

Agustín Camacho Guerrero

“Em busca da compreensão das relações  
dos lagartos com seus habitats e micro-habitats:  
um gradiente na Mata Atlântica”

Universidade Federal da Bahia



Salvador  
2006

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Agustín Camacho

“Em busca da compreensão das relações dos  
lagartos com seus hábitats e micro-hábitats:  
um gradiente na Mata Atlântica”

Dissertação apresentada ao Instituto  
de Biologia da Universidade Federal  
da Bahia, para a obtenção de Título  
de Mestre em Ecologia e  
Biomonitoramento.

Orientador: Pedro L. B. da Rocha

Salvador

2006

## Ficha Catalográfica

---

Biblioteca Central Reitor Macêdo Costa - UFBA

C172 Camacho, Agustín.  
"Em busca da compreensão das relações dos lagartos com seus habitats e micro-  
habitats : um gradiente na Mata Atlântica" / Agustín Camacho. - 2007.  
77 f. : il.

Inclui anexos.  
Orientador : Pedro L. B. da Rocha.  
Dissertação (mestrado) - Universidade Federal da Bahia, Instituto de Biologia, 2007.

1. Lagarto - Habitat. 2. Mata Atlântica. 3. Comunidades animais. 4. Ecologia.  
I. Rocha, Pedro L. B. da. II. Universidade Federal da Bahia. Instituto de Biologia.  
III. Título.

CDU - 598.112

### Comissão Julgadora

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---

Dedicado a mis padres.

Ellos me permitieron soñar y me dieron  
la fuerza y el apoyo para hacer del sueño  
una realidad.

---

“Duas características notáveis de trabalhos recentemente publicados são o interesse generalizado em trabalhos de campo quantitativos no estudo da densidade das populações, as taxas de dispersão, flutuação, reprodução, alimentação ou mortalidade, assim como uma consciência crescente sobre problemas de dinâmica evolutiva tais como seleção e competição. Ao mesmo tempo existe uma adoção geral e um ajuste dos tratamentos estatísticos dos dados ecológicos, os quais a pesar de serem inteiramente efetivos e necessários, seriam ruins, em parte, se estes excluíssem o igualmente valioso tipo de observações sobre os padrões da natureza, os habitats e as distribuições dos animais, com o qual os ecólogos e naturalistas podem contribuir.” (Elton 1947)

Tomado de Robert. M. May . 1984. An overview, real and apparent patterns in community structure. Em: **Ecological Communities: conceptual issues and evidences**. Traduzido por Agustín Camacho.

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## Agradecimentos

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Te agradeço com todo meu coração, Lina, por ser uma companheira tão maravilhosa em todos os aspectos da minha vida brasileira, também a tua família: Idalina, Edilton, Patrícia, Elisabete e Júnior, por serem a minha durante todo este tempo. Obrigado Peu, por ser meu orientador e amigo, e imprimir uma marca de qualidade, compromisso e profissionalismo onde você estiver. Obrigado aos LVTetes, por serem uma comunidade de pequenos e grandes cientistas ideal, onde reina a camaradagem e a vontade de melhorar. Charbel e Peu, obrigado de novo aos dois por serem “acusados” de perpetrar isto. Quero agradecer a todos aqueles que me ajudaram e acompanharam durante a extenuante aventura de coletar “no mato”: Alberto Moreira, Eduardo Moreira, Eduardo Fattori, Jorge Nei Freitas, os “mateiros” Biu, Zé e Cláudio e a entranhável família de Anísio, Fátima e seus filhos. Agradeço muito especialmente a Milena Camardelli, Wilton Fahning e André Mendonça, Patrícia Fonseca e Rafael Abreu. Eles foram incansáveis, prestativos e pessoas excepcionais. Obrigado a todos meus colegas, no mestrado e nos cursos fora dele, assim como as pessoas que compartilharam moradia e vivências comigo, em especial Enéas, Hêmyle e Dani. Obrigado por serem professores involuntários do meu aprendizado nesta fase tão desconcertante. Singularmente, quero agradecer ao Dr. Marcelo Nápoli, Juliana e Camila, pois sem eles nunca teria tido a oportunidade de dedicar meu mestrado à grande paixão que tenho pelos répteis e às florestas tropicais. Obrigado ao LAP, por ter sido minha ponte ao mundo da megadiversidade. *Gracias Giancarlo, y a todos los “Ulloa” (Mario, Beatriz, Ellen), por haberme tratado con tanto cariño. Nunca os olvido!*

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## **Introdução Geral.**

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Lembro da fascinação que me produziu minha primeira visita à coleção científica de répteis da Universidade Federal da Bahia. Os relativamente poucos espécimes que albergava já superavam, amplamente, a riqueza de espécies do meu país natal. Ao tempo que as respostas das pessoas que me guiavam: “Está por estudar... não se sabe... não tem nada escrito sobre isso...” se deslizavam, suavemente, pelos meus ouvidos. Seus formatos, tão variados, me prometiam, desde atrás dos vidros, um universo integrado ao nosso, ainda por descobrir.

Tesouros de diversidade em perigo (Myers et al., 2000; Brummit e Lughadha, 2003) e o desconhecimento de aspectos básicos das espécies (declarado, no caso dos lagartos brasileiros, por Rodrigues (2005)) podem ter o som de uma ária nos ouvidos de um licenciado europeu, com alma de naturalista de séculos anteriores. Entretanto, estes problemas constituem uma parte significativa das batalhas que enfrenta a Ecologia atual.

A falta de dados sobre a história natural das espécies se combina com a variedade de respostas destas diante dos mesmos fatores (Conroy, 1999) e a falta de relações lineares entre elas (McCune e Grace, 2002), dificultando a aplicação de técnicas estatísticas básicas, como regressão linear. Como se isto fosse pouco, as características das comunidades parecem reguladas por múltiplos fatores, fazendo-as variar no tempo e no espaço (Adler e Laurenroth, 2003), dependendo do lugar (Underwood, 1996), da escala (Maurer, 1999) e da filogenia (Vitt e Pianka 2005).

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Os problemas metodológicos tampouco são pequenos: os zeros nas amostragens (McCune e Grace, 2002), a falta de independência nos dados e as intrusões nas unidades experimentais (Hurberlt 1984), unidos à dificuldade de conseguir amostras aleatoriamente distribuídas e representativas (Michener, 1997), escondem o mundo natural das redes de pescar padrões dos ecólogos e os têm impedido, historicamente, de chegar a um consenso sobre como abordar problemas vitais para a conservação da natureza tais como a validade dos estudos de caso, defendida por Shrader - Freschette e Macoy (1994); e a decisão sobre o tamanho das áreas protegidas (debate relatado por Bergandi, 1992).

Ao mesmo tempo, a diversidade biológica vem sendo drasticamente reduzida. A Mata Atlântica, por exemplo, se encontra hoje representada por minúsculos fragmentos da sua área original (SOS Mata Atlântica, 2002), erodidos pelo constante embate de um mar de milhões de pessoas, que aumenta dia após dia, dissolvendo, inexoravelmente, os últimos testemunhos do que uma vez foi este ecossistema. A situação demanda, mais do que nunca, resgatar conhecimento dos remanescentes que ainda existem para guiar ações de planificação do uso, conservação do que ainda existe e na futura restauração das regiões já deterioradas. O problema para um mestrando em ecologia é definir por onde e como começar. Os esforços atuais de conservação da Mata Atlântica estão altamente relacionados com a distribuição da vegetação natural, através do monitoramento dos remanescentes florestais (SOS Mata Atlântica, 2002), da criação de corredores ecológicos (MMA, Conservation international, SOS Mata Atlântica, 2006) e da determinação da

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distribuição das espécies (Probio, 2006). A interação entre a cobertura vegetal, a topografia e o clima é freqüentemente encontrada na natureza, formando visíveis gradientes espaciais de co-variação: variação da vegetação com a altitude, variação da vegetação em direção ao mar, variação da vegetação unida a perturbação humana, etc. Estudando estes gradientes podemos não só gerar dados sobre abundância relativa e distribuição das espécies, mas ainda obter pistas sobre os fatores que mudam a composição das assembléias biológicas.

Nosso estudo encontra-se localizado no gradiente de vegetação e solos existente no litoral nordestino que vai desde os baixos tabuleiros cobertos por florestas (Ab'saber, 1977) da plataforma Barreiras, até as Restingas costeiras, com suaves dunas brancas, salpicadas de arbustos, bromélias e orquídeas (Lacerda e Araújo, 1984), onde o dendezeiro (*Elaeis guineensis*) e seu pequeno parente, o licuri (*Siagrus coronata*), identifica as matas que, quando próximas à costa, rodeiam as áreas alagadas dando refúgio a gigantescas bromélias (*Aechmmea multiflora*). O litoral norte da Bahia foi considerado como desconhecido, mas com provável importância para a biodiversidade no relatório sobre prioridades para conservação da Mata Atlântica, realizado por Conservation International do Brasil et al. (2000).

