCIATED TO LOWER ATTINE NESTS IN COCOA PLANTATIONS IN SOUTHERN BAHIA, BRAZIL

E.F. ALMEIDA[1,2], E.A. SANTOS[2], J.R.M. SANTOS[2], J.G. ALMEIDA JÚNIOR[1], J.H.C. DELABIE[2,3], L.O. NUNES[1] & C.S.F. MARIANO[1,2]

[1]Universidade Estadual de Santa Cruz UESC/DCB, Rod. Ilhéus-Itabuna Km 16, Ilhéus, BA, Brasil, e-mail: evelynfroes@hotmail.com. [2]U.P.A. Lab. Mirmecologia CEPEC/CEPLAC, Ilhéus, BA, Brasil [3]Universidade Estadual de Santa Cruz UESC/DCAA, Ilhéus, BA, Brasil

The Attini, a monophyletic tribe of Myrmicinae, includes more than 230 described species, mainly distributed in the Neotropics, having some Nearctic species too. All these species are obligatory dependent on fungus or yield cultivation; and the colonies of these ants constitute a complex and closed system due to their mutualism with the fungus. In ant nests, the occurrence of not-ant organisms is well documented, as a range of invertebrates can occur there. Inserted in a broader project on nesting strategies and associated fauna of lower attine nests, this study aims to determine the associated fauna found in the nests of these ants in cocoa plantations in southern Bahia. The experiment was carried out from August 2012 to July 2013 in nine counties of the south of the state of Bahia, Brazil. We collected 71 nests of nine species of attines belonging to the genera *Apterostigma*, *Cyphomyrmex*, *Mycocepurus*, *Myrmicocrypta*, *Sericomyrmex* and *Trachymyrmex*. Between them, an associated fauna was found in 19 nests, in which we noticed representatives of the phyla Annelida, Arthropoda, Mollusca and Nematoda. Among the most frequent groups, mites (Acari) dominated in 15 colonies, while springtails (Collembola) were present in the nests of seven attine species. If this fauna is compared with that one found in ant nests of the genus *Pachycondyla* (Ponerinae) living in the same cocoa plantations, the fauna associated to attine nests is rather less diverse. We infer that attine nests constitute a much closed system with no or little tolerance to other organisms due to the peculiarity of the symbiotic fungus cultivation, from which depends the colony viability, which makes very high the level of vigilance of the ants to any intruder. Furthermore, at least in regional forest and cocoa areas studied here, attine nests generally show an inconspicuous and small entry hole followed by a narrow pit. Therefore access to the colonies is rather limited and can be considered as a physical barrier which breaks the occurrence of organisms other than ants. Besides that, the protection given by individuals specialized in defense, although not verified in these ants but possible in such derived species, may also be an aspect to be considered as able to reduce the entry of any other organisms. It is yet evident that attine ant nests constitute an attractive habitat for a range of invertebrates (or even vertebrates in few cases, as documented in literature for reptiles), since saprophagous, parasites, generalist feeders and predators are recorded there. (FAPESB; PRONEX Program: project SECTI-CNPq PNX 011-2009)

HOW IMPORTANT IS THE PLANT SPECIES IDENTITY FOR DETERMINING ANTS PRESENCE ON IT?

E. ANTUNES, R.B.F. CAMPOS, G.M. LOURENÇO, B.C. BARBOSA & S.P. RIBEIRO

Laboratório de Ecologia Evolutiva de Insetos de Dossel e Sucessão Natural, Departamento de Biodiversidade, Evolução e Meio Ambiente/ICEB, Universidade Federal de Ouro Preto, MG, Brasil. eduardoantunes_du@hotmail.com

The interaction of plants with ants is an important relationship that constitutes an indirect defense mechanism against herbivory and the presence of extrafloral nectaries (EFN) involved in this protection. Consequently it is possible that the composition of species or guilds of herbivores is affected by the presence of ants. The ability to attract ants varies among species of plants depending strongly on the presence of EFN. Thus the defense against herbivores can vary according to the physiognomy of the vegetation, even within a single biome. There are several studies on the behaviour of specific groups of ants and herbivores, or the interaction between ants and plants. However, specific studies on the effects of interactions between ants, herbivores and plants for communities are rare for montane forests. To contribute to the construction of this knowledge, the present study aims to test the hypothesis that there is a relationship between ant species specificity in certain tree species in three distinct areas of montane forest in Itacolomi State Park, Minas Gerais. The studied areas were disturbed by substitution of native vegetation for tea plantation until the last century mid, when the park was stated for environmental conservation. Samples were carried out by canopy beating on 15 groups of trees in each of the three areas studied. We collected 23 species of ants in 132 trees. Due to the large number of voids, the largest part of the trees is not inserted in the analyses, and therefore analysed only five plant species. The results indicate that the identity of the plant species does not determine the set of ant species present therein. It is possible that the presence of certain structures, such as EFN or presence of producing honeydew are important in this determination. Another possibility is that the presence of certain ant species is not determined, but each plant by plant groups (segments canopy) which together constitute their territory, and where that kind transit. Moreover, each field appears to provide a specific fauna. Thus, it is possible that the composition of arthropod species in a given tree does not rely solely upon specific characteristics of that tree, but also the regional species pool. (CAPES, CNPq and FAPEMIG)

INTERACTION BETWEEN ANTS AND *Calloconophora pugionata* (HEMIPTERA) CREATES COMPETITIVE DOMINANCE AND REDUCES ARTHROPOD DIVERSITY ASSOCIATED WITH *Myrcia obovata* (MYRTACEAE)

R. FAGUNDES[1, 2], S.P. RIBEIRO[2] & K. DEL-CLARO[1],

[1]Programa de Pós-Graduação em Ecologia e Conservação dos Recursos Naturais, Universidade Federal de Uberlândia, Uberlândia, MG, Brasil, roberthfagundes@gmail.com. [2] Programa de Pós-Graduação em Ecologia de Biomas Tropicais, Universidade Federal de Ouro Preto, Ouro Preto, MG, Brasil.

The trophobiosis is a relationship between ants and honeydew-producer insects. The honeydew is a spatially limited resource, despite which may trigger interespecific competition. In this study, we evaluate the effect of honeydew-producing colonies of *Calloconophora pugionata* (Membracidae) on the structure of ant assemblages associated with the host plant *Myrcia obovata* (Myrtaceae) in a Ferruginous Rupestrian Field of Ouro Preto (MG/Brazil). The hypothesis was that an increase in the number of trophobiont herbivores results in an increase in tending-ant occurrence, but a reduction in ant species diversity. Additionally, reduction of patrolling ants would increase diversity of other arthropods associated to the plants. Our experiment consisted in a gradual exclusion of hemipteran colonies out of the host plant crown, and further record of the ant assemblage response (species richness, composition and occurrence). Ten plants with three *C. pugionata* colonies were selected to manipulation and ten kept untouched as control. We search and count ants and other arthropods visiting each plant every two days for two weeks. At the end, one hemipteran colony was removed and the fauna was reevaluated for another two weeks, and so repeatedly until the three colonies were completely removed from the plant (two months). We found 1897 ants of 10 species with 81.5% associated with the presence of *C. pugionata*. In this case, *Camponotus crassus e C. rufipes* was numerically dominant (89.4%). Results corroborated our main hypothesis: membracids had a positive effect to the occurrence of ants (Repeated measures ANOVA: Group*Period: $F_{3,354} = 4.4$; $p < 0.01$), especially on the ant species directly involved in tending *C. pugionata*: *Camponotus crssus* e *Camponotus rufipes* Repeated measures ($F_{3,354} = 3.6$; $p < 0.02$). In addition, excluding *C. pugionata* colonies increased ant species richness ($F_{1,118} = 10.47$; $p < 0.01$) . The composition of species changed after removal of all *C. pugionata* colonies (Discriminant analysis: Wilk's $\lambda = 0.206$; $\chi^2 = 110.47$; d.f. = 70; $p < 0.01$). A monodominance of *C. crassus* and *C. rufipes* changed to more equitable assemblage of ten species when all *C. pugionata* colonies were removed. Overall, arthropod occurrence was also reduced with increasing in *C. pugionata* colonies, especially spiders and herbivore insects ($F_{3,354} = 3.62$; $p < 0.05$). Our results shows that the interaction between ants and exudate-producer Hemiptera influences the structure of the ant fauna associated with the host plant. This work shows one more evidence that We trophobiosis can be one of the mechanisms structuring ant assemblage on trees. (CAPES, CNPq, FAPEMIG)

INTERACTIONS BETWEEN ANTS AND DIASPORES FROM *Guarea guidonia* (L.) Sleumer IN A SECONDARY FOREST PATCH IN ILHA DA MARAMBAIA, RJ

B.F. SILVA[1], A.J. MAYHÉ-NUNES[2] & A.F. NUNES-FREITAS[1,3]

[1]Programa de Pós-Graduação em Ciências Ambientais e Florestais, Universidade Federal Rural do Rio de Janeiro, BR-465, Km 7, CEP 23890-000 - Seropédica, RJ, Brasil, e-mail: bianca.fsilva@hotmail.com; [2]Departamento de Biologia Animal, Universidade Federal Rural do Rio de Janeiro, Seropédica, RJ, Brasil. [3]Departamento de Ciências Ambientais, Universidade Federal Rural do Rio de Janeiro, Seropédica, RJ, Brasil.

Interactions between ants and plants have been occurring for years, since the very beginning of Angiosperm evolution. The interaction between ants, fruits and seeds is reported in several parts of the planet. In rain forests, in particular, these interactions occur with plants which fruits do not have adaptations to be removed by ants, but their seeds are rich in lipids, named as non-myrmecochorous diaspores. *Guarea guidonia* (L.) Sleumer (Meliaceae), a species with seeds covered by sarcotesta which is rich in lipids, may attract several species of ants. The present study aims to identify which ant species interacts with the *Guarea guidonia* seeds and if the number of these interactions is related to the availability of seeds. The study was developed between March and April 2012, in a secondary forest area located at "Ilha da Marambaia", in the state of Rio de Janeiro, where *G. guidonia* is a common species. To evaluate which ant species interact with *G. guidonia* seeds, we established 25 sampling stations at intervals of 20 m throughout a trail 500 m long. In each station, a piece of filter paper (8 x 8 cm) with one seed was displayed. The stations were observed from 9 a.m. to 5 p.m. in a two-hour interval. The ants interacting with seeds were collected for identification. To verify if the number of interactions was affected by the availability of seeds, we established 12 stations with one seed and 12 stations with five *G. guidonia* seeds during the peak of fruiting season (March). To test whether the availability of seeds (one or five diaspores) influences on the ant attraction, we used chi-square test. We observed 226 events of interactions with *G. guidonia* diaspores, involving 22 species of ants. The species *Pheidole* sp1, *Pheidole* sp2, *Pheidole* sp3, *Wasmannia auropunctata* and *Solenopsis* sp3 represented 75% of the records. The stations with higher availability of seeds have been searched by ants more often ($\chi^2 = 23{,}13$; $p < 0{,}001$). *Pheidole* species are very abundant and common in rain forests, as well as their interactions with several kinds of plants. Ant species in general consumed the sarcotesta of the seeds. *Ectatomma edentatum*, *E. permagnum* and *Pachycondyla striata* also removed the seeds. The cleaning of the seeds by ants may influence the germination rates and the seed removal by ants enables that seeds reach sites more favorable for germination and the establishment of seedlings. The positive relationship between the amount of diaspores and seed removal shows that ants are attracted by a higher availability of resources. Therefore, fruits aggregated under the parent plant, without being dispersed, have a new chance of being removed by ants. (CAPES)

LEVELS OF ORGANIC MATERIAL FOUND IN AREAS WITH AND WITHOUT LEAF CUTTER ANTS (*Atta sexdens rubropilosa*) AMONG FLOODED GUM (*Eucalyptus grandis*) PLANTATIONS.

D. UKAN[1], M.Z. FERRONATO[2] & N.J. SOUSA[2]

[1]Professor, Dr., Department of Forestry Engineering (Departamento de Engenharia Florestal), Universidade Estadual do Centro-Oeste, PR 153 − Km 7 − Bairro Riozinho, Cx. Postal, 21, Fone (42) 3421-3000, CEP: 84500-000, Irati, Paraná, Brasil, mailto: daniukan@yahoo.com.br; [2]Universidade Federal do Paraná (UFPR), Curitiba, PR, Brasil.

Leaf cutter ants are considered to be forest pests due to the economic damage they cause. Data collection carried out for this work was done on flooded gum trees plantations, with the goal of evaluating the increase in organic material in areas with and without the presence of anthills. The soil samples were taken from Fazenda Santa Fé, in the city of Capão Bonito, São Paulo, Brazil, belonging to the company Fibrin S.A. Three plots were used, where the effect of the residue of the ants in the soil was tested using one area with the presence of anthills (four adult colonies of approximately 45 square meters of loose soil) and the other without anthills (control). From each anthill a soil sample was taken, from the center, depth of 0-20 cm, 20-40 cm, 60-80 cm, and 80-100 cm and the same procedure was repeated in the areas without the presence of residues of anthills. In total, 40 soil samples were collected; 20 in areas of anthills and 20 in areas without anthills, using a Dutch process. The statistical method used for this analysis was entirely random, with four repetitions and arrangements of treatments, using subdivided plots, with each anthill being its own experimental unit. The processing of this data was completed via Software Assistant 7.5 Beta, following Bartlett testing, ANOVA, and comparing the average Tukey levels of 5% probability. Through the chemical analysis of the soil, it was verified that there was no statistical difference between the treatments and samples of the soil with and without leaf cutter ants in flooded gum plantations to a level of 5% probability. However, it is possible to detect an increase rate of 3%, 4%, 1%, 7%, and 8% in the level of organic material in the areas that contained ant colonies. Thus, even with small percentages, the leaf cutter ants contribute to the improvement of degraded soil. Therefore, it is believed that the presence of anthills increases the levels of organic material in soil-when compared to areas without these insects-due to the disposal of their waste and, consequently, this increase in material shall contribute to the best future development of plants that grow in these areas.

MYRIAPODA ASSOCIATED TO THE NESTS OF THE BASAL ATTINI (FORMICIDAE; MYRMICINAE) IN SOUTHERN BAHIA, BRAZIL

J.G. ALMEIDA JÚNIOR[1], E.A. SANTOS[2], J.R.M. SANTOS[2], E.F. ALMEIDA[3], L.O. NUNES[3], J.H.C. DELABIE[2,3], & C.S.F. MARIANO[2,3].

[1]Programa de Pós-graduação em Zoologia, Universidade Estadual de Santa Cruz, BA, Brasil, e-mail: jailsonsal@hotmail.com. [2]Lab. de Mirmecologia (CEPEC/CEPLAC), Rod. Ilhéus-Itabuna, Km 22. [3]Universidade Estadual de Santa Cruz (UESC), Rod. Ilhéus-Itabuna, Km 16.

The basal ant genera of Attini have a Neotropical or Neartic distribution and are fungi or yeast growers, with which they have a symbiotic relationship. Little is known about the natural history of the species of basal Attini because most of the studies have referred to the genera *Atta* and *Acromyrmex* due to their economic importance. The species of the tribe nest in chambers digged in the soil, under rocks, in fallen trees or suspended soils associated to epiphyts, in pre-formed cavities, rotten wood, fissures in rocks, hollow fruits or between litter layers. In the nests, a range of organisms optionally divides the space with ants. Some of them, myrmecophilous commensals, are harmless for ants and use the resources offered there. In addition, other organisms are also common in ant nests such as Acari, Nematoda, Mollusca or Myriapoda, but studies analyzing these types of relationships are especially rare. The aim of this study was to determine the groups of Myriapoda associated with basal attine nests collected in southern Bahia and to identify any possible relationship. Whole nests of species of the genera *Cyphomyrmex*, *Mycetophylax*, *Mycocepurus*, *Sericomyrmex* and *Trachymyrmex* were located in the field and characterized for their nesting site (description of the habitat, depth and number of chambers, location of garbage, external characterization). Once collected, the nests were brought to the laboratory, the species were identified and the associated fauna was separated. The nest site in which each individual was found (fungus or yield garden, presence of substrate eventually on the body of youth or adult ants) was noted. The Myriapoda found were separated in morphotypes and identified to the order level when possible. Finally, inferences were made about the possible relationship with the Attini host colony. From 38 colonies collected, 11 had Myriapoda associated, totaling 20 individuals, all of them found in the fungi or yield garden: nine belonged to the Symphyla order, three to the Chilopoda class, three to the Diplopoda class, a single to the Polydesmida order, other four individuals of Myriapoda remained unidentified. The Symphyla order, with few representatives in Brazilian collections, stands out by being present in four colonies of basal attines, and two individuals were found in a colony of *Mycocepurus smithii*, a single individual in a colony of *Myrmicocrypta* sp.1, while two individuals were each time present in two colonies of *Trachymyrmex cornetzi*. The Chilopoda were found in colonies of three species of *Sericomyrmex*, which suggests some commensalism specialization for the genre. The two Diplopoda and the individuals of the Polydesmida order were respectively found in a colony of *Sericomyrmex* sp.1 and *Sericomyrmex* sp.2 and in a colony of *Trachymyrmex fuscus*. (CAPES, PRONEX FAPESB/CNPq SCTI PNX011/2009)

NESTMATE RECOGNITION IN THE ANT *Pseudomyrmex concolor* SMITH (PSEUDOMYRMECINAE)

P.S.M. PACHECO-JUNIOR[1,2,3] & K. DEL-CLARO[1,2]

[1]Programa de Pós-graduação em Entomologia, Faculdade de Filosofia Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Av. Bandeirantes, 3900, ZIP Code 14040-901, Ribeirão Preto, SP, Brazil, e-mail: paulo.pacheco.junior@gmail.com. [2]Laboratório de Ecologia Comportamental e Interações (LECI), Instituto de Biologia, Universidade Federal de Uberlândia, Uberlândia, MG, Brazil. [3]Núcleo de Estudos Científicos e Tecnológicos sobre Abelhas Regionais (NECTAR), Universidade Federal do Amapá, Macapá, AP, Brazil.

In the north of the Amazon region, the stinging ant *Pseudomyrmex concolor* Smith establishes mutualistic association with the tree *Tachigali myrmecophila* Ducke (Caesalpiniaceae). *P. concolor* is a highly aggressive ant, attacking intruders and defending their host plant against herbivores. Ants discriminate intruders through nestmate recognition mechanisms. This is an important feature for maintaining the colonial cohesion in eusocial insects, since it allows recognition of colony non-members. Thus, the studies about nestmate recognition are important to understand the adaptive success in ants. Although very conspicuous, the mutualistic relationship between *P. concolor* and *T. myrmecophila* has been poorly studied regarding the behavioral ecology. Here, we have investigated the behavior of nestmate recognition in *P. concolor*. Field observations were carried out in Terra Firme Forest located in the River Curiaú Reserve, Macapá, Amapá, Amazônia, Brazil. Twenty plants of *T. myrmecophila* occupied by *P. concolor* were paired according to height, number of leaves and leaflets. We sampled ten pairs of *T. myrmecophila* concerning two behavioral experiments: (1) re-introducing an ant to its colony (control) and (2) removing a single ant from its original colony to another one (treatment). Ants were collected, marked and introduced on the distal leaflet of leaves for both experiments. Thus, performing twenty introductions for each behavioral test for five minutes, we recorded the absence or presence of an aggressive behavior (bites or stings) regarding the first contact between resident and intruder. Furthermore, we performed twenty introductions of inter-specific ants and termites in each tested plant. Results showed that *P. concolor* recognize and discriminate nestmate of non-nestmates, confirming the nestmate recognition hypothesis in eusocial insects. Aggressive behaviors such as bites and stings were targeted significantly to workers of test group ($\chi 2$=19,79 P<0,001 n=20). Moreover, all interspecific ants and also termites introduced in the plant were beaten for *P. concolor* workers. On the other hand, nestmates introduced in their own plants were not attacked, being accepted in their colony of origin. Aggressiveness is a common behavior in ants that defend environmental and territorial resources such as food and place to live. The stinging ant *P. concolor* engaged in mutualistic relationship with the myrmecophyte *T. myrmecophila* is very effective to avoid intruders, defending their colonies and hence their host plants. However, that defense depends upon the ability of *P. concolor* to recognize nestmates and non-nestmates, ie members belonging or not the plant where their nest. Nestmate recognition is fundamental for maintaining the fitness in ants, which may reflect directly into ant-plant mutualistic relationships. (CNPq)

PLANT TRAITS AND HERBIVORY OF *Cecropia glaziovii* TREES AND THEIR SYMBIONTIC *Azteca* ANT COLONIES

K.N. OLIVEIRA[1], F.M. JESUS[2], A.C. MARADINI[3], M.M. ESPÍRITO-SANTO[4] & R.I. CAMPOS[1,2]

[1]Laboratório de Ecologia de Formigas, Departamento de Biologia Geral, Universidade Federal de Viçosa (UFV), Av. Peter Henry Rolfs, s/n, Campus Universitário, CEP: 36570-000, Viçosa, MG, Brasil, e-mail: karlanunesbio@gmail.com; [2]Laboratório de Orthoptera, UFV, Viçosa, MG, Brasil; [3] Laboratório de Ecologia de Comunidades, UFV, Viçosa, MG, Brasil; [4] Laboratório de Ecologia Evolutiva, Universidade Estadual de Montes Claros (UNIMONTES), Montes Claros, MG, Brasil.

The presence of a conspicuous symbiotic relationship with ants is one of the most exceptional characteristics of the genus *Cecropia*. Plants provide nesting space and food for ants which in turn defend plants against herbivorous insects. However contradictory results make it still unclear if the ant presence is really positive to the plant. *Cecropia glaziovii* Sneth is a fast growing neotropical tree, and it is almost always inhabited by ants of the genus *Azteca*. Here we evaluate if *C. glaziovii* features can be related to ants presence nesting on plant. More specifically we tested if the presence of *Azteca* nests on plants can influence herbivory, foliar thickness and growth in these plants. In a fragment of Atlantic Forest of southeastern Brazil, we sampled 42 individuals of *C. glaziovii* ranging from 0.89 and 2.99 meters high in which 20 were colonized by ants and 22 were not. For each plant individual were selected the three most basal leaves to measure herbivory rate. All these leaves were photographed and based on pixel analysis we calculated the proportion of leaf damage using *ImageJ* software. The same leaves had their thickness measured with a manual micrometer. Finally, all plants had their height measured twice in November 2012 and April 2013. Plant growth rate were measured based on total height increment (THI) formula, as follow: THI = (ln H_{final} – ln $H_{initial}$)/t, where H = height in meters and t = time in days (149). As expected, plants colonized by ants had smaller foliar damage (3.7%±1.9) than plants not-colonized (13.3%±5) ($F_{(1,28)}$=6.05; p=0.02). On the other hand leaf damage was positive related to leaf thickness in both groups of plants ($F_{(1,27)}$=9.22; p<0.01), however did not differ between plants colonized and not-colonized ($F_{(1,42)}$=2.42; p=0.13). Finally, plants colonized by ants grew faster (THI=0.081 ± 0.011/day) than plants not-colonized (THI=0.046 ± 0.011/day) ($F_{(1,40)}$=4.69; p=0.04). *Azteca* ants seem to be very territorial and aggressive and it is plausible that they actively prevent other insects to climb or land in their plants especially near the nest entrance (domatia). For this reason, plants colonized by ants suffer less herbivory than plants without ants. At the same time, this result could be an indirect indication that plants with ants would spend less energy in defense and more in growth, and for this reason they would grow faster than plants without ants. Finally, our results show that leaf thickness is not related to plant defense and, on the other hand, could be associated to resource quantity to chewing herbivores. In general, our results highlight that at least for the studied system the plants seems to benefit from the ants presence. (FAPEMIG, CNPq, UFV)

PRELIMINARY ASSESSMENT OF THE DIVERSITY OF HEMIPTERA ASSOCIATED WITH THE MOSAIC OF DOMINANT ANTS IN CACAO PLANTATION

T.E.D. MARQUES[1], K.M. FISCHER[2], J.R.M. SANTOS[3], C.S.F. MARIANO[4] & J.H.C. DELABIE[3]

[1]Programa de Pós-Graduação em Ecologia e Conservação da Biodiversidade, Universidade Estadual de Santa Cruz, Campus Soane Nazaré de Andrade, Rodovia Jorge Amado, Km 16, Salobrinho, Bahia, Brasil, e-mail: thamyevellini@yahoo.com.br; [2]Universität Kassel-Witzenhausen, Alemanha; [3]Laboratório de Mirmecologia, Centro de Pesquisa do Cacau, Ilhéus, BA, Brasil; [4]Departamento de Ciências Biológicas, Universidade Estadual de Santa Cruz (UESC), Ilhéus, BA, Brasil; [5]Departamento de Ciências Agrárias, Universidade Estadual de Santa Cruz (UESC), Ilhéus, BA, Brasil.