Estudos observacionais destas regiões de co-variação podem parecer sem sentido para os reducionistas mais radicais, na procura de leis em ecologia, pois não resulta possível diferenciar um único agente causal.

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Isto não resultaria um problema tão grave, uma vez aceito que as leis em biologia têm domínios restritos de aplicação (como sugerido por Weber, 1999) e que os resultados dos processos biológicos podem variar em função do lugar, da escala e do tempo (Levins e Lewontin 1980; Maurer, 1999, Wu e David 2002; Adler e Laurenroth 2003). Deste modo, uma forma promissora para tentar entender a natureza, com objetivo de gerar conhecimento útil à sua conservação, pode ser buscar significativas extensões de terra, do ponto de vista ecológico e de manejo, onde os principais fatores de variação estejam em relativo acordo, e estudar sua relação com as assembléias em áreas ainda preservadas. Os padrões levantados derivados destes gradientes poderiam então ser considerados leis biológicas de distribuição das espécies, e as regiões arranjadas seguindo estes gradientes seriam seus domínios de aplicação. Princípios mais gerais sobre as comunidades biológicas, concordando com Levins e Lewontin (1980), podem ser extraídos depois, a partir dos resultados encontrados em diferentes situações.

Uma vez justificado o lugar de estudo, explicarei minha forma de interpretar o padrão detectado nos dados. Diferentes cientistas podem obter diferentes interpretações das mesmas observações em função do seu contexto teórico (Platt 1964). Por isto, parece importante apresentar minha forma de entender os padrões encontrados, a fim de que outros possam julgar melhor o conteúdo desta dissertação. Esta parte não consta no manuscrito porque diz a respeito da minha concepção pessoal do sistema biológico que estudei e que me levou a encarar este trabalho do

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modo que o fiz. O que farei em seguida será justificar, do melhor modo possível, esta concepção.

O modelo triádico básico desenvolvido por (Salthe 1985, *apud* El-Hani e Queiroz 2006) propõe uma forma de interpretar as relações existentes entre sistemas hierárquicos: os padrões observados em um determinado nível focal seriam provocados pela seleção, decorrente de processos ocorridos em um nível superior, exercida sobre as potencialidades derivadas de processos ocorridos em um nível inferior ao focal. Wu e David (2002) justificam e explicam a aplicação de teoria hierárquica na modelagem de sistemas ecológicos.

Assumindo o modelo triádico básico como adequado para interpretar padrões na natureza e visto que a conservação dos ecossistemas terrestres passa pela gestão da vegetação natural, e que esta reflete características do ecossistema (clima, posição geográfica, topografia) e do impacto antrópico (desmatamento), um nível focal adequado para avançar no entendimento dos fatores que afetam a conservação das assembléias seriam as próprias características das assembléias (composição, abundância, biomassa), neste caso, o grupo de estudo deveria ser fortemente controlado por processos ocorrentes no nível superior (ecossistema), relacionados com características do ecossistema de interesse para a conservação (i.e. gradientes na estrutura da vegetação). A estrutura da vegetação influi diretamente na quantidade de irradiação que chega embaixo dela, de modo que um grupo de animais ectotérmicos, como os lagartos, poderia ser um bom candidato ao nível focal.

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Supostamente, o grupo deveria ser relativamente bem definido filogeneticamente, para tentar homogeneizar suas potencialidades procedentes do nível inferior. Por exemplo, dado que a fisiologia de um organismo está determinada em grande medida pela sua genética, se necessito recorrer a características fisiológicas para entender como um grupo animal está distribuído pelo ambiente, será mais fácil com um grupo de características fisiológicas semelhantes, como os lagartos, do que com um grupo mais variado, como herpetofauna em geral.

Para poder interpretar a relação existente entre os processos ocorrentes no nível superior (representado pela variação da vegetação) e o nível focal (características da assembléia de lagartos), o grupo de estudo precisaria de uma razoável quantidade de informação sobre processos ocorrentes em um nível inferior de organização (sua ecofisiologia, características comportamentais herdadas) para começar a entender a natureza deste controle. Esta informação encontra-se disponível para boa parte das espécies em nossa área de estudo (Magnusson et al., 1985; Vitt, 1991; Vitt e Coli, 1994; Rocha et al., 2000; Vitt et al., 2003) assim como informação sobre seu uso de hábitat e micro-hábitat (Rand e Humphrey, 1968; Vanzolini 1972, Duellmann, 1990; Vitt, 1995; Vitt e Zani, 1998; Teixeira, 2001; Mesquita et al., 2006).

Os lagartos parecem cumprir a condição de seleção de potencialidades derivadas de processos no nível inferior por processos ocorrentes no nível superior relacionados com a vegetação. Pode-se exemplificar isto usando o trabalho de Conroy (1999), quem estudou a distribuição de uma

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assembléia de lagartos em um ecótono de vegetação entre uma floresta esclerófila, mais aberta com uma floresta chuvosa, na Austrália. Seu trabalho mostra como algumas das espécies habitam em ambos os lados do ecótono enquanto que outras habitam em um único lado. Neste caso, o ecótono (indicador de processos ocorrentes no nível superior, tais como mudanças nas características físicas e nos tipos de micro-habitats disponíveis) estaria, supostamente, determinando, nesta maneira seletora, o padrão de distribuição dos lagartos (o nível focal) em função de potencialidades expressadas nos lagartos (i.e. capacidade de agüentar um alto ou baixo nível de irradiação, necessidade de usar determinados micro-habitats), decorrentes de processos que ocorrem em

um nível inferior (sua fisiologia, características comportamentais herdadas).

Além de tudo isso, o tamanho e comportamento destes animais os colocam ao alcance da amostragem de um biólogo com poucos recursos de financiamento, pois podem ser coletados com técnicas relativamente baratas, como armadilhas de queda ou coleta ativa (Doan 2003; Ribeiro 2006) e em número suficiente para obter alguma confiança estatística sobre os padrões encontrados.

A abundância dos lagartos tem sido várias vezes relacionada com diversas características da estrutura e da distribuição espacial da vegetação (Rocha 1997; Glor et al., 2001; Germaine e Wakeling; 2001; habitat sobre a composição dos lagartos, entendida esta como uma

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característica importante da assembléia (Conroy, 1999; Nogueira et al., 2005).

Ao tempo que em outros grupos, como as plantas (Tilman 1999) e os invertebrados aquáticos (Dangles e Malmqvist 2003), têm sido evidenciado o efeito da identidade das espécies sobre as características das assembléias (o que ressalta importância da composição nas características das assembléias), os controladores da abundância e

biomassa propostos em estudos herpetológicos têm sido, sem que haja um consenso: complexidade do tipo de hábitat e abundância de recursos alimentares (Garcia e Whalen, 2003); riqueza de espécies combinada com

altitude, com resultados contraditórios provenientes de herpetofauna de folhiço (Scott, 1976; Fauth, Croth e Slowinsky, 1989; Brown e Alcalá, 1991) e riqueza combinada com área da ilha para herpetofauna em geral (Rodda e Dean-Bradley, 2002).

Os escassos trabalhos relacionando a disponibilidade de micro-hábitats e a abundância dos lagartos apresentam diferentes resultados em função da espécie estudada (Heatwole e Sexton, 1966), se referem a um único micro-hábitat (Whitfield e Pierce, 2005) ou analisaram conjuntamente comunidades herpetológicas de folhiço (Heinen, 1992; Vonesh, 2001), sem fazer uma análise separada para os lagartos. Desta forma, se desconhece se existe um efeito geral, e preditivo, da disponibilidade de micro-hábitats sobre a abundância dos lagartos no nível de assembléia.

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Com propósito de avançar no entendimento das relações entre as características do hábitat e as características das assembléias de lagartos, nós testamos a hipótese de que a principal variação no hábitat (representada pela estrutura da vegetação) influencia na composição, densidade e biomassa de lagartos no nível de assembléia.

Para avaliar se a disponibilidade de micro-hábitats tem capacidade preditiva sobre a abundância dos lagartos ao nível de assembléia, correlacionamos a disponibilidade de diferentes micro-hábitats com as abundâncias das espécies de lagartos mais associados com estes.

**Manuscrito.**

**Revista “*Journal of herpetology*”**

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1 LRH: A. G. Camacho and P. L. B. da Rocha

2

3 RRH: Understanding the relationship of lizards with their habitats and microhabitats:

4 a gradient in the Atlantic Rainforest.

5

6 Understanding the relationship of lizards with their habitats and microhabitats: a

7 gradient in the Atlantic Rainforest.

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9

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1 Abstract

2 Despite their positive contributions for conservation, few studies in the Neotropics  
3 focused on the relationship between habitat, microhabitats and lizard taxocenoses  
4 characteristics, like composition, abundance or biomass. We analyzed how lizard  
5 taxocenose composition, abundance and biomass change with habitats organized  
6 along a spatial gradient of vegetation structure. We also evaluated if the abundances  
7 of lizard species and the availability of their most related microhabitat variables are  
8 correlated. Results showed significant relationships between the habitat gradient and  
9 taxocenose composition and abundance, which could be explained by the physiology  
10 of lizard species, and functional traits of some species strongly associated to biomass  
11 values. For most species, no significant linear association was found between species  
12 abundance in plots and availability of their most associated microhabitats. We suggest  
13 that: a) vegetation structure affects composition of lizards through interaction with  
14 physiological requirements of lizards species; b) Density and biomass at the level of  
15 assemblage are regulated by the functional traits of the species that share a plot; c)  
16 Microhabitats can be necessary for the establishment of a species at the scale of a plot  
17 but are weakly or non related with lizard abundance at the assemblage level.

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1 Introduction

2 In the Neotropics, most studies on lizard assemblages have focused on the recognition  
3 of resource use patterns (Ortega, Maury & Barbault 1982; Duellmann, 1990; Vitt,  
4 1995; Vitt and Zani, 1998; Teixeira, 2001; Rocha and Rodrigues, 2005; Mesquita et  
5 al., 2006), on the ecophysiological characteristics of their component species  
6 (Magnusson et al., 1985; Vitt, 1991; Vitt and Coli, 1994; Rocha et al., 2000; Colli et  
7 al., 2003; Mesquita and Colli, 2003; Vitt et al., 2003a; 2003b; Van Sluys et al., 2004;  
8 Vitt and Pianka, 2005), and on the analysis of zoogeographical patterns (Vanzolini,  
9 1974; 1976; Freire, 1996, Rodrigues, 1996; Borges-Nojosa and Camaraschi, 2005). In  
10 these studies, results were based on the information carried by the individuals: diet,  
11 habitat and microhabitat use, temperature, geographical position. Despite these works  
12 may suggest that there is a relationship between lizard populations and the distribution  
13 of habitats or the availability of their microhabitats, measures of habitat structure and  
14 microhabitats availability are needed in order to provide direct evidence of these  
15 relationships and to advance in their understanding.

16 According to Underwood et al. (2000), identifying patterns of variation in abundance  
17 of species through the landscapes is the first step for understanding the processes  
18 which generate them, and this should be done by the means of hypothesis test in order  
19 to avoid theory leadeness and methodological biases in their results. Moreover, this  
20 stage of the ecological research process provides the fundamental data on which rely  
21 the definition of the conservation status of species (Rodriguez et al., 2000), decision  
22 making in adequate landscape management (Primack and Rodrigues, 2001), and  
23 definition of regional ideal situations of conservation as goals for restoration projects  
24 (White and Walker, 1997). As the Neotropics hold the dubious honour of hosting the  
25 most endangered hot spots of terrestrial biodiversity, including the Atlantic

1 Rainforest, one of the five most endangered (Myers et al., 2000; Brummit and  
2 Lughadha, 2003), there is a dramatic call for all the actions listed before and the  
3 knowledge to support them.

4 What do we know about the effects of habitat change on the characteristics of lizard  
5 assemblages? Studies from Conroy (1999), Lima, Suarez and Higuchi (2001), and  
6 Germaine and Wakeling (2001) show us that different species can respond differently  
7 to the same changes and that each of them can be associated with different aspects of  
8 habitat change. Data coming from other studies on herpetological assemblages  
9 (Rocha, 1997; Hofer, Bersier and Borcard, 2000; Vega, Bellagamba and Fitzgerald,  
10 2000; Garcia and Whalen, 2003; Nogueira, Valdujo and França, 2005) show that, due  
11 to the commonness of high dominance inside lizard assemblages, the response of  
12 lizard assemblages in terms of total abundance and biomass to habitat change could be  
13 merely reflecting changes in the most frequent species. These facts point out the  
14 necessity of studying the effects of habitat change also in terms of changes in species  
15 composition.

16 Herpetological studies have proposed different candidates for the control of  
17 abundance and biomass at the assemblage's level: food availability for lizards  
18 (Garcia and Whalen, 2003); species richness associated to altitude and habitat change  
19 (Brown and Alcalá, 1961; Scott, 1976, Fauth, Crother and Slowinsky, 1989; Rodda  
20 and Dean-Bradley, 2002), and presence of gaps inside forests (Greenberg, 2000).

21 However, except for Fauth, Crother and Slowinsky, (1989) and Greenberg (2000),  
22 each of these works suffer from non standardized sampling, presenting contradictory  
23 results among them. Moreover, the role of functional traits (like density or body size)  
24 of component species on assemblage abundance and biomass was usually not taken  
25 into account. For other taxonomical groups, like plants and invertebrates, assemblage



1 productivity (a measure of biomass) was shown to be influenced by some species  
2 typically bigger and size and/or greater in density, which are more efficient than  
3 others in biomass conversion (Tilman, 1997; Dangles and Malmqvist, 2003).  
4 Studies about the relationship of lizard populations and their microhabitats presented  
5 different results depending on the species evaluated (Heatwole and Sexton, 1966;  
6 Whitfield and Pierce, 2005). Works on whole herpetofaunal communities found  
7 positive relationships between them and different microhabitat variables, however,  
8 they sampled a reduced fraction of the local set of lizard species and lizard response  
9 was analyzed together with snakes and amphibians, allowing those groups to affect  
10 the results (Heinen (1992) and Vonesh (2001)). In this way, the overall effects of  
11 microhabitats availability on the abundance of lizards at the assemblage level remain  
12 unknown.

13 To advance in the understanding about the relationships between habitat variation  
14 (measured as vegetation structure) and the main characteristics of lizard assemblages,  
15 we tested the hypotheses that the main variation in habitat (measured as structure of  
16 vegetation and tree cover) significantly influences composition, density and biomass  
17 of lizards, along a vegetation gradient situated in the Atlantic Rainforest.

18 To evaluate the hypothesis that the abundances of lizards are associated with  
19 microhabitat availability, we assessed the generality of the existence of correlations  
20 between lizard abundances and the availability of the microhabitats to which each  
21 lizard species is usually associated.

## 22 Methods

### 23 Study area

24 We developed this study in the northern coast of Bahia, northeastern Brazil. Natural  
25 areas in the west side of this region are dominated by an undulated geomorphology

1 usually referred to as “Tabuleiros” (Ab’Saber, 1977) which are covered by forests.  
2 Towards the coast, the forests merge with a forested to shrubby physiognomy, the  
3 “Restinga”. Near the seashore, the “Restinga” is usually associated with low and  
4 white sand dunes, forming patches of shrubs with terrestrial bromeliads  
5 (*Hohemberguia littoralis*). Taller vegetation in the Restinga is usually associated with  
6 marsh areas and rivers, forming marginal lines or islands where tall “dendê” palms  
7 (*Elaeis guineensis*) and giant bromeliads (*Aechmea multiflora*) are frequent and the  
8 ground is covered with leaf litter. In this region, mean annual temperature vary  
9 between 21-26°C, never descending bellow 18°C. Annual pluviometry reaches 2000  
10 mm, or more, and rains are more concentrated from March to July (INMET, 2006).  
11 Three sites, inside two private properties, were sampled during this study:  
12 One sampling site was in “The “Fazenda Camurujipe” (12°30’5’’S, 38°2’19’’W). This  
13 is a private farm with a 1.390 ha umbrophyllous rainforest remnant situated in the  
14 “Tabuleiros” part of the gradient. It was only partially cleared in the past, and  
15 remained untouched for the last 35 years, as related by the biologist responsible for  
16 the lands management.  
17 Fazenda “Praia do forte” is a private land that includes a forested reserve (Sapiranga’s  
18 reserve, 12°34’6.96’’S, 38°2’17.23’’W) and a well preserved Restinga. We located the  
19 second site at this reserve, which is in an intermediate situation between the  
20 “Tabuleiros” and the “Restinga”(see figure 1). According to local inhabitants, its 567  
21 ha were used for traditional subsistence agriculture till 29 years ago, when it was  
22 transformed in a reserve by its owners.  
23 We placed our third sampling site inside the 340 ha well preserved Restinga  
24 (12°34’12.10’’S, 38°0’2.66’’W), which has not been, until now, deforested.  
25 Lizards capture

1 We used time-constrained plots (Heyer, 1995) bigger (60 x 25 m) than those  
2 previously used in herpetological surveys (Brown and Alcala, 1961; Fauth, Croth and  
3 Slowinsky, 1989; Heinen, 1992; Schlapfer and Gavin, 2001; Vonesh, 2001; Whitfield  
4 and Pierce, 2005) as this improve precision in estimates of abundance (Andrew &  
5 Mapstone, 1987), and we suppose that it could avoid the problem of the small number  
6 of captures yielded in plots sampling (Crump and Scott *pers. obs.*, 1994 *apud* Doan,  
7 2003). We used two complementary collecting techniques (pitfall traps with drift  
8 fences and time and area constrained visual encounter). We sampled during the day  
9 and at nights, to collect nocturnal species and polychrotids, which are difficult to find  
10 during the day (Vitt et al., 1996). Difficulties with transportation inside the study  
11 areas prevented random allocation of plots. However, we distributed plots as  
12 separated as vegetation and time permitted (80 meters at least) and established them  
13 near and far from water courses and reserve edges, in order to control possible effects  
14 derived from those characteristics (figure 1).