Mutualism is a mutually ecological interaction in which both species involved are benefited. One of the most classic examples of mutualism is the interaction between ants (Hymenoptera: Formicidae) and the hemipteran suborders Auchenorrhyncha (Membracidae) and Sternorrhyncha **(**Aphididae, Coccidae, Pseudococcidae). In such interactions, ants benefit from a liquid secretion called “honeydew”, metabolized by hemiptera from the phloem sap of the plant. This liquid is rich in carbohydrates and amino acids. In return, ants provide them with protection against predators, parasites and pathogenic organisms and guide them to more favorable locations to their feed. Ants are abundant in tropical crops such as cacao (*Theobroma cacao L.*, Malvaceae) in southern Bahia, where can be found up to 250 species. The ant-communities dominating cacao are structured by a mosaic which form depends on intra and inter-specific competition, where a small percentage of species interact with a single species of hemiptera. Thus, the aim of this study is to describe the interactions among ants and hemiptera in a cacao plantation and evaluate whether the mosaic formed by ants is related to the distribution of hemipteran species. The experiment was conducted on cocoa farms in the experimental areas of Cocoa Research Center (CEPLAC) (14°45'S, 39°13'W), Ilhéus, BA, Brazil, between July and August 2013. We analyzed 240 cacao trees, and the species involved in ant-hemiptera-interactions were collected. The biological material was identified in the Laboratory of Myrmecology CEPEC/CEPLAC. The species frequency on trees was tested by chi-square test. We found 118 interactions: *Wasmannia auropunctata* (n = 55 plants), *Dolichoderus bidens* (n = 31), *Crematogaster acuta* (n = 10), *Azteca chartifex* (n = 10) and *Cephalotes atratus* (n = 7) had a greater number of interactions with hemiptera in plants than *Nylanderia fulva*, *Pheidole midas*, *Pheidole* group *Fallax* sp., and *Brachmyrmex heeri*, for which we observed a lower number of interactions. Membracidae, Aphididae and Pseudococcidae were hemipteran families associated with species of ants at higher frequency (n = 78, 21 and, 17 plants, respectively). However, they do not coincide with the distribution of ants in cacao plantation ($\chi 2$ = 7.09, p> 0.05), corroborating the hypothesis in which the mosaic formed by the coexistence of different species of ants may have four or five most frequent species, each with a hemipteran species that dominates this relationship. (PRONEX SECTI-FAPESB/CNPq, projeto PNX 0011/2009)

PRESENCE AND DISTRIBUTION OF *Wolbachia* AND *Blochmannia* ENDOSYMBIONTS IN COLONIES OF *Camponotus textor* FOREL, 1899 (HYMENOPTERA, FORMICIDAE)

M.O. RAMALHO[1], C. MARTINS [1,2], V.G. MARTINS[1] & O.C. BUENO[1]

[1]Universidade Estadual Paulista- “Júlio de Mesquita Filho”, Unesp -Rio Claro, IB, CEIS, Av. 24 A, 1515, Bela Vista, CEP 13506-900, Rio Claro –SP, Brasil, email: manutsmk@hotmail.com. [2]UFPI, Universidade Federal do Piauí, Campus Universitário de Parnaíba, Av. São Sebastião, 2819, CEP 64202- 020 Parnaíba, Piauí, Brasil.

Endobacterium occurrences are common in arthropods. Among them, we can point out the *Blochmannia*, which was first described in 1887 by Blochmann in *Camponotus ligniperdus* (*Camponotus ligniperda* previously) and *Wolbachia*, whose first observation was made in the mosquito *Culex pipiens*. This work discusses a study on the host *Camponotus textor*, who is a weaver ant common in the forests of Central America and South. Although abundant, is a little studied species. The objective of this study was to investigate the presence and frequency of *Wolbachia* and *Blochmannia* endobacterium in colonies of *C. textor*. For this purpose, we used the primer pairs of MLST, and additional wsp as a marker (for *Wolbachia*), and primers 462F and Bloch 16S- 16S Bloch-1299R (to show the *Blochmannia*) as a means to elucidate the possible forms transfer of endosymbionts and how they behave within this same host species. Individuals from nine colonies were collected in the city of states SP, MG and BA and stored in 80% ethanol until DNA extraction with TNES. The fragment amplification was performed with a total volume of 25□L containing template DNA, PCR buffer, MgCl2, dNTP's, 2□L primers and Taq DNA polymerase (Invitrogen). Purification was performed using GFX PCR and Gel Band Purification (GE Healthcare) and sequencing with the BigDye Terminator (v.3.1) from Applied Biosystems, at 3130 Genetic Analyzer automated sequencer (Applied Biosystems). Sequences were edited in BioEdit, and compared with other GenBank through BLAST tool. As became evident *Blochmannia* multiple infections, cloning was necessary for the isolation of the strains. All individuals analyzed presented *Blochmannia* infection, and beyond that was also detected the endosymbiont *Candidatus sodalis melophagi*, but further studies are needed to understand this symbiotic relationship. *Wolbachia* analysis allowed the incorporation of a novel strain belonging to the database to supergroup A. Regarding the form of dispersion of these endosymbionts by the host, it was clear that for both *Wolbachia* as *Blochmannia* for may have been moved vertically and horizontally. (CAPES)

SEED MANIPULATION BY *Acromyrmex subterraneus* IN LABORATORY CONDITIONS: THE IMPORTANCE OF SEED STORAGE TIME.

T.V. FERNANDES[1], D.C. DIAS[1] & R.I. CAMPOS[1].

[1]Laboratório de ecologia de Formigas (LEF), Departamento de Biologia Geral, Universidade Federal de Viçosa, Ed. Shotaro Chimoya, s/n, Campus Universitário, Viçosa-MG, Brasil, CEP: 36570-000, e-mail: tiagovf@yahoo.com.br

Mabea fistulifera (Euforbiaceae) seeds have oleaginous appendices called elaiosome which is extremely attractive to ants. For this reason these seeds are collected and taken to nest by ants where they performed two main types of behaviors: i) elaiosome removal to feed the immatures and ii) elaiosome removal and seed scarification causing some injuries in the seed skin. Considering that these two types of ant behavior can be very important for seed germination this work was designed to answer the following questions: i) Is there any difference in frequency of these two types of behavior? ii) The seed storage time influences these two types of behavior? To answer these questions we used 10 mature nests of *Acromyrmex subterraneus* (Myrmicinae) already kept in laboratory conditions for more than two years. For each nest we offered 40 seeds of *M. fistulifera* every 48 h during 10 days (200 seeds per nest). The nests continued to be fed with leaves of *Acalypha sp*. every other day of seed offering. The seeds that were manipulated by ants (seeds discarded in the nest trash) were collected after 10 days and separated into two groups: i) seeds that had its elaiossome removed but were not scarified by the ants (FNE) and seeds without elaiosome and scarified (FES). All the experimental procedure described above, was performed twice using the same seed lot: the first occurred one month after the seed collection and the second after six months. All the seeds were stored in a plastic bag at constant temperature 25 ° C. We used a total of 4000 seeds in each experiment. We found that frequency of the two types of behavior studied (FNE and FES) were statistically different for both experiments (one and six month of storage) but there was an inverse trend. The seed storage time caused an inversion in the ant behavioral preference. While for one-month-stored seeds the most frequent behavior was the elaisome removal associated with the seed scarification (FES – 74.13% of the seeds), for the six-month-stored seeds the most recurrent pattern was the elaiossome removal without seed scarification (FNE – 65% of the seeds). We can conclude that the frequency of seed scarification by the ants is higher in “younger” seeds. Probably in “older” seeds, the amount of wax layer decreased by the time of storage and for this reason the behavior of seed scarification became less attractive to the ants. This result has important implications for studies relating ants with seed germination and it demonstrates that seed storage time is an important factor to be considered. (CAPES, CNPq, FAPEMIG)

SPECIFIC HOST-ANT ASSOCIATIONS REVEAL CRYPTIC SPECIES IN THE MYRMECOPHILOUS BUTTERFLY GENUS *Aricoris* (LEPIDOPTERA: RIODINIDAE)

L.A. KAMINSKI[1] & L. VOLKMANN[2]

[1]Departamento de Biologia Animal, Instituto de Biologia, Universidade Estadual de Campinas, CP 6109, 13083-970, Campinas, SP, Brazil, e-mail: lucaskaminski@yahoo.com.br. [2]Ecosistemas argentinos, INES Bernardo Houssay, Capilla Del Monte, Córdoba, Argentina.

The myrmecophilous butterfly genus *Aricoris* (Nymphidiini) comprises 24 species typically occurring in open and dry habitats in the neotropics. The taxonomy of this genus is based exclusively on adult morphology and the validity of some taxa has been debated for nearly a century until recently several synonyms were proposed. During studies about the life history of *Aricoris chilensis*, which includes seven synonyms, we perceive the existence of a complex of cryptic species, with sympatric species associated with different host-ant species. Here, we review the '*chilensis* complex' based on ecological and morphological information of immature stages. Behavioral observations were taken in February 2013 in the mountainous region of Cordoba, Central Argentina. Adult behavior, ant-association, host plant records, and early instars (first to third) were observed during the day (ca 10:00–15:00 h). This data was supplemented with nocturnal observations (ca 23:00–01:00 h), period of activity of the mature larvae (fourth and fifth instars). All eggs and larvae were reared to adult stage in laboratory. Samples of immature stages were fixed for morphological analysis. Using ecological data from symbiotic interactions between larvae, ants and host plant used, we could solve some longstanding taxonomic problems. Larvae of *A. chilensis* are gregarious, fed on Asclepiadaceae, and are tended by *Camponotus* spp., being *Aricoris susanae* **Syn. nov.** a new synonym. Other *Aricoris* species preferably fed on *Acacia caven* (Fabaceae), but they differ as tending ants. *Aricoris cisandina* **Reval.** is obligately associated with *Camponotus mus*, while *Aricoris cosquinea* **Reval.** is tended by *Brachymyrmex* sp. Moreover, it was possible to identify a new species of *Aricoris* associated with a distinct *Camponotus* species. Tending ants of *Aricoris* vary greatly in morphology (size) and behavior (recruitment and aggressiveness). Morphological differences in larval ant-organs associated with distinct host-ant species are remarkable. For instance, *A. cosquinea* is constantly tended by dozens of tiny *Brachymyrmex* and has all functional ant-organs since hatching, while larvae of *A. cisandina* are tended by large workers of *C. mus* and have well developed tentacle nectary organs. These differences in immature stages make identification easier at this stage than in adults. Our results obtained for a small region of Argentina show that a correct understanding of the specific limits on *Aricoris* necessarily involves morphological and ecological knowledge of the immature stages. (FAPESP, Fondo para las Américas, Rufford Foundation)

VARIATIONS IN THE COMMUNITY OF ANTS AND INTERACTIONS BETWEEN ANTS AND PLANTS ACCORDING TO ONTOGENY OF *Caryocar brasiliense*

E.B.A. KOCH[1,2], F.C. CAMAROTA[1,2] & H.L. VASCONCELOS[1,2]

[1]Universidade Federal de Uberlândia. Departamento de Ciências Biológicas, Campus Umuarama, Bloco 2D, Sala 26, 38400-902, Uberlândia, MG, Brasil, e-mail: elmoborges@gmail.com
[2]Laboratório de Ecologia de Insetos Sociais – LEIS , Rua Ceará, s/n - Bloco 2D – Sala 18 – Bairro Umuarama, Uberlândia, MG, Brasil.

Ants can confer various types of services for plants, and among these, the most common is the protection against herbivores. Several experimental studies have proven that the presence of ants can indeed benefit plants, diminishing the rates of herbivory, thus increasing the rates of growth and/or reproductive success. During the plant ontogeny, with alterations in the phenology, the availability and quality of resources can change dramatically. These changes in the supply of resources can facilitate or inhibit the presence of some species of ants. In this study, we sought to determine whether there is variation in the ant community and in the interactions between ants and plant according to the stage of development of *Caryocar brasiliense*. More specifically we seek to answer the following questions: (1) Are there differences in the ant community structure between plants of *C. brasiliense* in different stages of development? (2) Do these possible differences result in differences on the effect of ants on the plant? This study was conducted in areas of *cerrado sensu stricto* in Reserva Ecológica do Panga, localized in the southwest of Brazil. We used 81 individuals of *C. brasiliense*, which were separated into categories related to their ontogenetic stages: pre-reproductive individuals, medium-sized reproductives and large-sized reproductive. In order to determine whether there are differences in the proportion of predation with ontogeny, a predation experiment was conducted, where prey (termites) were offered on different branches of the plants. We tested the effect of the ant defense with a removal experiment where the presence of the ants has been manipulated on the three different ontogenetic categories of the plants. To this, leaves shoots were marked and afterwards, at the end of the experiment, herbivory rate was calculated. To check differences in ant community related with ontogeny, we collected the ants using mechanical beating on the plants and pitfall-traps containing baits (honey and urine). We recorded 64 species of ants. We found differences in species composition of ants with ontogeny. Species richness differed between the developmental stages, increasing with ontogeny, while the abundance was different between plants pre-reproductive and reproductive. The proportion of predation also differed with ontogeny, with termites being more attacked on large-sized reproductive plants. Despite not seeing differences on herbivory rates between the different categories, we found a significant effect of the ants as biotic defenses, varying with the ontogenetic stage of the plant. Our results suggest that ontogeny may be "keystone" to understand the variations in ant communities and their interactions with the plant, since it can directly affect the assembly of ants and, consequently, the services provided by these to their mutualistic partner.

BIOINDICATION, BIOINVASION AND PEST CONTROL

ACTINOMYCETE BACTERIA (*Pseudonocardia*) ISOLATED FROM THE INTEGUMENT OF *Acromyrmex subterraneus subterraneus* INHIBIT THE ENTOMOPATHOGENIC FUNGI *Metarhizium anisopliae* AND *Beauveria bassiana*

T.C. MATTOSO[1], D.D.O. MOREIRA[1] & R.I. SAMUELS[1]

[1]Laboratório de Entomologia e Fitopatologia, Unidade de Mirmecologia, Universidade Estadual do Norte Fluminense (UENF), Av. Alberto Lamego, 2000, CEP 28013-602– Campos dos Goytacazes, RJ, Brasil, e-mail: thallesmattoso@hotmail.com.