15 From October 2004 to February 2006, along six one-week sampling trips (October  
16 2004, February 2005, April 2005, August 2005, January 2006 and February 2006), we  
17 collected and characterized 20 plots inside each of the three sites (except for Praia do  
18 Forte area, where a plot could not be established). Active sampling sessions lasted 30  
19 min during the day and 40 min at night, and were performed three times per plot  
20 during each trip. At each plot, captures and sightings were done by two biologists and  
21 ten 40 l pitfall traps, enhanced with 3-5m long plastic fences. Closed pitfall traps were  
22 haphazardly disseminated inside plots five days before start sampling and were  
23 opened during the entire trip. Different collector combinations were used (but always  
24 one experimented and one not experimented) and sampling hours were interspersed  
25 among plots, avoiding collector's skill (Scharff et al., 2003) and time of day bias.

1 Total effort summed 413 person\*hours of active sampling and 4130 pitfall\*days spent  
2 along 88,500 m<sup>2</sup> of sample units.

3 We carried captured animals in plastic bags inside ice containers to the base camp,  
4 killed them with sodium pentobarbitol, and fixed them in 10% formalin for testimony  
5 and further studies on diet and reproduction. After 48h, we immersed them in ethanol  
6 70%. We estimated lizard biomass per plot weighting the animals already preserved in  
7 alcohol with a semi-analytic scale (precision 0.01g). We gave sighted animals the  
8 medium weight calculated for the species with our own biomass measures or, in the  
9 case of large *Ameiva ameiva* and *Tupinambis merianae*, using literature data (Klein,  
10 1998). To ensure that individuals were not counted twice, we only included sightings  
11 in the analyses when no further capture on the species sighted was done in the same  
12 plot and when this was easily recognizable.

13 Environmental variables

14 Inside each plot, we characterized the habitat by measuring density of leaves in four  
15 strata and tree cover. We also measured the availability of different microhabitat  
16 descriptors, which were chosen following previous observations on lizards inside the  
17 study area and literature records (Vanzolini, 1953; Rand and Humphrey, 1968;  
18 Jackson, 1978; Peters and Orejas-Miranda, 1986; Vitt, 1995; Rodrigues, 1996;  
19 Rodrigues et al., 2002a; 2002b; 2005; Dias and Rocha, 2004). Numerical and  
20 methodological characteristics of habitat and microhabitat descriptors are summarized  
21 in Table 1.

22 We estimated vegetation structure of each plot, measuring visually the proportion of  
23 volume occupied by leaves in ten randomly located imaginary vertical cylinders of 1,5  
24 m diameter centered in the observer. We assigned a value of density for each level of  
25 vegetation, previously identified for Atlantic Rainforests by Steinmetz and Martinez

1 (2004): from ground level to 5m high, from 5 to 10 m high, from 10 to 15 m high and  
2 more than 15 m. No tree taller than 25m was observed.

3 We estimated tree cover taking digital 1 Mp photographs of the canopy at each plot,  
4 using a 70 cm high tripod and a Sony Cybershot 4.1 digital camera. Then, we  
5 transformed each photograph into two tone black and white using the program Photo  
6 Paint 7®, adjusting visually the tonal “threshold” of each colored photograph for the  
7 best representation of vegetation shape with black pixels. We calculated the  
8 percentage of pixels representing vegetation. Black and white photographs were saved  
9 in TARGA format, and then we used an “ad hoc” developed program, “area”, for  
10 calculating the total number of black pixels in each photograph.

11 We estimated low vegetation density using the point-quarter method (Krebs, 1998)  
12 measuring distance to the nearest plant’s part (leaves, branches, trunks) in each of the  
13 quadrants at, approximately, 1.5m high. We measured leaf litter cover by visually  
14 estimating percentage of leaf litter cover in circles of 1,5m diameter.

15 We counted all the individuals of bromeliad found in sampling plots, individuals of  
16 *Aechmea multiflora*, are referred as “giant bromeliads” as they where extremely big,  
17 and *Aechmea blanchetiana* (Baker) L.B.S.m, and *Hohemberguia cf. stellata*  
18 (Schult.F) just as “bromeliads” hereinafter. We also counted all the dead trunks with  
19 more than 10 cm in diameter within each plot, and measured the area of rock surfaces  
20 assuming a rectangular shape and measuring its longest perpendicular lines. We  
21 categorized rocks as exposed, if they were touched by sun rays during the sampling  
22 sessions, or shaded, if they where not. We also recorded presence of water bodies in  
23 the plot.

24 Analysis

25 Effect of habitat change on lizard composition, abundance and biomass

1 We represented the main directions in variation of habitat descriptors of all the plots  
2 performing a Principal Component Analysis (PCA), based on correlation matrix, and  
3 using varimax rotation. To represent the variation in species composition in only one  
4 axis, we used Non Metric Multidimensional Scaling (NMS) (PC-ORD® McCune and  
5 Grace, 2002), as it performs better with distributional problems frequent in  
6 populational data (McCune and Grace, 2002). We relativized original abundances  
7 matrix by rows, and used Bray Curtis coefficient (McCune and Grace, 2002) and used  
8 a random starting point and 500 runs with real data. We applied Monte Carlo test,  
9 with 999 runs of randomized data, to calculate the probability that the loss of  
10 information due to ordination is as low as that obtained from a matrix with random  
11 distribution of abundance values. Our criterion for evaluating stability of the solution  
12 was standard deviation in stress equal or minor than 0.002, with 100 iterations to  
13 evaluate stability and 500 as maximum number of iterations. Finally, the proportion of  
14 the distances between plots existent in the original abundances matrix that was  
15 represented by the new matrix was measured using a Mantel test, for which we  
16 calculated the significance of the correlation via Monte Carlo randomization method,  
17 with 1000 randomizations.

18 Total abundance and biomass per plot and the NMS axis of variation in composition  
19 of lizard species were regressed against the PCA synthetic axes. We ranked biomass  
20 values to improve normality of residuals, as suggested by Quinn and Keough (2003).  
21 Bonferroni correction of original alpha value (0.05) for multiple tests was applied to  
22 those tests (six) prior to considering the result statistically significant.

23 Relation of microhabitat variables with lizard's abundance in plots

24 Our microhabitat analysis intended to test if the availability of specific microhabitats  
25 had a consistent relationship with the abundances of the majority of lizard species. In

1 order to do so, we detected the most characteristic microhabitats of each species based  
2 on two sets of data. The first one was created through compilation of the information  
3 on the habitat (open or forested) and characteristics of the microhabitat (type and  
4 height) where the individuals of each species were first sighted during sampling  
5 sessions. The second one was generated from data available on literature about  
6 patterns of habitat use by lizards. To obtain these data, we performed a literature  
7 survey using the ISI Web of Science database and Google Scholar search tool and  
8 different combinations of the species names and the terms “lizards”, “ecology”,  
9 “habitat”, “microhabitat”, and “gradient”. References cited in the retrieved papers,  
10 which supposedly contained useful data were also analyzed. We considered that the  
11 characteristic microhabitat of each species is the one where the species were more  
12 frequently found both in previous references and our study. We used a total of 17  
13 microhabitat categories: tree trunk, branch, dead trunk, tree base, tree roots, low  
14 branch or leave, litter, sand, liana, giant bromeliad, bromeliad, palm, rocks, houses,  
15 ground, grass, vines. We tested the association between microhabitat availability and  
16 species density in plots based on Spearman’s rank correlation tests, and on visual  
17 inspections of scatter plots. As our results showed that the habitat gradient affects the  
18 density of lizard species, Spearman tests were based only on data from the areas  
19 where the species occurred (Camurujipe, Sapiranga and/or Praia do Forte), and among  
20 them only from plots inside habitats to which the species was associated (open  
21 habitats: area covered by trees < 50%; forested habitats: area covered by trees > 50%),  
22 among them, we used only data from plots where the microhabitat variable under  
23 analysis was available. A paper was only related to one of the species’ habitat or  
24 microhabitat when the observations were clearly specified in the study under review.  
25 The microhabitat descriptor most associated with a species in question was the one

1 that best represented the category, or categories, more times observed for each  
2 species, in terms of number of papers repeating the same category in literature and  
3 also of number of observations during this work. We did not performed Bonferroni  
4 correction for the evaluation of microhabitat influence on abundance, as we were  
5 interested only in the generality of low p values ( $< 0.05$ ), not in discover which  
6 relationship was in fact significant.

## 7 Vocabulary

8 Some terms are referred to concepts that imply two meanings at the same time, like  
9 abundance. Because of that, we defined their meaning in this work to avoid  
10 misinterpretation: abundant / rare: adjectives applied to species relative to the total  
11 number of individuals sampled, common / uncommon: adjectives applied to the  
12 species relative to the number of plot where they where found. We used the terms  
13 Specific abundance or biomass to refer to the total number of individuals or biomass  
14 of one species, divided by the number of plots in which the species occurred. Those  
15 measures show how capable is a species to increase the abundance and biomass at the  
16 level of assemblage when it is present.

## 17 Results

### 18 Sampling results

19 517 lizards from 20 species grouped in 6 families were captured or sighted during  
20 fieldwork. The iguanid, *Tropidurus hygomi* was the most abundant species (157  
21 individuals), the one with the highest specific abundance (7.4 animals) and second  
22 highest specific biomass (59.5 g). It occurred in the region with lower vegetation  
23 strata in the gradient (see figure 2). The tiny, diurnal geckonid, *Coleodactylus*  
24 *meridionalis* was the most abundant species in forested habitats (111 individuals) and  
25 the most common species (incidence = 24 plots). It had the highest specific abundance



1 in the same habitat (4.6 animals) and also the one with less specific biomass (0.7 g),  
2 and occurred along almost the entire gradient. *Tupinambis merianae* was rare (7  
3 individuals) and relatively uncommon (incidence = 6 plots) but it had, by far, the  
4 highest specific biomass (996.8g) and occurred from open Restinga to high forest.  
5 The rarest species in the sample, for which we collected only one individual were:  
6 *Tropidurus strobilurus*, *Polychrus marmoratus*, and *Micrablepharus maximiliani*. We  
7 collected *Dryadosaura nordestina* (2 individuals) only in one sample. Table 5  
8 summarizes characteristics of abundance, incidence and specific density and biomass  
9 of each species sampled.

10 Ordination results

11 PCA analysis of habitat descriptors extracted two synthetic axes of variation with  
12 eigenvalues greater than 1, which explained 74.2 % of total variation in habitat  
13 descriptors. Varimax rotation improved interpretation of axes generating two  
14 qualitatively different informations. The first axis, explained 43.2 % of the total  
15 variation and represented a gradient of variation in density of vegetation at the two  
16 higher vegetation strata 10-15 m and higher than 15 m strata (loadings: 0.90 and 0.89,  
17 respectively). The second axis explained 31.0 % of variation and represented a  
18 gradient in density of vegetation at 0-5 m and 5-10 m strata and of amount of tree  
19 cover (loadings: 0.71, 0.70 and 0.89 respectively). PCA loadings on habitat  
20 descriptors are summarized in table 2. As 0-5 m strata was frequently related to *A.*  
21 *punctatus* (see table 4) in literature and our data, this variable was also used as  
22 microhabitat descriptor. The ordination axis of composition of lizards generated by  
23 NMS showed a high stress (32.0), but as this index is cumulative, a higher stress is  
24 expected in the ordination of a high number of sampling units (McCune and Grace,  
25 2002). Nevertheless, mean stress generated in the ordination was significantly smaller

1 than obtained with randomized data (Monte Carlo  $p = 0.001$ ) showing that the original  
2 lizard composition matrix is, in fact, structured (organized in a non random manner).  
3 Mantel test indicated that the distances in the one-dimensional ordination matrix  
4 represented 50.39 % of the variation in distances of the original lizards composition  
5 matrix (Monte Carlo  $p = 0.001$ ).

#### 6 Regression results

7 After Bonferroni correction for multiple tests, alpha value for three tests was reduced  
8 to 0.016. Therefore, the multifactorial model with two independent axes was  
9 significant only for composition ( $r^2 = 0.388$ ,  $P = 0.001$ ) and abundance ( $r^2 = 0.339$ ,  $P <$   
10  $0.001$ ). The first PCA axis showed a significant relationship only with composition ( $B$   
11  $= -0.457$ ,  $P < 0.001$ ), whereas the second axis was significantly correlated with  
12 composition and density of lizards ( $B = - 3.165$ ,  $P > 0.001$ )(see table 2).

13 Diagnostics of multiple regressions using scatter plots (figures 3, 4 and 5) showed that  
14 whereas the segment of the composition axis representing plots dominated by species  
15 from forests was not affected by the variation in vegetation density at high strata  
16 (figure 3), values of composition in the other part of the same axis (plots with  
17 heliophilous species mainly) were absent at the places with higher density of  
18 vegetation at those vegetation strata. The second axis, on the contrary, showed that  
19 those values of composition could also be situated in densely forested areas, and at the  
20 same time, plots composed mainly by forest-dwelling species (those mainly founded  
21 in Sapiranga and Camurujipe plots, but also in Praia do Forte) were mainly restricted  
22 by tree cover.

23 Figure 4 shows that despite low values of abundance are distributed all along the two  
24 axes, higher abundance values were higher in open plots and restricted to plots with  
25 lower density at high vegetation strata.

1 After the conservative Bonferroni correction, the model regression of biomass and  
2 also partial regressions between lizard abundance and the first PCA resulted in low  
3 but non-significant p values (see table 3). Figure 5, however, shows identifiable,  
4 although non linear relationships between biomass in plots and the PCA axes, highest  
5 biomass values were found all along the two PCA components coinciding with the  
6 presence in plots of *T. meriana* (see figure 2), the species with the most specific  
7 biomass. On the other hand, higher values of biomass appeared much more frequently  
8 in open plots and those with lower density at higher vegetation strata (mainly coming  
9 from Sapiranga and Praia do Forte), in which a species with bigger specific biomass  
10 were the most abundant (*T. hygomi*).

#### 11 Literature review and tests with microhabitats

12 Our bibliographic survey resulted in 25 papers, from 1968 to 2005, containing  
13 observations on habitat or microhabitat use, or both, of the sampled species (see table  
14 4). Among the retrieved studies, all the species were represented by at least one  
15 published paper with some clear observation on their habitat and microhabitat. We  
16 determined a most associated microhabitat descriptor for 15 species and, from those,  
17 13 appeared in more than two plots, so included in the analysis. Observations made  
18 during our study were generally in accordance with those found in the literature,  
19 facilitating selection of the most associated microhabitat descriptor. Only for *Bogertia*  
20 *lutzae* and *Coleodactylus meridionalis*, our data showed a not previously related  
21 predictive relationship with giant bromeliads and leaf litter, respectively. Table 5  
22 shows the most associated microhabitat descriptor for each species, when one was  
23 identified, and also Spearman's correlation coefficient, significance and number of  
24 sampling units used for each test.

1 After controlling possible effects of the vegetation gradient over the abundance of  
2 each species in plots, this did not usually showed a linear and predictable relationship  
3 to the availability of their most associated microhabitat descriptors. This was  
4 demonstrated by the low correlation coefficients and non significant relationships  
5 found. The exception was *Bogertia lutzae*, a geckonid who was mainly found in small  
6 groups (two adults and sometimes hatchlings) in giant bromeliads. Analysis of scatter  
7 plots showed solid abundance response curves, with maximums in abundance  
8 associated with aggregations of values in the independent variable, or none  
9 relationship of any kind (figures 6 and 7).

## 10 Discussion

### 11 Habitat change and composition

12 The position of lizards along the studied gradient is in agreement with previous  
13 observations found in the literature and with the ecophysiological data available for  
14 some species: larger heliophilous teiids, like *Ameiva ameiva* and *Kentropyx calcarata*,  
15 who present high and very constant activity temperatures ( $37^{\circ}\text{C} \pm 0.009^{\circ}\text{C}$  and  
16  $35.36^{\circ}\text{C} - 37.6^{\circ}\text{C}$ , respectively) independent of substrate temperature (Vitt and Colli,  
17 1994; Vitt, 1991), occurred more frequently in lower forested plots. The smaller teiid,  
18 *Cnemidophorus ocellifer* has also a high mean activity temperature ( $37.5^{\circ}\text{C} \pm 2.35$   
19  $^{\circ}\text{C}$ ), but it is associated with substrate and air temperatures (Mesquita and Colli, 2003)  
20 which can explain its dependence on open areas. Other *Tropidurus* species and  
21 *Mabuya macrorhyncha*, are also considered heliophilous but present relatively lower  
22 mean and more variable activity temperatures ( $32.1-35.6^{\circ}$ ) (Van Sluys et al., 2004;  
23 Rocha et al., 2001; Vrcibradic et al., 2001). Assuming that temperatures reach  
24 tolerable levels during more time over the day in lower forested places than in high  
25 forests, this could explain why they are present in both open and lower forested plots.