The leaf-cutter ants are well known to maintain symbiotic associations with the fungus *Leucoagaricus gongylophorus* that serves as source of food for their colonies. Although, some papers reported a second symbiotic relation in their colonies, the integumental bacteria *Pseudonocardia*, found on recently emerged worker ants, specifically suppresses the fungus *Escovopsis*, a pathogen of the fungus *L. gongylophorus*. However, our studies have shown that *Acromyrmex subterraneus subterraneus* workers with *Pseudonocardia* biofilms were less susceptible to infections of the entomopathogenic fungus *Metarhizium anisopliae*, suggesting an antagonistic relation between these microorganisms, and a new role for the bacterial symbionts, not only protecting the fungus garden from parasites but also protecting the more vulnerable recently emerged workers from pathogens. The current study was conducted to investigate if the *A. subterraneus subterraneus* integumental *Pseudonocardia* bacteria inhibit two species of entomopathogenic fungi: *M. anisopliae* and *Beauveria bassiana in vitro*. To isolate the *Pseudonocardia* strain used in this study, five workers, visually possessing abundant biofilms were brushed with a sterile paint brush and this material was immersed in 0.5 mL of Tween 80 (0.05%). The obtained suspensions were spread into Petri dishes containing chitin agar media and the isolates cultured for 20 days. *Pseudonocardia* was transferred to Sabouraud dextrose agar media and then transplanted to the center of Petri dishes with the same medium 15 days later. Then two plugs of each of the fungi: *M. anisopliae* (ESALQ-818) and *B. bassiana* (CG-24) were transplanted 5 cm from the bacteria on each side of the Petri dish. Twenty days later the halo formations were recorded photographically. This study is the first to show *Pseudonocardia* strains isolated from the integument of the leaf-cutter ant *A. subterraneus subterraneus* inhibit entomopathogenic fungi *in vitro*, further supporting the *in vivo* evidence that these bacteria could protect these ants from pathogens. (CAPES, CNPq, FAPERJ)

ACTIVITY OF ACTINOMYCETE LINEAGES OVER THE ENTOMOPATHOGENIC FUNGUS *Metarhizium* sp.

J.C. COUCEIRO[1,2], B.M.R. SOUZA[1] & T.M.C. DELLA LUCIA[1,3]

[1]Laboratório de Formigas-Cortadeiras, Departamento de Entomologia, Universidade Federal de Viçosa (UFV), Av. P.H. Rolfs, s/n, Campus Universitário, CEP 36570-000 – Viçosa, MG, Brasil, e-mail joel.couceiro@ufv.br. [2]Programa de Pós-graduação em Entomologia, Universidade Federal de Viçosa, Viçosa, MG, Brasil. [3]Departamento de Biologia Animal, Universidade Federal de Viçosa, Viçosa, MG, Brasil.

Leaf-cutting ants have an obligatory symbiosis with the fungus *Leucoagaricus gongylophorus*, which is used as their main food source. However, many non-mutualistic fungi considered to be harmful to the fungus garden or to the ants may be found in the nest, e.g. *Escovopsis*. Actinomycetes of genus *Pseudonocardia* are also mutualistic in this symbiotic net and are found on the integument of *Acromyrmex*. These actinomycetes secrete specific antibiotics which inhibit *Escovopsis* growth and can work against entomopathogenic fungi. The objective of this study was to investigate whether *Pseudonocardia* lineages can inhibit or not entomopathogenic fungus *Metarhizium* sp. Actinomycete lineages were isolated from three leaf-cutting ants species: *Acromyrmex subterraneus molestans*, *A. balzani* e *A. niger*. Paired inhibition tests were conducted between each one of three actinomycetes isolated with *Metarhizium* in Czapek culture medium. Discs of 1 cm in diameter containing these microorganisms were put in opposite sides of Petri dishes, 1 cm away from the border. Dishes without actinomycetes were used as control. For each lineage, 10 replicates were conducted and the dishes were put in incubator at 25 $\pm$ 3°C for 10 days. Radial growth of fungus was measured daily. Results were analyzed using t-test at 5% significance level. Tests with the *Pseudonocardia* lineage obtained from *A. niger* showed significant difference in the mean growth between groups, with higher means of the treatments compared to control group. This indicates this lineage stimulated *Metarhizium* sp. growth. On the contrary, *Metarhizium* sp. was adversely affected by the actinomycete lineage obtained from *A. balzani*. The third lineage, from *A. subterraneus molestans*, did not have any effect on *Metarhizium* growth. We conclude that different lineages provoke different effects. (FAPEMIG, CNPq)

ARBOREAL ANTS AS BIOINDICATORS IN A BURNED AREA OF MONTANE FOREST

B.G. ROBERTO[1]; S.P. RIBEIRO[1]; R.B.F. CAMPOS[1]; C.B. COSTA[1] & D.V.S. ANJOS[1]

[1]Laboratório de Ecologia Evolutiva de Insetos de Dossel e Sucessão Natural, Departamento de Biodiversidade, Evolução e Meio Ambiente, Instituto de Ciências Exatas e Biológicas, Universidade Federal de Ouro Preto (UFOP). Campus Universitário Morro do Cruzeiro, CEP 35400-000 – Ouro Preto, Minas Gerais, Brasil. polegadabio@gmail.com

The use of ants for the evaluation of environmental impact incurred (bioindicators) has generated accurate results. The low cost and speed in responding to a disturbance makes the study of these insects as tools for developing restoration plans, monitoring and conservation.Furthermore, studies on diversity and distribution of insects are still rare for Montane Forests in the tropics. Based on that this work aims to compare and evaluate, through the use of arboreal ants as bioindicators, two adjacent areas of Montane Forest: one that was impacted by the fire and the other not. The hypothesis tested in this project is that the burned area will have a smaller diversity of ants than the non-burned area. Also we test the hypothesis that there is a distinct ant species composition according to the time sequence before fire Samples were collected at the Parque Estadual do Itacolomi / MG (PEIT). Located in Ouro Preto and Mariana municipalities, between parallels 20 º 22'30 "and 20 º 30'00" south latitude and meridians 43 º 32'30 "and 43 º 22'30" west longitude in southeastern Minas Gerais. The PEIT is located in the transition between Cerrado and Mata Alântica. It has an area of about 7,543 hectares and is composed mostly of Seasonal Semideciduous Forest. The local altitude exceeds 1000m, so this forest has a distinct physiognomy, considered a Montane Forest. Two areas were selected to perform the sampling. The first suffered a fire on which there was significant loss of vegetation cover and the second area, adjacent to the first, has not been impacted by the fire and was used as the control area. In each area were placed four 20m transects parallel and spaced at 5m. In each transect were placed 5 arboreal pitfalls, totaling 20 pitfalls in each area. Monthly samples were collected from 10/2010 to 10/2011, totaling 480 samples. So far we analyzed seven months of collection, totaling 34 ant species, distributed in 13 genera, with *Camponotus* Mayr, 1861 the richest: 11 species. Other 8 orders of Arthropoda were identified, the order Diptera presented 149 individuals, being the most abundant. The samples were taken initial four months after the fire and show that the composition of ant species in each of the areas differ significantly (NMDS: Stress = 0.37, ANOSIM R = 0.34, p = 0.0002). The same comparison was made between samples taken one year after the start of the study (16 months after the fire) and was no longer possible to detect significant differences between the communities regarding the species composition (NMDS: Stress = 0.88; ANOSIM R = 0.09, p = 0.1). (CNPq,UFOP)

ATTRACTANTS OF LEAF-CUTTING ANTS OF THE GENERA *Atta* AND THEIR POTENTIAL TO MASK TOXIC SUBSTANCES

L.R. BOTERO[1], L. ARANGO[1], E. LOPEZ[1], J.P. RAMIREZ[1], G.L. HERNANDEZ[2], D. MATINEZ[2], D.J. TUBERQUIA[2] & B.E. GONZALEZ[1]

[1](GRINBIO) Grupo de investigación en biodiversidad, biotecnología y bioingeniería, Universidad de Medellín, Carrera 87 Nº 30-65 Medellín-Colombia-Suramérica, e-mail: lbotero@udem.edu.co. [2]Grupo de investigación Biología CES-EIA, Universidad CES. Calle 10A Nº 22-04 Medellín-Colombia-Suramérica.

The ants of the genus *Atta* are considered one of the most limiting pest in some South American countries, causing losses that could exceed one billion dollars annually due to extreme defoliation caused to crops. The biology of leaf-cutting is complex, making it difficult to control. For control products are effective, they must penetrate to underground nests and eliminate fungal cultures that feed the insects and/or the unique queen. This study evaluated the effectiveness of 21 natural attractants for leaf-cutting ants (genus *Atta*), 10 evaluated under laboratory conditions: carrot root (*Daucus carota*), leaves Pine (*Pinus patula*), pericarp of mango (*Mangifera indica*), eucalyptus leaf (*Eucalyptus grandis*), pineapple husks (*Ananas sativa*), pericarp of peach (*Prunus persica*), banana peel (*Musa paradisiaca*), orange peel (*Citrus sinensis*) and mandarine peel (*Citrus nobilis*). In addition to these, 11 other attractants were evaluated under field conditions: albedos of orange and lemon, rolled oats, papaya (*Carica papaya*), pineapple core, blended carrot, cape gooseberry (*Ribes rubrus*), and 5 juices: carrot, mandarin, orange, papaya and pineapple. Attractants were cut (3 mm) and dried (40°C) and pieces of paper (5 mm) were impregnated with juices. Containers with attractants (1.5 g) were placed under laboratory and field conditions. Under laboratory conditions using colonies formed by three cameras (fungus-queen, food and waste; 20°C) and locating the attractants into the chambers of the ants feed by 4 hours. Under field conditions placing the attractants for 1 hour on the sides of the trails in supply of ants at 10-15 cm away from the holes of income to the nest located in Barbosa-Antioquia, Colombia (26°C). In order to evaluate the preference of them, after the time of exposure, the containers were removed to analyze the difference in weight, were evaluated, the time to start exploring as well as to start and finish the total transport attractant. The analysis showed differences in the attractiveness of plant materials under laboratory and field conditions. Mango (1.4 mg/ant.h), banana peel (0.8 g/ant.h), pineapple (0.7 mg/ant.h) and peach (0.6 g/ant.h) were favorite in laboratory conditions. Under field conditions, pineapple (47 mg/ant.h), banana peel (44 mg/ant.h), carrot (43 mg/ant.h), pineapple core (39 mg/ant.h) and pineapple husks (39 mg/ant.h) were the favorite attractants. Bigger castes were working, so it was common observing more than two ants carrying a piece of attractant. Special care should be included in the size of the pieces of the attractant to facilitate their capture and transportation.

CULTURE MEDIUM EFFECT ON GROWTH KINETICS OF FUNGUS ASSOCIATED WITH LEAF-CUTTER ANTS *Atta* SPP. (FORMICIDAE: ATTINI)

J.P. RAMIREZ[1,3], L.R. BOTERO[1], E. LOPEZ[1], G.L. HERNANDEZ[2], D. MATINEZ[2], B.E. GONZALEZ[1] & P.P. GOMEZ[2]

[1](GRINBIO) Research Group Biodiversity, Biotechnology and Bioengineering, University of Medellin, Cra 87 No 30-65 Medellin-Colombia- South America, e-mail: johanar95@outlook.com. [2]Research group Biology CES-EIA, University CES. Street 10 A No 22-04 Medellin-Colombia-South America. [3]Master Student of Urban Engineering, University of Medellin.

The leaf-cutter ants belonging to genera *Atta* and *Acromyrmex*, have a habit of cutting and transporting of plant fragments to cultivation of fungal gardens of *Leucoagaricus gongylophorus*, with which carry a mutualistic symbiotic relationship in which the fungus feeds of plant material transported by ants; ants in turn feed by the fungus gongylidia used as sole food source for larvae, workers, soldiers and queen. The objective of this research was to evaluate the growth of the symbiotic fungus of leaf-cutter ants *Atta* spp. in three different commercial culture mediums: oxytetracycline glucose yeast agar (OGY), potato dextrose agar (PDA), Sabouraud Agar (SB) as strategy for isolation and culture and, as an alternative to the optimization for future growth inhibition studies of fungus. The nests of *Atta* genus were collected in different regions of the department of Antioquia (Colombia) and established for more than 6 months under laboratory conditions. Symbiotic fungi cultivated by ants were used to evaluate the commercial medium. They were cultured by extension method taking a piece of fungus and placing it in the center of the 15 Petri dishes for each commercial medium. The growth was measured as the increase in diameter of the initially sown seed fungus into the Petri dishes. It was evaluated every seven days for two months. The results of these tests show that commercial media had significant differences in growth kinetics resulting for PDA with a 0.3208, OGY 0.3132 and SB 0.4021 per unit time. These results show that the commercial medium potato dextrose and oxytetracycline glucose yeast, show high effectiveness in achieving rapid growth of fungus and find the growth rate per unit time. Although different responses were observed in growth between fungi isolated from different colonies of ants these media let us to have inputs for inhibition assays symbiotic fungi using plant extracts or finding other uses for pharmaceutical or nutritional level.