1 Ecophysiological data available for *A. fuscoauratus* (Vitt et al., 2003a) and *A.*  
2 *punctatus* (Vitt et al. 2003b), suggest that they avoid sun exposure which is in agree  
3 with the restriction caused by tree cover for compositions values of plots with  
4 presence of those species. Data on geckonids from genus *Coleodactylus* (Vitt et al.  
5 2005) and *Gymnodactylus* (Colli et al. 2003), showed that these species behave as  
6 thermoconformists, which is in agree with their bigger distribution along the gradient.  
7 No other study had evidenced before the two kinds of response detected by us,  
8 namely, a negative influence of higher vegetation strata with heliophilous lizards and  
9 the restriction caused by tree cover for forest species. Rocha (1997) evaluated the  
10 effects of variation in vegetation height on the abundance or evenness of Restinga  
11 lizards and found no relationship, deducing that this was due to the lack of arboreal  
12 species. Our results suggest that heliophilous Atlantic Rainforest lizards are restricted  
13 by the existence of higher vegetation strata than those that can be usually found in the  
14 Restingas, as we could find heliophilous lizards both in open and densely forested  
15 habitats, with heights generally about 10 m or less, but much less inside forest plots  
16 with 10-15 m and more than 15 m strata, resulting in a mixture of species from forests  
17 and open habitats. Nogueira et al. (2005) found that higher gallery forests had very  
18 different lizard species from those found in adjacent grasslands. However, Conroy  
19 (1999), who studied the variation in a gradient from schlerophyllous forest to a  
20 rainforest found a similar degree of flexibility in the distribution of species among the  
21 gradient, such differences in the rigidness of the distribution of lizard assemblages  
22 seem be related to the abruptness of the studied gradients, whereas our study and  
23 Conroy's work were done on adjacently situated forests and lower forests with open  
24 areas, the study in the Cerrado had a large stripe of grasslands between typical  
25 Cerrado and gallery forests. This suggests that the spatial distribution of the

1 vegetation (graded or interspersed) is important for the degree of mixing between  
2 lizard assemblages from different habitats.

### 3 Habitat change and abundance

4 Garcia and Whalen (2003) found increased densities of lizards in open coastal habitats  
5 when compared with adjacent shrub deserts. This result was mainly due to one species  
6 response. Our results, from a richer assemblage, are in agreement with those from  
7 Garcia and Whalen (2003) in that the highest abundances of lizards in some plots  
8 were extremely influenced by one of the sampled species. In our study, *T. hygomi*,  
9 the species that showed the highest specific density in the taxocenose (see table 5).

### 10 Habitat change and biomass

11 Using data from surveys in islands and mainland from tropical regions, Rodda and  
12 Dean-Bradley (2002) observed an increase in herpetofaunal biomass inversely related  
13 to canopy height. They gave little importance to this pattern because the correlation  
14 coefficient was very weak (probably due to the high heterogeneity and lack of  
15 linearity in the relationships that we found in both their results and ours) and because,  
16 in their opinion, the high values in biomass reached high heights of the canopy.  
17 However, in their figure, most of high biomass values come from 10m or less in  
18 height, which is consistent with our findings. At our study site, two facts were  
19 associated with the presence of high biomass values: the presence of large and less  
20 frequent lizards (mainly *T. meriana*), all along the gradient, and the high frequency  
21 of medium sized heliophilous lizards (namely, *T. hygomi* and *C. abaetensis*), more  
22 abundant in open and lower strata forested plots from Praia do Forte. Our  
23 methodically detected local pattern coincides with that presented by Rodda and Dean-  
24 Bradley (2002) from a geographically and taxonomically much wider sample, but  
25 with high methodological heterogeneity.

1 Our results are in accordance with general principles extracted from plant studies  
2 (Tilman 1997) and aquatic macroinvertebrates (Dangles and Malmqvist 2003) which  
3 give importance to the functional traits of the component species on the regulation of  
4 characteristics at the level of taxocenose. It remains to evaluate if lizard species from  
5 open habitats and habitats with lower vegetation strata have common and distinct  
6 patterns in functional traits than forestal species.

#### 7 Microhabitats and lizards abundance

8 Although many lizard species were mainly found in a certain kind of microhabitat, the  
9 low correlation coefficient and low significance of the relationships evidenced that  
10 there was not a general increase of lizard's abundance in plots linked to the  
11 availability of their most used microhabitats. In agreement with results from Heatwole  
12 and Sexton (1966) and Whitfield and Pierce (2005), our results show that determined  
13 microhabitats can be necessary for a lizard species establish in a place. However, we  
14 further demonstrate that they do not direct the abundance of the lizard taxocenose,  
15 pointing out that other processes are affecting that characteristic at this organization  
16 level. This is in apparent contradiction with results from Heinen (1992) and Vonesh  
17 (2001) who found several microhabitats predicting leaf litter herpetofauna. However,  
18 the number of lizards in their samples were very low when compared with  
19 amphibians (19 lizards versus more than 150 amphibians in Vonesh' study and 33  
20 lizards versus 378 amphibians in Heinen's) and the kind of controlling variables  
21 where mainly related with humidity conditions of the sample (litter depth and light in  
22 Heinen (1992), wet litter mass, hill category, soil humidity, number of logs, and shrub  
23 cover in Vonesh (2001)). As we related each species abundance only against its most  
24 associated microhabitat descriptor, there are no problems of this kind in our results.

1 There seem to be, however, some microhabitat “adjusted” species (*Coleodactylus*  
2 *meridionalis* and *Bogertia lutzae*). We found that, for one of these species, qualitative  
3 properties of microhabitats may have an effect on population density: despite the high  
4 variation in number of “normal” bromeliads (see appendix I), the gekconid *B. lutzae*  
5 appeared more often inside giant bromeliads and its abundance in plots showed a  
6 significant relationship with them.

#### 7 Implications for lizard’s conservation

8 We provided first rigorous data on the relative abundance of many lizard species,  
9 which are basic for the determination of their conservation status (Rodriguez et al.,  
10 2000), following international criteria (IUCN, 2001), in a global priority area for  
11 conservation as it is the Atlantic Rainforest (Myers et al., 2000; Brummit and  
12 Lughadha, 2003). We also showed their relationships with directly manageable  
13 environmental elements both in conservation and habitat restoration, like are  
14 vegetation structure and microhabitats. We hope this will aid lizards conservation in  
15 one of the five hottest of biodiversity hot spots.

#### 16 Acknowledgments:

17 We wish to thank to the Fundação de Amparo à Pesquisa da Bahia (Fapesb) for  
18 supporting this study with a Masters dissertation scholarhip (A.Camacho) and a  
19 researcher scholarship (P.L.B.Rocha). All people which helped during any part of this  
20 study and especially along the field work: Milena Camardelli, André Mendonça and  
21 Wilton Fahning. Dr. Marcelo Napoli and all his laboratory for support and for sharing  
22 the field work stuff and expenditures. We are indebted to Adriano Paiva Adamson, for  
23 allowing the use of base camp, and of the boat for accessing one of the areas, for  
24 satellite images, and for allowing this study inside the Garcia D’ávila Foundation  
25 lands. We are grateful to Miguel Trefaut Rodrigues (University of São Paulo) for



1 helping in taxonomic identification and Angeles Fairas da Silva Nascimento and  
2 Maria Lenise Silva Guedes: Herbário ALCB, in the Federal University of Bahia for  
3 bromeliads identification. This study was realized under the IBAMA/RAN collecting  
4 license N° 194/05.

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Table 1. Characteristics of environmental variables measured in sampling plots.

Variable name	Purpose	Calculation	Unit
Tree cover			N of black pixels
			1= 0-25%
	Habitat		2= 25-50%
Density at different vegetation strata	descriptors	Estimated in ten random points	3= 50-75%
			4= 75-100%
Low vegetation density			Plants / m <sup>2</sup>
Liter cover			Percentage
Rocks surface	Microhabitat	Measured for all rocks in the plot	m <sup>2</sup>
Shaded/ Exposed	descriptors		
Dead trunks			
Bromeliads and “Giant bromeliads”		Counted	Number
Position of plot	Location	Registered	U.T.M.

Table 2. Percent of variation explained and loadings of habitat descriptors in each of the two PCA generated axes of variation.

	PC1	PC2
% of variation explained	43.2	31.0
Tree cover	0.20	0.89
+ than 15m	0.83	0,12
10-15m	0.90	0,11
5-10m	0.37	0.70
0-5m	-0.47	0.71

Table 3. Results from regressions between PCA components of variation in habitat and composition, density and biomass of lizards.