DIET CONSISTENCY ALTERS TOXICITY OF IMIDACLORPID IN *Acromyrmex subterraneus subterraneus* AND *Atta sexdens rubropilosa*

T.C. MATTOSO[1], W. DÁTTILO[2], D.D.O. MOREIRA[1], V. MORAIS[1], M. ERTHAL JR.[3] & R.I. SAMUELS[1]

[1]Laboratório de Entomologia e Fitopatologia, Universidade Estadual do Norte Fluminense, Av. Alberto Lamego, 2000, CEP 28013-602– Campos dos Goytacazes, RJ, Brazil, e-mail: thallesmattoso@hotmail.com. [2]Instituto de Neuroetología, Universidad Veracruzana, Xalapa, VZ, CP 91190, Mexico. [3]Universidade Candido Mendes-Campos, UCAM-CAMPOS, Brazil.

Conventional control of leaf-cutting ants is mainly carried out by application of solid insecticide baits. However, new insecticides need to be investigated for leaf-cutting ant management. The use of different insecticides and alternative approaches could increase the efficiency of chemical control methods. Here we investigated the differences in the toxicity of the neonicotinoid insecticide imidacloprid (IMI) when formulated in three different diet consistencies (solid; semi-solid; and liquid), against workers of two species of leaf-cutting ants, *Acromyrmex subterraneus subterraneus* and *Atta sexdens rubropilosa*. The solid diet was composed of 10% sucrose + 1.5% agar, the semi-solid diet was 10% sucrose + 0.5% agar and the liquid diet was composed of 10% sucrose in water. Diets with insecticide (Evidence®, Bayer Brazil) contained 0.003 g IMI/mL (*Acromyrmex*) and 0.005 g IMI/mL (*Atta*). Ants were allowed to feed *ad libitum* for 24h. Ants were then transferred to new Petri dishes and offered cotton wool balls soaked in 10% sucrose. Survival was monitored on a daily basis for 5 days following exposure to IMI. The survival curves were analysed using the program GraphPad Prism. The liquid and semi-solid diets resulted in the lowest levels of survival of *A. subterraneus* with 9% survival after 5 days when using liquid diet as compared to 6% survival when exposed to semi-solid diets. These results were not statistically different (χ^2= 0.002; P=0.96). However, the solid diet resulted in 53% survival and this result was statistically different to that seen for liquid and semi-solid diets (P<0.0001). The survival pattern for *A. sexdens* was similar to that of *A. subterraneus*, although the semi-solid and liquid diets caused 100% mortality in 4 and 5 days respectively. Solid diets resulted in 23% survival on day 5. The results showed the higher efficiency of liquid and semi-solid diets when compared to solid diets, probably as a result of higher ingestion rates. Therefore control strategies using solid baits should be re-examined in the light of these findings. (CNPq, FAPERJ)

EMERGENCE AND SEXUAL RATIO OF *Szelenyiopria talitae* SP. NOV. (HYMENOPTERA: DIAPRIIDAE), A NEW PARASITOID OF *Acromyrmex subterraneus subterraneus* (HYMENOPTERA: FORMICIDAE)

M. ERTHAL JR.[1,2], C.L.M. DE SOUZA[1,3], D.D.O. MOREIRA[3], V. MORAES[3], T.C. MATTOSO[3] A.F.N. DA SILVA & R.I. SAMUELS[3]

[1]Universidade Candido Mendes-Campos, UCAM-CAMPOS, Brazil. [2]Instituto Federal Fluminense, Campus Campos-Guarus. [3]Laboratório de Entomologia e Fitopatologia, Universidade Estadual do Norte Fluminense, Av. Alberto Lamego, 2000, CEP 28013-602– Campos dos Goytacazes, RJ, Brazil, e-mail: miltonerthal@hotmail.com

Wasps of the family Diapriidae are widespread in the tropics and some species are parasitoids of ants. The occurrence of diapriids were registered in ants of the subfamilies Myrmicinae, Formicinae and Dorylinae, however biological and behavioral data of their relationship are scarce. The aim of this study was to investigate biological features of the emergence and sexual ratio of *Szelenyiopria talitae*, a new species of gregarious parasitoid of leaf-cutter ant brood, *Acromyrmex subterraneus subterraneus*. Ten *Acromyrmex* colonies were collected in Bom Jardim, RJ and two had signs of diapriids parasitism, noted by the dark coloration of the larvae. The parasitized cocoons were removed from the ant colony, transferred to Petri dishes and maintained at 24°C and 85% RH. The emerging wasps were counted every two hours for 36 hours. Emerging wasps were counted daily during 18 days. The sexual ratio was established by antenna morphology. A total of 1,357 wasps were counted. Each cocoon had 1 to 10 wasps, with just males or females. Emergence initiated at ten o´clock and terminated at 22 h, with maximum between 13 and 16 h. As nests are naturally in darkness, this pattern of diapriids circadian cycle can be explained by the outside environment temperature. In the first five days the numbers of males equaled the females, when the sexual ratio reaches 1:1. After that, the number of females was higher than males and at eighteenth day the ratio female x male was 1:0.3 (783 females and 574 males). Analyzing the accumulated frequency we concluded that 50% of males and females emerged on fifth and sixth days. This characteristic, males emerging before females, could be an adaptive strategy to ensure that a low number of females are killed by ants. Also, the emergence of males before females could be related to male sexual maturation. The knowledge of leaf-cutter ant natural enemies can open opportunities for new alternative biological control methods of this pest. (FAPERJ, CNPq)

EVALUATION OF INHIBITION GROWTH SYMBIOTIC FUNGUS OF LEAF-CUTTING ANTS IN LIQUID CULTURE CAUSED BY *Canavalia ensiformis* EXTRACTS.

L.R. BOTERO[1], C. MONTOYA[1], N. AGUDELO[1], E. GRAJALES, G.L. HERNANDEZ[2] & D. MATINEZ[2]

[1](GRINBIO) Grupo de investigación en biodiversidad, biotecnología y bioingeniería, Universidad de Medellín, Carrera 87 No 30-65 Medellín-Colombia-Suramérica, e-mail: lbotero@udem.edu.co. [2]Grupo de investigación Biología CES-EIA, Universidad CES. Calle 10A No 22-04 Medellín-Colombia-Suramérica.

Leaf-cutting ants (genus *Atta*) are considered one of the most limiting pest for Agriculture and Forestry in countries like Colombia, Brazil and others South American countries, causing big losses due to extreme defoliation in attacked crops. The effectiveness of some products is based on penetrate to the underground chambers and eliminate the cultivated fungi which the ants used to produce his food. This study evaluated the in vitro liquid culture of fungus *Leucoagaricus gongylophorus* and the growth inhibition caused for *Canavalia ensiformis* extracts like alternative for control of ants of genus *Atta*. Effectiveness evaluation of inhibition of aqueous and ethanolic extracts was performed in PDA liquid medium supplemented with each of extracts. Aqueous and ethanolic extracts of seed, aqueous and ethanolic extract of leaf callus preserved (by 2 months) and Aqueous extract of new leaf callus. Determining the effectiveness of the extracts in the control of development was made by assessing weight of the biomass generated after 20 days of culture. Ethanolic extracts of seed and new leaf callus of *C. ensiformis* exhibited percentages inhibition of the symbiotic fungus growth up to 50% in liquid medium, indicating the feasibility of using this plant species for control of leaf- cutting-ant through growth inhibition of the fungus.

EVALUATION OF INSECTICIDES FOR THE CONTROL OF *Linepithema micans* (FOREL) (HYMENOPTERA: FORMICIDAE) IN VINEYARDS OF THE SOUTH OF BRAZIL

A. NONDILLO[1], C. CHAVES[2], F.B. FIALHO[2], O.C. BUENO[1] & M. BOTTON[2]

[1]Instituto de Biociências, UNESP – Universidade Estadual Paulista, Campus de Rio Claro, SP. Departamento de Biologia, C.E.I.S. - Centro de Estudos de Insetos Sociais, Av. 24 A, 1515, CEP 13.506-960, Rio Claro, SP, Brasil, e-mail: alinondillo@yahoo.com.br. [2]Embrapa Uva e Vinho, Bento Gonçalves, RS, Brasil.

Linepithema micans (Forel) (Hymenoptera: Formicidae) is the most important ant species associated with *Eurhizococcus brasiliensis* (Wille) (Hemiptera: Margarodidae), a soil scale responsible for vine decline and death in south Brazil. The control of *E. brasiliensis* has been carried out through the use of neonicotinoid insecticides applied into the soil. An alternative to reduce the scale's infestation in vineyards would be the control of dispersive ants. In this work, we evaluated the effect of imidacloprid, fipronil and thiametoxan as chemical barrier, and toxic baits for the control of *L. micans*. The experiment was carried out in a greenhouse using Paulsen 1103 (*Vitis berlandieri* x *Vitis rupestris*) vine rootstocks planted in 5L vases artificially infested with *L. micans* complete colonies. The treatments evaluated were (1) thiamethoxam (250, 187.5 and 125 g./ha), (2) fipronil (4, 5 and 50 ml/ha) and (3) imidacloprid (650g./ha) as chemical barrier. We also evaluated an aqueous solution of invert sugar (50% and 70%) containing boric acid (0.5%, 1.0% and 12%), and paste or gel containing pyriproxyfen (0.3% and 0.5%) and hydramethylnon (0.5%). Both liquid and solid toxic baits were offered *ad libitum* in bait-holders on the soil of the vase with weekly replacement. The effects of insecticides and toxic baits on the control of *L. micans* were assessed in three experiments in a completely randomized experimental design with ten repetitions per treatment. Evaluations lasted fifteen weeks in the first experiment, seven weeks in the second experiment, and thirteen weeks in the third experiment. Evaluations were carried out weekly. Colonies were kept fasting with only water supplied, for 24 hours, after wich a water solution of inverted sugar (70%) was offered in the center of a white formic board (3 x 3 cm) and the number of workers on the food source was recorded every 10 minutes for 1 hour. The maximum number of ants foraging within each hour was used as a response variable in data analysis. This amount was converted into a percentage of the maximum number of ants observed in each vase over the whole experiment. The data were evaluated separately for each experiment. For each treatment a curve of the percentage of ants foraging as a function of time was plotted, adjusting the function: $Y= A.\ e^{-B.x.(x>0)} + C$. Treatments were grouped hierarchically by similarity, using the F test on contrasts in order to compare different treatment groups. The analyses were made using the software R (2012). The hydramethylnon (toxic bait) and thiamethoxam (chemical barrier) were the most efficient active ingredients for the control of *L. micans*. (CNPq)

HOW IS GOING THE REHABILITATION OF POST-MINING AREAS? CAN ANTS TELL US SOMETHING?

A.C.M. QUEIROZ[1,2], R.G. CUISSI[1], C.J. LASMAR[1], E.O. CAÑEDO-JR.[1,2], A.M. RABELLO[1,2], E.A. DA SILVA[1,3], F.A. SCHMIDT[1] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras (UFLA), Campus da UFLA, S/N, CEP 37200-000 – Lavras, MG, Brasil, e-mail: queirozacm@gmail.com. [2]Programa de Pós-Graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.[3]Programa de Pós-Graduação em Entomologia, Universidade Federal de Lavras, Lavras, MG, Brasil.

We evaluated the effectiveness of different types of post-mining rehabilitation techniques through the following comparisons: (1) rehabilitation with different ages, (2) use of different exotic grasses for revegetation (*Melinis minutiflora* and *Brachiaria decumbens*), (3) use of native plants and *M. minutiflora* and (4) use of *M. minutiflora* on mining site and sterile pile. In this way we verified the effectiveness of rehabilitation techniques and seasonality effects on the ant species composition and richness, and the relationship of environmental variables to these diversity measures. In Nova Lima, Minas Gerais, Brazil, we selected five post-mining areas rehabilitated by *M. minutiflora* and *B. decumbens* grasses (two to ten years old), two post-mining areas rehabilitated only by *M. minutiflora* grass, two post-mining areas rehabilitated by the use of native species and seven undisturbed areas presenting natural vegetation of the region (four areas of native grassland with shrubs “campo sujo”, two of riparian forests and a ironstone outcrop “canga”) as reference areas (control areas). In each area, we established one transect (16 in total, 154 sampling points) and installed pitfall traps at hipogaeic, epigaeic and arboreal strata, whenever possible, to capture ants. We also measured environmental variables (representing conditions and resources for ants and vegetation structure in rehabilitated areas) that were correlated with ant diversity measures. We collected 172 species. The older rehabilitated post-mining area presented a similar ant species richness compared to reference areas, but not similar species composition. The rehabilitated areas with *B. decumbens* have more species than areas rehabilitated with *M. minutiflora*, but not composition similar to control areas either. We suggest that the use of *B. decumbens* or *M. minutiflora* grasses should not be recommended because they are exotic species and ineffective in rehabilitation, regarding diversity maintenance. Analysis of the diversity components showed that the use of native species can promote rehabilitation of ant communities more efficiently and in less time. The greater efficiency of rehabilitation with *M. minutiflora* in mining sites than on the sterile piles can be caused by the proximity of these areas to those of the control and, possibly, by the higher soil stabilization in mining sites. Thus, anthropogenic impacts change the ant community structure and the rehabilitation progress and, especially, exotic species are not efficient. Other factors that must be observed in rehabilitation progress are the distance from the source (control areas) and the time they were implemented. (Fapemig, CAPES, CNPq, Vale S/A)

HOW IS THE IMPACT OF MINING ON BIODIVERSITY USING ANT COMMUNITIES AS BIOINDICATORS?

A.C.M. QUEIROZ[1,2], C.J. LASMAR[1], R.G. CUISSI[1], F.T. TANURE[1], A.M. RABELLO[1,2], E.O. CAÑEDO-JR.[1,2], F.A. SCHMIDT[1] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras (UFLA), Campus da UFLA, S/N, CEP 37200-000 – Lavras, MG, Brasil, e-mail: queirozacm@gmail.com. [2]Programa de Pós-Graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

We evaluated the effect of mining on biodiversity using ant species richness and composition and the relationship of these diversity components to environmental variables (surrogates of conditions and resources for ants) in impacted mining areas. We tested the following hypothesis: i) Ant species richness is negatively affected by mining and has positive relationships with environmental variables; ii) Mining activities change environmental variables and ant species respond differently to these changes leading to specific species composition in disturbed and undisturbed mining areas. The study was carried out in two mining sites of Vale S/A in Nova Lima, Minas Gerais, Brazil in February 2012 (rainy season). In each site, we carried out the ant sampling in six disturbed mining areas and five undisturbed areas (control areas), which are made up of natural open vegetation habitats such as "campo sujo" and "canga". In each area we established a transect with 10 sampling units, where in each, we installed one pitfall trap at hipogaeic, epigaeic and arboreal strata to capture ants and measured the following variables: plant species richness, plant density, height and circumference at the base of plants, herbaceous and shrubby vegetation structure, litter weight and diversity and canopy cover. We collected 90 ant species. Only *Dorymyrmex brunneus* was exclusively found in mining areas. The ant species richness was negatively affected by mining ($p < 0.0001$), which also altered species composition ($p < 0.0001$). This can be due an indirect effect caused by loss of habitat and decrease of conditions and resources for ants. These diversity measures are related to environmental variables due to a greater quantity and quality of resources in preserved areas ($p < 0.05$). In this study most species collected in control areas are frequently found in other open habitats. In mining areas we found the presence of species, such as *D. brunneus* and *Solenopsis invicta,* typical of disturbed areas. Therefore, mining affects ant communities by changing habitat structure which could be relevant to biodiversity conservation in areas under human impacts. (FAPEMIG, CAPES, CNPQ, VALE S/A)

LOSSES IN WOOD PRODUCTION OF PLANTS ARTIFICIALLY DEFOLIATED SIMULATING THE NATURAL PATTERNS OF *Acromyrmex crassispinus* ATTACK ON *Pinus taeda* PLANTS

M.A. NICKELE[1]; W. REIS FILHO[2], S.R.C. PENTEADO[3] & M.F.O. MARTINS[3]

[1]Laboratório de Dinâmica Evolutiva e Sistemas Complexos, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, PR, Brasil, email: nickele.mariane@gmail.com. [2]Epagri/Embrapa Florestas, Colombo, PR, Brasil, [3]Embrapa Florestas, Colombo, PR, Brasil.

Acromyrmex crassispinus cause different levels of defoliation on *Pinus taeda* seedlings. The objective of this work was to evaluate the effects of artificial defoliation simulating the natural patterns of *A. crassispinus* attack on wood production of *P. taeda* plants. The experiment was carried out in São Mateus do Sul, state of Paraná, Brazil, where a planting of *P. taeda* was done in August, 2007. The experimental defoliation levels were: level 0: control; level 1: 50% defoliation; level 2: 75% defoliation; level 3: 100% defoliation, without the cut of the apical meristem; and level 4: 100% defoliation, including the cut of the apical meristem. The experimental design was a randomized complete block, and artificial defoliation was done on 20 plants for each attack level. Twenty plants that did not suffer defoliation were selected as the control (level 0). Each plant was numbered and identified with a defoliation level. Artificial defoliation was done when plants were 30 days old, since the most severe *A. crassispinus* attack on *P. taeda* plants occurs during this time. The assessments were done when plants were six years old (August, 2013), measuring the diameter to 1.30 m above ground and height of the plants. There are not significant losses on wood production to the plants with less than 75% defoliation ($F_{4, 89}$= 7.37, $p<0.0001$). However, there are significant losses in wood production to the plants with 100% defoliation, irrespective of the cut of the apical meristem and also the death of some plants. The mean losses in wood production of plants defoliated in level 3 and 4, in relation to the control, were 34.1% and 39.2%, respectively, when plants were six years old. Not all *A. crassispinus* attack in the first month after planting means significant losses in wood production. The losses in wood production occur when plants suffer more than 75% defoliation. (RIGESA)

OCCURRENCE OF EXOTIC ANT SPECIES IN NATURAL AND URBAN AREAS IN THE CITY OF RIO DE JANEIRO

M.N. SANTOS[1,3], J.H.C. DELABIE[2] & J.M. QUEIROZ[3]

[1]Laboratório de Fitossanidade, Instituto de Pesquisas do Jardim Botânico do Rio de Janeiro (JBRJ), Rua Jardim Botânico, 1008, CEP. 22.460.000, Rio de Janeiro, RJ, Brasil, e-mail: msatos@jbrj.gov.br; [2]Laboratório de Mirmecologia, Centro de Pesquisas do Cacau (CEPEC) Itabuna, Bahia, Brasil; [3]Programa de Pós-Graduação em Ciências Ambientais e Florestais da Universidade Federal Rural do Rio de Janeiro (UFRRJ), Departamento de Ciências Ambientais, Instituto de Florestas, Seropédica, RJ, Brasil.

We sampled five natural areas and 10 urban areas (parks) in the city of Rio de Janeiro aiming at checking for the occurrence of exotic ants. The collection was manual, using sardine baits to attract the ants. In each site, we used 200-m transects and 20 sampling stations. In addition, we measured the following environmental variables: soil compaction, air humidity, canopy cover, number of exotic plant species, and age of the area. We found in the samples four exotic ant species: *Monomorium floricola* (Jerdon, 1851); *Paratrechina longicornis* (Latreille, 1802); *Pheidole megacephala* (Fabricius, 1793), and *Tetramorium simillimum* (Smith, F. 1851). Out of 15 areas sampled, one urban park had *Monomorium floricola*, 3 urban parks had *Pheidole megacephala*, 4 areas had *Tetramorium simillimum* (1 natural area and 3 urban parks), and 8 areas had *Paratrechina longicornis* (1 natural area and 7 urban parks). Based on the ordination diagram of the canonical correspondence analysis, the first two axes explained 94.71% of the variation in the composition of exotic ant species. The most important variables to predict the patterns of species composition were soil compaction, relative humidity, and area age. The exotic species *Pheidole megacephala* was found mainly in parks with high values of soil compaction, contrary to the other exotic species. Soil compaction was positively related to grass cover as revealed by the regression analysis ($r^2 = 0.82$; $P = 0.001$). These findings suggest that environmental conditions have a strong influence on ant species composition and the regime of land use seems to determine the presence of exotic species, which are found more frequently in urban parks.

PARASITISM RATES OF THREE PHORID SPECIES, PARASITOIDS OF THE LEAF-CUTTING ANT *Atta bisphaerica*, IN A BRAZILIAN PASTURE

H.C. MARTINS[1], T.M.C. DELLA LUCIA[1,2] & M.A.L. BRAGANÇA[3]

[1]Programa de Pós-graduação em Entomologia, Universidade Federal de Viçosa, Av. PH Rolfs, Centro, CEP: 36.570-000 – Viçosa, MG, Brasil, e-mail: hendriacirqueira@gmail.com. [2]Departamento de Biologia Animal, Universidade Federal de Viçosa, Viçosa, MG, Brasil. [3]Curso de Ciências Biológicas, Universidade Federal do Tocantins, Porto Nacional, TO, Brasil.

The leaf-cutting ant *Atta bisphaerica* stands out as an important pest of pasture and sugarcane in Brazil. Previous study showed that this leaf-cutting ant is host to at least three genera of parasitoid flies of the family Phoridae, but there is no information about parasitism rates by the different phorid species. The purpose of this research was to obtain data on parasitism rates on *A. bisphaerica* by phorid species in pasture area and to verify variation in total rates of parasitism between colonies of this host. The study was conducted in four nests of *A. bisphaerica* located in pasture area around the campus of the Federal University of Viçosa (UFV), Viçosa County, Minas Gerais State, Brazil, between June and September 2012. An average of 642 ant workers was collected in each nest, at intervals of about 15 days, totaling eight samples. The ants were taken to the laboratory and were placed in plastic trays kept under controlled conditions (25 ± 1º C, 75 ± 5% RH), and were fed with a 10% honey-water solution. The trays were inspected daily and dead individuals were transferred singly to glass vials which were then taken to environmental chambers (25 ± 1º C, 85 ± 5% RH), where they were kept until the flies emerged. A total of 20,549 workers of *A. bisphaerica* were collected of which 1,520 (7.4%) were parasitized. Phorid belonging to three genera were found: *Apocephalus*, *Eibesfeldtphora* (probably the species *A. attophilus* e *E. bragancai*) and *Myrmosicarius* (specie *M. grandicornis*). The genus *Apocephalus* reached the highest rate among the parasitized workers (64.73%), followed by *Eibesfeldtphora* (25.53%) and *Myrmosicarius* (9,74). The four colonies showed the following average rates of parasitism: colony 1 (6.4 ± 0.46), colony 2 (7.2 ± 1.10), colony 3 (7.3 ± 1, 18), colony 4 (1.32 ± 7.8), with no significant difference between them (F = 0.27, P = 0.85, n = 32). The parasitism rate on *A. bisphaerica* by phorids found here (7.4%) is higher than those found in most studies with other leaf-cutting ants (*Atta sexdens* and *Atta laevigata*), which are usually between 2 and 6%. On the other hand, the great predominance of phorid parasitoids of the genus *Apocephalus* towards the genus *Eibesfeldtphora* and *Myrmosicarius* have also been observed in studies with other leaf-cutting ants in Brazil. The similarity in parasitism rates between colonies is probably due to the homogeneity of the habitats where nests were located. (CNPq, SEDECTI-TO)

PIPERACEAE NATIVE OF ANTIOQUIA (COLOMBIA) AS ALTERNATIVE FOR BIOLOGICAL CONTROL OF THE CUTTING ANTS GENUS *Atta* (FORMICIDAE: ATTINI).

J.P. RAMIREZ[1, 3], L.R. BOTERO[1], L. ARANGO[1], E. LOPEZ[1], G.L. HERNANDEZ[2], D. MATINEZ[2], D.J. TUBERQUIA[2] & B.E. GONZALEZ[1]

[1](GRINBIO) Research Group Biodiversity, Biotechnology and Bioengineering, University of Medellin, Cra 87 No 30-65 Medellin-Colombia- South America, e-mail: johanar95@outlook.com. [2]Research group Biology CES-EIA, University CES. Street 10 A No 22-04 Medellin-Colombia-South America [3] Master Student of Urban Engineering, University of Medellin.

The ants of *Atta* genus have been listed as one of the five most important plague of agriculture in the Neotropics with annual losses of more than one billion dollars due to high defoliation caused on fruit crops (pineapple, lemon, orange), ornamental and forest (pine and eucalyptus). Nowadays there is no effective method to control the ants and chemical insecticides have low specificity, this generates plague resistance and high environmental costs which limits their use. The Piperaceae are a group of wild plants wide distributed in Colombia, its potential in controlling pests has been reported. The objective of this research is to explore the extracts potential from 4 species of Piperaceae (*Piper auritum*, *Piper aduncum*, *Piper carpunya*, *Piper peltatum*) collected in different regions of Antioquia (Colombia) as an alternative to conventional chemical handling cutters ants *Atta* genus. For testing, the collected plant material was dried (37°C) and used for polar extracts prepared (96% ethanol) and nonpolar (D10/20 solvent). For testing insecticide spray extracts under laboratory conditions, ant colonies were established for more than 6 months. Dilutions included in these experiments were 100%, 50% and 25%. Monitoring was performed in mortality at 1, 4, 6, 12, 24, 48, 72 and 96 hours. Spraying with different plant extracts reached lethal dose 90 (LD90) after 72 hours for *P. auritum* (ethanol 100%; D10/20 100%), *P. aduncum* (ethanol 50%; D10/20 25%), *P. carpunya* (ethanol 100%, D10/20 100%) and *P. peltatum* (ethanol 50%; D10/20 50%). Piperaceae species most effective were *P. aduncum* and *P. peltatum*. During test the mortality analyzes showed that the ethanol extracts of *P. aduncum* and D10/20 reached DL90 after 12 hours. The results of this study show that it is possible determine the presence of high potential active insecticide in these plant species, and contributes to find effective and environmentally friendly alternatives for the biological control of leaf-cutting ants.