	PC1		PC2		Model	
	B	p	B	P	r <sup>2</sup>	p
Composition	-0.200	0.056	-0.565	<0.001	0.388	0.001
Abundance	-1.545	0.022	-3.165	<0.001	0.339	<0.001
Biomass	-0.198	0.056	-0.215	0.039	0.134	0.020



Table 4. Habitats and microhabitats associated to lizards in preterit literature and during our study. Abbreviations: HL and MHL = habitat and microhabitat in literature F = forested, O = Open, HO and MO = places where lizards were found during active captures, TT = tree trunk, DT = dead trunk, TB = tree base TR = tree roots, BR = branch, LB = low branch, L = litter, S = sand, Li = liana, GB = giant bromeliad, B = bromeliad, P = palm, R = rocks, H = houses, G = ground, GR = grass, VI = vines. In the second and third columns, numbers in parenthesis identifies the work where the observation was done, for the two last, are individuals caught or sighted on the same habitat or microhabitat type. For lizards captured in pitfall traps only habitat type was noted.

Taxa	Author/Year	Literature		This study	
		Habitat	Microhabitat	Habitat	Microhabitat
Geckonidae					
<i>Bogertia lutzae</i>	Rodrigues 1992(1)	O(2) F (1)	BR(2), B(1)(2)	F(19) O(7)	GB(16)
	Vanzolini 1972(2)				B(6)P(3)
<i>Coleodactylus meridionalis</i>	Rodrigues 1996(1)	F (1)(2)(3)	L(1)(2)(3)	F(110)	L(88)
	Vanzolini 1972 (2) 1974(3)			O(1)	
<i>Gymnodactylus darwini</i>	Freire 1996(1)	O (3)	BR(3)DT(4)	F(48)	TB(2)B(1)
	Rocha 1998(2)	F (1)(2)	(1)L,TT, TR(1)(2)		T(2)DT(1)
	Teixeira 2001(3) Vanzolini 1972(4)				(4) LI(1)R(1)C(1)
<i>Phyllopezus pollicaris</i>	Rodrigues 1996(3)	O(1)(2)(3)	R, H(1)(3)	F(11) O(1)	TT(10) DT(1)
	Vanzolini 1972(1) 1974(2)		TT(3)		R(1)

Taxa	Author/Year	Literature		This study	
		Habitat	Microhabitat	Habitat	Microhabitat
<i>Hemidactylus</i>	Araujo 1991(1)	O(4)(1)(2)	H(4)S,B(1) TT(3)	O(2)	B(2)
<i>mabouia</i>	Crump 1971 (2)	F(2)			
	Rodrigues 1996(3)				
	Vitt 1995(1)				
Teiidae					
<i>Ameiva ameiva</i>	Araújo1991(1)	O	G(4)(5)(7)(9)	F(15) O(1)	L(11)
	Crump 1971(2)	(3)(5)(6)(7)	L(4)(6)BR, DT(8)		
	Freire 1996(3)	F(2)(3)(4)(	S(6) bromeliad		
	Rocha 1997(4)	6)(8)	and cacti patches		
	Teixeira 2001(5)	(9)	(1) under bushes		
	Vanzolini 1974(6)		(3)R		
	Vitt 1995(7)				
	Vitt & Colli				
	1994(8)				
	Vitt & Zani1998(9)				
<i>Cnemidophorus</i>	Dias & Rocha 2004	O,F(1)	S(1)	F(19)	L(8)S(2)
<i>abaetensis</i>	(1)			O(18)	
<i>Cnemidophorus</i>	Dias & Rocha 2004	O(1)(2)(3)(	G(6)(8)	O(13)	S(12)
<i>ocellifer</i>	(1)	4)(5)(7)	S(1)(4)(5)(7)		
	Freire 1996(2)		R,GR (2)(3)(7)		
	Mesquita & Coli				
	2003 (3)				
	Rodrigues 1996 (4)				
	Rocha 1997 (5)				
	Teixeira 2001 (6)				
	Vanzolini1974 (7)				
	Vitt 1995 (8)				

Taxa	Author/Year	Literature		This study	
		Habitat	Microhabitat	Habitat	Microhabitat
<i>Kentropyx</i>	Crump 1971(1)	F(1)(2)(3)(	G(4)(6)DT, BR,	F(18)	L(15)B(1)
<i>calcarata</i>	Rand & Humphrey 1968(2) Rocha 1998(3) Teixeira 2001(4) Vanzolini 1974 (5) Vitt 1991(6)	5)(6) O(3)(6)	L(2)(3)(5)(6)VI(5) LI,BU,PS, TT,R(6)		LB(2)
<i>Tupinambis</i>	Vitt 1995 (1)	O(1)	G (1)	F (5)	S(2)L(3)
<i>merianae</i>				O(2)	
Gymnophthalmidae					
<i>Leposoma</i>	Rodrigues,Dixo	F(1)	L	F(20)	L(6)
<i>annectans</i>	& Accacio 2002(1)				
<i>Dryadosaura</i>	Rodrigues et al.,	F(1)(2)	G(fossorial?)(1)	F	-
<i>nordestina</i>	2005, Freire 1996(2)				
<i>Micrablepharus</i>	Freire 1996(1)	F, O(1)	L, B, under bushes	O(1)	-
<i>maximilianii</i>					
Policrotidae					
<i>Anolis</i>	Crump 1971(1)	F(1)(2)(3)(	BR(5)(7) VI,	F	T(2)
<i>fuscoauratus</i>	Freire 1996(2) Rand & Humphrey 1968(3) Vanzolini 1974(4) 1972(5)1980(6) Vitt <i>et al</i> 2003b(7)	4)(6) (7)	(5)(7) between 2m off the ground (5)L (5)(6)(7) T(2)(5)(7)		LB(5)

Taxa	Author/Year	Literature		This study	
		Habitat	Microhabitat	Habitat	Microhabitat
<i>Anolis punctatus</i>	Crump 1971(1)	F(1)(3)(4)(	TT(3)(6)	F	LI(1)
	Rand & Humphrey	5)(6)	4-10m high		T(4)
	1968(2)		(2)DT,VI,L		Always
	Rodrigues 2002(3)		P(2)(6)BR(2)		less than 5m
	Vanzolini 1974(4)				
	1972(5)				
<i>Polychrus marmoratus</i>	Vitt 2003a(6)				
	Rand & Humphrey	F(1)(2)	Edge of forests	F	BR(1)
	1968(1)		BR(1)		
<i>Enyalius catenatus</i>	Crump 1971(2)				
	Vanzolini 1974(1)	F (1)(2)(3)	Low in TT (1)	F	TB(2)BR(3)
<i>Tropiduridae</i>	Vanzolini 1972(2)		BR 3-5m high,		L(1)
	Jackson 1978(3)		(2)DT, BR 2m		
			High (4)		
<i>Tropidurus hygomi</i>	Vanzolini 1972	O	S/ BR	F(51)O	TT(4)LB(9)
				(107)	DT(2)S(31)
<i>Tropidurus strobilurus</i>	Vanzolini 1974(1)	F(1)(2)	TT(1)(2) 2 mts	F	TT(1)
	Rodrigues et al		high, DT (2)		
	1989 (2)				
<i>Tropidurus semitaeniatus</i>	Rodrigues 1996(5)	O (1)(2)(3)	R (1)(2)(3)	O(7)	R(7)
	Vanzolini 1972(2)	(4)	(4)(5)		
	Vanzolini 1976(4)				
	Vitt 1995(1)				
<i>Scincidae</i>					

Taxa	Author/Year	Literature		This study	
		Habitat	Microhabitat	Habitat	Microhabitat
<i>Mabuya</i>	Teixeira 2001,	O(1)(2)(3)(	B(1)(4)	F(8) O(1)	GB(2) B(2)
<i>macrorhyncha</i>	Araujo 1991(2)	4)	Bromeliad	and	BR(1) P(3)
	Freire 1996(3)		cacti patches(2)		
	Rocha 1998(4)		G(4)		

Table 5. Numerical characteristics of the species sampled and results from Spearman correlation tests. Abbreviations: A = total number of individuals collected and sighted, I = incidence, SPD= specific density, SPB = specific biomass, MAD = most associated microhabitat descriptor, CC = correlation coefficient, Sig. = significance, N = number of sampling units used. GB = giant bromeliad; L= leaf litter, DT = dead trunks; LVD = low vegetation density; 0-5m = density of vegetation at the 5-0 m strata; R = rocks; TT = tree trunks; - = not identified MAD or test not made.