RECOVERY TECHNIQUES AND EFFECTIVENESS OF SEED REMOVAL BY ANTS

A.M. RABELLO[1,2], R.G. CUISSI[1], C.J. LASMAR[1], E.O.CANEDO-JÚNIOR[1,2], A.C.M. QUEIROZ[1,2] & C.R. RIBAS[1]

[1]Laboratório de Ecologia de Formigas, Setor de Ecologia e Conservação, Departamento de Biologia, Universidade Federal de Lavras (UFLA), CEP: 37200-000 - Lavras, MG, Brasil, e-mail: ananzamr@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.

We evaluated the seed removal by ants in recovered areas with different techniques and Cerrado control areas (as reference areas), examining: (1) richness and composition, (2) seed removal rates, (3) influence of environmental variables on species composition, and (4) indicator seed-removing ant species. We carried out the study in Nova Lima, Minas Gerais, southeast Brazil, in February and March (rainy season), and July (dry season) 2012. The recovery techniques analyzed were: exotic (EP) and native (NP) plant species, exotic grasses ("*Melinis minutiflora*-CG and "*Braquiaria* spp."-BR), and on sterile material (SM) and mining site (MS). We collected the following environmental variables: canopy cover, diameter, tree height and diversity, understory structure, and litter diversity and weight. In each area we installed one transect with five sampling points, and offered fifty artificial fruits per point. We did not find difference in the seed-removing ant species richness between seasons, but we observed that recovery with EP showed a higher number of ant species than recovery with NP and control areas. There was no difference between CG and BR, but they presented a lower ant species richness than control areas; while recovery on the MS showed better performance than on SM and its control area. Rates of seed removal were different between seasons and higher in control areas than in recovery areas. On the EP, the removal rate was higher than NP and control areas. We found higher removal rate in CG than in BR and SM showed a higher removal rate than MS. Recovery techniques EP and NP, in both seasons, were different in relation to species composition. The same was detected using different exotic grasses and between recovery on SM and MS. Environmental variables, except litter weight in most cases, explain changes in the seed-removing ant composition in both seasons. Independent of season, canopy cover was the most important environmental variable. *Pachycondyla striata* was an indicator of control areas, while *Pachycondyla verenae* was indicator of recovery with CG, EP and on MS, and *Solenopsis invicta* of NP. Seasonality did not affect species richness, but can affect ant foraging, decreasing ant activity during dry season, which was observed through the variation in the seed removal rate. Different recovery techniques caused changes in the soil conditions and in litter and make habitats more susceptible to invasion, affecting species composition. Environmental variables influenced ant composition because they represent habitat structure, consequently determining the resources and conditions important to ants. In this way the presence of *S. invicta* (normally related with disturbed areas) indicates an incomplete recovery process. Analyzes about the quality of recovery efforts using habitat structure and ecological functions offer more accurate and efficient knowledge about environments under the recovery process. (FAPEMIG, CAPES, VALE S/A)

***Ricinus communis* AND *Sesamum indicum* AS NATURAL INSECTICIDES AND THEIR POSSIBLE APPLICATION IN BAITS FOR CONTROL OF LEAF-CUTTING ANTS *Atta* SPP.**

L. ARANGO[1], L.R. BOTERO[1], E. LOPEZ[1], J.P. RAMIREZ[1], G.L. HERNANDEZ[2], D. MATINEZ[2], D.J. TUBERQUIA[2] & B.E. GONZALEZ[1]

[1](GRINBIO) Grupo de investigación en biodiversidad, biotecnología y bioingeniería, Universidad de Medellín, Carrera 87 No 30-65 Medellín-Colombia-Suramérica, e-mail: lbotero@udem.edu.co. [2]Grupo de investigación Biología CES-EIA, Universidad CES. Calle 10A No 22-04 Medellín-Colombia-Suramérica.

Leaf-cutting ants *Atta* spp. (Hymenoptera: Formicidae) are considered an important polyphagus pests of the Neotropics. This is because they cut portions of fresh plants and transport them to the nest to process them and use them as substrate for a basidiomycete fungus *Leucoagaricus gongylophorus* on which they feed themselves. Farmers and agriculturalists claim that the commercial baits are not only expensive, but ineffective; they might reduce the amount of worker ants for a while, but the nest would remain alive if the queen is not eliminated. The objective of this study is to evaluate the insecticide potential of seeds and leaves of castor (*Ricinus communis*) and sesame seed (*Sesamum indicum*) extracts as possible active ingredient for cutting ants *Atta* spp. control. For the study: 1. The laboratory colonies were established, 2. The vegetable polar (ethanol 96%) and not polar (solvent 10/20) of seeds and leaves of castor and sesame seed extracts were produced, 3. The effectiveness of the extracts to control *Atta* spp. were proven by aspersion after 1, 6, 24 and 72 hours using 100%, 50% and 25% of the extracts concentration. The results showed a differential control capacity using 100% of extracts of castor seed (ethanol-1 hour; 100% mortality; D10/20-72 hours-80% mortality), castor leaves (ethanol-6 hour-100% mortality; D10/20-72 hours-46% mortality) and sesame seeds (ethanol-1 hour-100% mortality; D10/20-72 hours-70% mortality). A reduction in the effectiveness were detected when the concentration was reduced to 50% of extracts of castor seed (ethanol-72 hour- 65% mortality; D10/20-72 hours-80% mortality), castor leaves (ethanol-72 hour- 80% mortality; D10/20-72 hours-90% mortality) and sesame seeds (ethanol-72 hour-80% mortality; D10/20-2 hours-100% mortality). Finally the maxima effectiveness reached when the extract concentration were reduced to 25% were for castor leaves (ethanol-72 hour-100% mortality; D10/20-72 hours-100% mortality) and sesame seeds (ethanol-72 hour-75% mortality; D10/20-72 hours-95% mortality). The results of this study show that it is possible determine the presence of high potential active insecticide in these plant species, and contribute to find effective and environmentally friendly alternatives for the biological control of leaf-cutting ants.

SAMPLING SYSTEMATIC PLAN FOR LEAF-CUTTING ANTS *Atta* SPP. (HYMENOPTERA: FORMICIDAE) IN EUCALYPTUS SP. WITH A SPATIAL APPROACH

A. SANTOS[1], R. ZANETTI[2], A. KRETZSCHMAR[3], O. LASMAR[4] & B.V. FERNANDES[5]

[1]Laboratório de Fitossanidade, IFMT – Campus Cáceres, Av. dos Ramires s/n, CEP 78200-000, Cáceres, MT, Brasil, email: alexandre.santos@cas.ifmt.edu.br. [2]Departamento de Entomologia, Universidade Federal de Lavras (UFLA), Lavras, MG, Brasil. [3]INRA, Unité de Biostatistique et ProcessusSpatiaux, Avignon, France. [4] Universidade Júlio Mesquita Filho (UNESP), Jaboticabal, SP, Brasil.[5] V&M Florestal, Paraopeba, MG, Brasil.

A fundamental step in integrated pest management is the evaluation of the pest population and how it is distributed in the field. In the case of ants, several studies have been developed to meet this distribution and how to sample them properly, but without a spatial approach. The study was conducted in 2008 in three *Eucalyptus* sp. stands (11.73, 15.26 and 19.73ha) at commercial forest of 4-year-old, with a spacing of 3x2m, with a pre-dominantly loamy soil, located in the municipal of Paraopeba (19°16'28"S latitude, 44°24'15"W longitude and 733m of altitude), state of Minas Gerais, Brazil. All of the nests present in the 3 stands were located and referenced (census) with a measuring tape that were converted for Universal Transverse Mercator (UTM) coordinates with the georeferenced stand maps. The leaf-cutting nests data position in eucalyptus stands were submitted to systematic samplings plans in the grid distances at 50, 75, 100, 125 and 150m, with the circular parcels of 5, 7.5, 10, 12.5, 15, 17.5 and 20m, using R statistical software. Sampling error (%) distribution with 95% interval of confidence was calculated with: Error = $(N_{atta}- \Sigma(N_{sampling})*A_{stand}/A_{sampling)}/N_{atta}*100$, where: N_{atta}=total number of nests in the stand, $N_{sampling}$= total number of nests sampling, A_{stand}= stand's area and $A_{sampling}$= sampling total area.The results of spatial sampling process showed decreasing errors when increasing the stands area or when with increasing ant nests. For the practical insect management purpose, we are interested in the longdistance grid and lesscircular parcel dimension of systematic sampling that produces until 10% of sampling error. For this, the results suggest that a circular parcel of 7.5m radius in a 125m grid distance improve the better sampling plan. This spatial approach shows high potential for create sampling plans for simulation process that reduces development costs of sampling plans. (CAPES, CNPq, FAPEMIG, V&M Florestal)

SEED REMOVAL BY ANTS AND IMPLICATIONS FOR RECOVERY TIME AFTER MINING

R.G. CUISSI[1], A.M. RABELLO[1,2], C.J. LASMAR[1], A.C.M. QUEIROZ[1,2], E.A. da SILVA[1], E.O. CANEDO-JÚNIOR[1,2], T.S. MORETTI[1], F.T. TANURE[1] & C.R. RIBAS[1]

[1]Universidade Federal de Lavras, Departamento de Agronomia, Setor de Ecologia e Conservação, Lavras, Minas Gerais, Brazil, CEP: 37200-00, e-mail: rafaelcuissi@gmail.com. [2]Programa de Pós-graduação em Ecologia Aplicada, Universidade Federal de Lavras, Lavras, MG, Brasil.[3]Programa de Pós-graduação em Entomologia, Universidade Federal de Lavras, Lavras, MG, Brasil.

Mining activity completely alters the landscape through the removal of the vegetation and soil layers resulting in their drastic degradation and their associated biota. This study evaluated the seed removal by ants in areas with different recovery times after mining (2, 4, 6, 8 and 10 years – R2, R4, R6, R8 and R10, respectively) and non-impacted areas (controls) in different seasons (dry and rainy). For this we tested the following hypotheses: (1) the richness and composition of seed-removing ant species and (2) seed removal rates; are altered with the increase in recovery time. Moreover, we verified the influence of environmental variables on the seed removal rate and ant species composition. Samples were collected in Nova Lima, Minas Gerais, southeastern Brazil. Within all areas we installed a 200m transect containing five sampling points 40m apart. Each sampling point contained 50 artificial fruits attractive to seed-removing ants. We found no difference on the ant species richness between seasons, but species richness was higher in the control areas followed by R4 and R8. In the rainy season, we found differences in species composition between control areas and the different recovery times, and only the R2 and R8 were different between themselves. These changes can be explained by environmental variables such as diameter, height and density of trees, canopy cover, understory density and litter diversity (together explained 20.5% of the change in composition). For the dry season we detected differences between control areas and the different recovery times, and R4 was different from all other areas. These changes can be explained by the same environmental variables described above, excluding only the understory density (together explained 19.9% of the change). Removal rates were different in all areas of recovery and between seasons, and in most cases were higher during the rainy season. Ant species richness does not respond exactly to the increase in recovery time, but its composition changes. This result is related to the presence of open-habitat tolerant species in early recovery, presence of new species for the intermediate times and specialist species for areas with longer recovery times, reinforcing the intermediate disturbance hypothesis. The removal of seeds by ants should be considered when evaluating the recovery process, linking information on the ant community and habitat structure. We emphasize the importance of the ecological function of seed removal by ants as a powerful tool to evaluate the recovery of degraded areas. (CAPES, CNPQ, FAPEMIG, VALE S/A)

SPECIFICITY IN THE ASSOCIATION OF *Pseudacteon* COQUILLET (DIPTERA, PHORIDAE) TO FIRE ANT *Solenopsis geminata* GROUP (HYMENOPTERA, FORMICIDAE)

T.P.L. PEREIRA[1]; J.H.C. DELABIE[2] & F.R. BRAVO[1]

[1]Pós Graduação em Zoologia, Universidade Estadual de Feira de Santana, Av. Transnordestina, B. Novo Horizonte, 44036-900; thallesplp@gmail.com; [2]Laboratório de Mirmecologia, CEPEC-CEPLAC & Universidade Estadual de Santa Cruz, Rod. Jorge Amado, Ilhéus-BA

The fire ant *Solenopsis geminata* group can be harmful to man in many ways, like through its sting which can cause lesions and trigger allergic reactions, and by attacking crops. Otherwise, they can also be used as biocontrol agents. The usual way to combat these ants is through the use of insecticides that, apart from being possibly ineffective, present a danger to man and the environment, such a as contamination of aquifers. The species of *Pseudacteon* Coquillet (Diptera, Phoridae) are parasitoids of fire ants and are important biological control agents of these. This study aimed to: conduct a survey of phorid parasitoids associated with fire ants, *Solenopsis geminata* and *Solenopsis saevissima* and verify the specificity of the association between hosts and parasites. The study was done in the areas of experimental CEPLAC-Ilhéus, Bahia. Twelve colonies of *Solenopsis saevissima* and six of *Solenopsis geminata* were upset with the aid of a spud and observed for 30 minutes. The parasitoids that were flying on ants were captured with entomological aspirator. The study was done in a way that is closer to natural conditions, compared with work already done, without interference in the composition of the colony. We collected 73 parasitoids of the genus *Pseudacteon* associated with ants, 27 males and 46 females. Males have not been identified so far, because the taxonomy of the genus is based mainly in females. Among females, were found: associated with *S. saevissima* two individuals of the species *P. pradei* six of the species *P. arcuatus*, 16 of the species *P. fowleri* and two a new species, *Pseudacteon* sp. nov. 1. Associated with *S. geminata*, were found only two species: 19 individuals *Pseudacteon* new sp.1 and a single individual *Pseudacteon* new sp. 2. Analyzing these results we see that there are species of parasitoids that may be considered generalists, as *Pseudacteon* new sp. 1 and more specialized in the choice of the host as the other species. Literature data indicate that *P. arcuatus* never been observed associated with *S. saevissima* but only *S. geminata*, also demonstrating to be a generalist species. The study of host specificity can open new perspectives on their use in biological control of fire ants. (CAPES, FAPESB, CEPLAC)

TOXICITY OF FRACTIONS AND ISOLATED COMPOUND OF *Croton floribundus* AGAINST *Atta sexdens* (HYMENOPTERA: FORMICIDAE)

J.R.C. SANTOS[1], S.H.P. SILVEIRA[2], J.C. SANTOS[1], R. ZANETTI[1] & D.F. OLIVEIRA[3]

[1]Programa de Pós-graduação em Entomologia, Departamento de Entomologia, Universidade Federal de Lavras, Campus Universitário, Caixa Postal 3037 – CEP 37200-000, Lavras, MG, Brasil, e-mail: juara_agro@hotmail.com. [2]Laboratório de Entomologia Florestal, Universidade Federal de Lavras [3]Programa de Pós-graduação em Química, Universidade Federal de Lavras.

Toxicity of plant extract of *Croton floribundus* against workers of *Atta sexdens* was evaluated in laboratory conditions. The fraction hexane, ethyl acetate, methanol, residue fractions hexane and ethyl acetate, and aqueous and organic phases and these residues were tested. We used two controls, one without and one with sulfuramid (0.3%). We used six Petri dishes containing 20 ants for each treatment. We evaluated three concentrations of crude extract (200, 400 and 600 mg/g of citrus pulp). The fractions and phases were evaluated by proportional calculations, multiplying the mass by the correction factor of 1.2. The fractions and residue were dissolved in methanol and this solution added citrus pulp, and we removed the solvent by rotary evaporator. Then, we added 10% saccharose solution in each formulation. In each treatment was made adding 2 g of formulation per Petri dish, and then it was removed after 24 hours and we added artificial diet. The mortality of ants was evaluated in 1th, 2th, 3th, 5th, 7th, 9th, 11th, 13th, 15th, 17th, 19th and 21th days after application. The data were analyzed for mortality curve using the Weibull distribution. The ethyl acetate fraction, methanol fraction and the aqueous fraction of methanolic of *C. floribundus* presented activity against ants. The ethyl acetate fraction exhibited 64% mortality after 21 days of evaluation in two concentrations tested (400 and 600 mg/g). In the aqueous phase, the behavior of the curve of mortality at the highest concentrations was similar to positive control (87.69% after 21 days, LT 50 = 7.9 days). Caurenoic acid was isolated of acetate fraction, but it wasn't active against ant. (FAPEMIG, CNPq, CAPES)

TOXICITY OF PARTITIONS OF DICHLOROMETHANE OF *Duguetia lanceolata* TO WORKERS OF *Atta sexdens rubropilosa* (HYMENOPTERA, FORMICIDAE).

M.G. BASTOS[1], A.O. BARBOSA[1], V.C. DOMINGUES[2], M. CECCATO[1], I.C. REISS[1], J.B. FERNANDES[2], M.F.G.F. DA SILVA[2] & O.C. BUENO[1]

[1]Ceis – Centro de Estudos de Insetos Sociais, Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP) - Câmpus Rio Claro, Av. 24A, 1515, CEP 13506-900 - Rio Claro, SP, Brasil, e-mail: mgbastoss@yahoo.com.br. [2]Departamento de Química, Laboratório de Produtos Naturais, Universidade Federal de São Carlos (UFSCar), Rod. Washington Luís, Km 235- SP-310, CEP 13565-905 - São Carlos, SP, Brasil.

The leaf-cutting ants *Atta sexdens rubropilosa* use vegetable substrate to cultivate the growing symbiotic fungus in their colonies. Because of this, they are considered pests for agriculture and the control of these ants is of great importance. New methods and strategies have been studied using substances of plant origin, an alternative to control these pests, because they have a less detrimental effect on the environment. This study evaluated the toxicity of partitions of dichloromethane of the extracts of different parts of the plant *Duguetia lanceolata* on workers of *A. sexdens rubropilosa.* Each extract was submitted to liquid-liquid partition. Partitions of dichloromethane of extracts from leaves, branches, seeds and fruit peels were incorporated into artificial solid diets on concentration of 2.0 mg/mL and used in feeding the ants, where each partition of the extracts of *D. lanceolata* was a treatment. To evaluate the effects of each treatment were used 50 workers of *A. sexdens rubropilosa* divided into five Petri dishes. Five other plates were the control group fed only with pure artificial diet. The plates were examined daily for removal and recording of the number of dead workers for a period of 25 days. Data were compared using the nonparametric test "log-rank" ($p<0.05$). The comparison between the survival curves revealed that partitions of dichloromethane of the extracts of leaves, branches, seeds and fruit peels of *D. lanceolata* showed a significant reduction in survival compared to control ants. The median survival values were observed: Control > 25 days, leaves = 5 days, branches = 12 days, seeds = 9 days, fruit peels = 10 days. The partitions of the leaves and seeds showed total mortality of workers, respectively, in 20 and 21 days, while the partitions of the branches and fruit peels showed 92 and 82%, respectively, mortality of workers. Therefore, the partitions of dichloromethane of *D. lanceolata* are potentially toxic to the leaf-cutting ants *A. sexdens rubropilosa*, requiring new isolation studies in the search for compounds or mixtures of compounds with insecticidal properties. (CNPq, FAPESP)

TOXICITY OF PLANT EXTRACTS AGAINST *Atta sexdens* (HYMENOPTERA: FORMICIDAE)

S.H.P. SILVEIRA[1], J.C. SANTOS[2], W.L.P. SILVA[3], R. ZANETTI[4] & D.F. OLIVEIRA[5]

[1]Laboratório de Entomologia, Universidade Federal de Lavras, Campus Universitário, Caixa Postal 3037 - CEP 37200-000, Lavras, MG, Brasil, e-mail: fanipradoss@gmail.com. [2]Programa de pós- graduação em Entomologia, Universidade Federal de Lavras.[3] Programa de pós-graduação em Entomologia, Universidade Federal de Lavras. [4]Programa de pós-graduação em Entomologia, Universidade Federal de Lavras. [5]Programa de pós-graduação em Química, Universidade Federal de Lavras.

Atta and *Acromyrmex* are generalist herbivores and important pest throughout the Neotropical region. The most widely used insecticide in your control is the sulfluramid. However, it is subject to restriction of use because its toxicity. It is therefore necessary to develop new products to control these ants. The objective of this study was to evaluate the toxicity of plant extracts for use in toxic baits against *Atta sexdens*, under laboratory conditions. The experiments consisted of extracts of *Croton floribundus, C. urucurana, Erythrina falcata, Eugenia handroana, Gymnanthes concolor, Myrsine ferruginea, Siparuna guyanenses, Trichilia catigua* and *Zanthoxylum pohlianum* and two controls, one without and one with sulfluramid (0.3%). For each treatment, we used six Petri dishes with 20 ants each. We evaluated three concentrations of plant extracts: 200, 400 and 600 mg per gram of dried citrus pulp. We added 2g of formulation of citrus pulp, saccharose and plant extract. These formulations were removed after 24 hours and were offered artificial diet. The mortality of ants was assessed in 1th, 2th, 3th, 5th, 7th, 9th, 11th, 13th, 15th, 17th, 19th and 21th days after application. The data were analyzed for mortality survival using the Weibull distribution. The plant extracts of leaves of *M. ferruginea* and *S. guyanenses* not showed activity. Mortality was less than or equal to the control without active ingredient. Extract plant of *C. floribundus* (bark and leaf), *C. urucurana* (leaf), *E. handroana* (leaf), *E. falcata* (leaf), *G. concolor* (leaf), *T. catigua* (bark) and *Z. pohlianum* (leaf) had activity against ants via ingestion. (CNPq, FAPEMIG)

TRACE METALS IN ANTS FOR ENVIRONMENTAL IMPACT ASSESSMENT CAUSED BY EXTRACTION OF NICKEL IN SOUTHERN BAHIA, BRAZIL

A.L.B. SOUZA[1], E.C. MÉNDEZ[2] & M.A. SOUZA[3]

[1]Laboratório de Biologia, Departamento de Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia (UESB), Av. José Moreira Sobrinho, S/N, CEP 45206-190 – Jequié, BA, Brasil. e-mail: anabiggi@bol.com.br. [2]Graduação em Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia, período sanduíche na University of Glasgow, Glasgow, Scotland, United Kingdom. [3]Graduação em Ciências Biológicas, Universidade Estadual do Sudoeste da Bahia, Jequié, BA, Brasil.

Among the bioindicator organisms adequate for environmental impact studies, the ants are effective to predict changes. There are four reasons for choosing ants as bioindicators: (1) they are functionally important at all trophic levels; (2) they are abundant and diverse in habitats where they occur; (3) they are easy to collect and process; (4) they are extremely sensitive to environmental changes, and respond quickly to perturbations in the environment. In this study, we analyzed the incorporation of trace metals in populations of the genera *Atta* and *Odontomachus* near a nickel miner and performed a sampling of the ant community of the mined area. At the environs of the mining, other two regions with morphoclimatic equivalent aspects, were included in all analyzes, in order to have controls of the experimental area. The analysis of trace metals was performed using a flame atomic absorbtion spectroscopy (FAAS) in the Laboratory of Analytical Chemistry of UESB, while the ecological analyzes were performed in the Laboratory of Biology of that institution. The difference between the means of mined and control areas was analyzed by Student's t test using the statistical program BioEstat 5.0. Even with the short time elapsed, of the five metals analyzed, only the iron ($t = 0.1189$) had significantly higher concentrations in control areas ($p < 0.05$), while the concentrations of nickel ($t = 1.6222$), copper ($t = 1.6457$), manganese ($t = 0.2308$) and zinc ($t = 2.1016$) showed significantly higher concentrations in the mined areas ($p < 0.05$). More samples are still needed for a concise result, despite prior evidence of pollution recorded. (PETROBRÁS,UESB).

URBAN ANTS ASSOCIATED TO HEALTH FACILITIES IN IPAMERI, GO

D.A. da SILVA[1], C.A. RODRIGUES[1,2,] , A.M. SILVA[1] & M.S. ARAÚJO[1]

[1]Universidade Estadual de Goiás (UEG), UnU Ipameri, GO 330, Ipameri, GO, Brasil, CEP: 75780-000, e-mail: denise_florestal@hotmail.com. [2]Universidade Estadual Paulista (FCAV/UNESP), Jaboticabal, SP, Brasil, CEP: 14884-900P.

Family Health Strategy (FHS) is the name given nowadays to one of the most successful Brazilian initiatives in health in recent decades. Ipameri, GO county, currently has six FHS's units and, in these, there are major concerns with different damages caused by synanthropic pests, among them, the ants which can act as carriers of pathogen agents. The structure of ant communities from a given habitat may be influenced by biotic and abiotic factors, making it necessary to investigate which factors within an ecosystem regulate the presence or absence of determined ants' species in the local communities. Thus, the aim of this study was to identify the urban ant species occurring in Ipameri, GO FHS's and through faunistic indexes, investigate the seasonality of ant communities in these environments. The survey of the ant fauna was conducted in six FHS's units. The frequency of sampling of ant communities was monthly. The traps with baits based of honey, biscuits and pineapple cake were arranged in different FHS's environments (reception, kitchen, medical, nursing, medicine and laundry area with access to the backyard). The faunal indexes used for comparison of ant communities in different FHS's were the Relative Frequency and the Constancy. Due to this index, the species were distributed in: constants; accessory and accidental. Along 12 consecutive months of collections, at the FHS's, it was collected a total of 2080 ants belonging to seven genus and 12 species distributed in four subfamilies (Myrmicinae: *Pheidole*, *Solenopsis* and *Crematogaster*; Formicinae: *Camponotus* and *Paratrechina*; *Dolichoderinae*: *Tapinoma melanocephalum* and *Linepithema humile*; Pseudomymecinae: *Pseudomyrmex*). Stood out from the others, the *T. melanocephala* species, which was considered constant in all the FHS's investigated and in density terms of individuals captured, with the total of 2080 ants captured, 1630 were of that species. The others, taken along the study in different FHS's were considered accidental, with emphasis on *Paratrechina* sp.1, which had been present in all the FHS's. Significant difference in the affluence of the ant communities in the ESF 2 and 4 that stood out from the others (ANOVA, $p < 0.05$), both with nine species. Future works will be developed to investigate the role of the main identified ants (*T. melanocephalum* and *Paratrechina* sp.1) as possible carriers of pathogenic microorganisms in these non-hospital environments.