Taxa	A	I	SPD	SPB	MAD	CC	Sig.	N
Geckonidae								
<i>Bogertia lutzae</i>	25	13	1.9	5.4	GB	0.620	0.000	39
<i>Coleodactylus meridionalis</i>	111	24	4.6	0.7	L	0.261	0.023	59
<i>Gymnodactylus darwini</i>	48	21	2.2	5.9	DT	-0.195	0.092	43
<i>Hemidactylus mabouia</i>	2	2	1.0	2.7	-	-	-	-
<i>Phyllopezus pollicaris</i>	12	7	1.7	40.7	-	-	-	-
Teiidae								
<i>Ameiva ameiva</i>	16	12	1.3	43.5	L	-0.045	0.366	59
<i>Cnemidophorus abaetensis</i>	37	13	2.8	29.0	LVD	0.193	0.237	19
<i>Cnemidophorus ocellifer</i>	13	8	1.6	4.5	LVD	-0.267	0.402	12
<i>Kentropyx calcarata</i>	18	11	1.6	22.7	L	0.017	0.455	59
<i>Tupinambis merianae</i>	7	6	1.1	996.8	-	-	-	-
Gymnophthalmidae								
<i>Leposoma annectans</i>	20	10	2.0	1.4	L	0.183	0.220	20
<i>Dryadosaura nordestina</i>	2	1	2.0	10.0	-	-	-	-
<i>Micrablepharus maximiliani</i>	1	1	1.0	?	-	-	-	-
Policrotidae								
<i>Anolis fuscoauratus</i>	11	8	1.3	2.0	LVD	-0.029	0.430	38
<i>Anolis punctatus</i>	7	4	1.7	18.8	0-5m	0.089	0.355	20
<i>Polychrus marmoratus</i>	1	1	1.0	6.3	-	-	-	-
<i>Enyalius catenatus</i>	12	7	1.7	27.1	LVD	0.058	0.366	38
Tropiduridae								
<i>Tropidurus hygomi</i>	157	21	7.4	59.5	LVD	0.081	0.623	39
<i>Tropidurus strobilurus</i>	1	1	1.0	17.2	TT	-	-	-
<i>Tropidurus semitaeniatus</i>	7	2	3.5	27.3	R	-	-	-
Scincidae								

<i>Mabuya macrorhyncha</i>	9	8	1.1	31.4	-	-	-	-
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FIG. 1. Study sites, showing position of sampling plots (black rounds), scale (low on the right) and situation of the northern littoral of Bahia in northeastern Brazil. Darker pixels show forested areas, clear gray and whitish represent deforested and sandy lands.

FIG. 2. Composition of lizard species ordered by NMS and Weighted Averaging. Letters indicate location and habitat of sampling plots. C = Camurujipe, S = Sapiranga; P = Praia do Forte, O = open habitat.

FIG. 3. Relationship between composition and the main gradients in vegetation structure. Symbols indicate sampling site, open symbols indicate open habitat. Square = Camurujipe; triangle = Sapiranga; circle = Praia do Forte.

FIG. 4. Relationship between total abundance per plot and the main gradients in vegetation structure. Symbols indicate sampling site, open symbols indicate open habitat. Square = Camurujipe; triangle = Sapiranga; circle = Praia do Forte.

FIG. 5. Relationship between total biomass per plot and the main gradients in vegetation structure. Symbols indicate sampling site, open symbols indicate open habitat. Square = Camurujipe; triangle = Sapiranga; circle = Praia do Forte.

FIG. 6. Relationships of forest lizards' abundances per plot with a measure of the availability in sampling plots of their most related microhabitat descriptor. Top, species from Camurujipe. N=20. Middle, species present in Camurujipe and Sapiranga. N=38. Bottom, lizards that occurred along the three areas. N=48.



FIG. 7. Relationships of forest lizards' abundances per plot with a measure of the availability in sampling plots of their most related microhabitat descriptor. Top, lizards that occurred along the three areas N=59. Middle and Bottom, species existent in Sapiranga and Praia do Forte. N=38. *C. abaetensis* only occurred at Praia do Forte. N=19, and *C. ocellifer* which occurred only in open plots from both Sapiranga and Praia do Forte N=21.

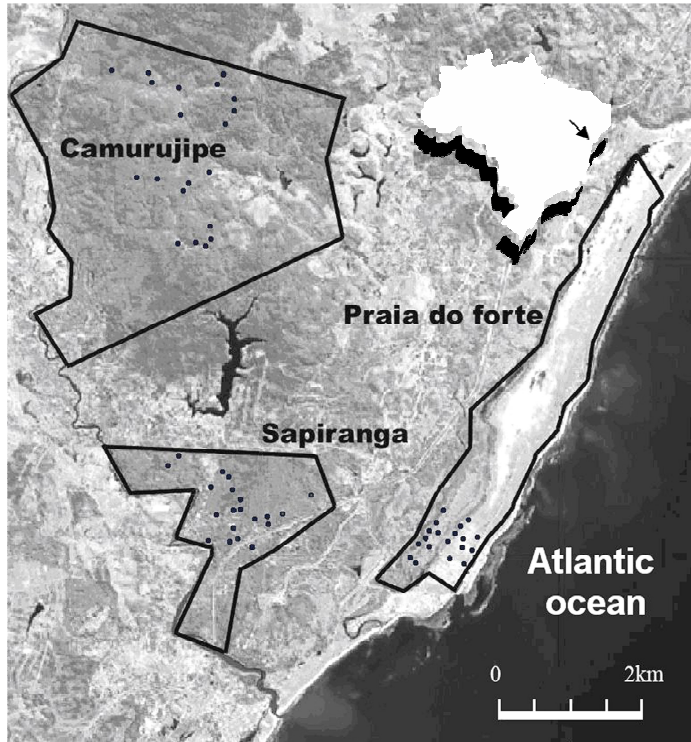


FIG. 1.

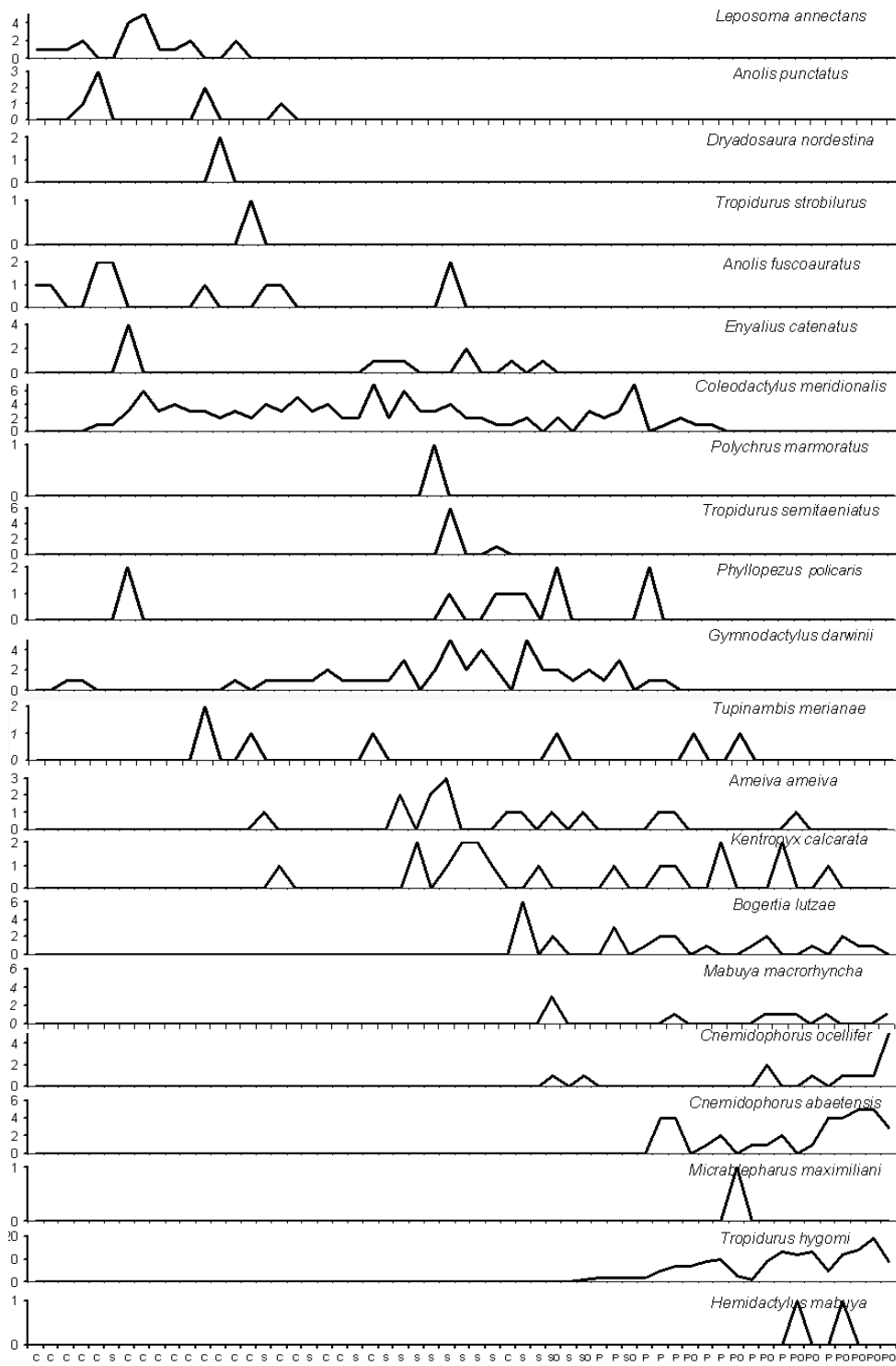


FIG.2.

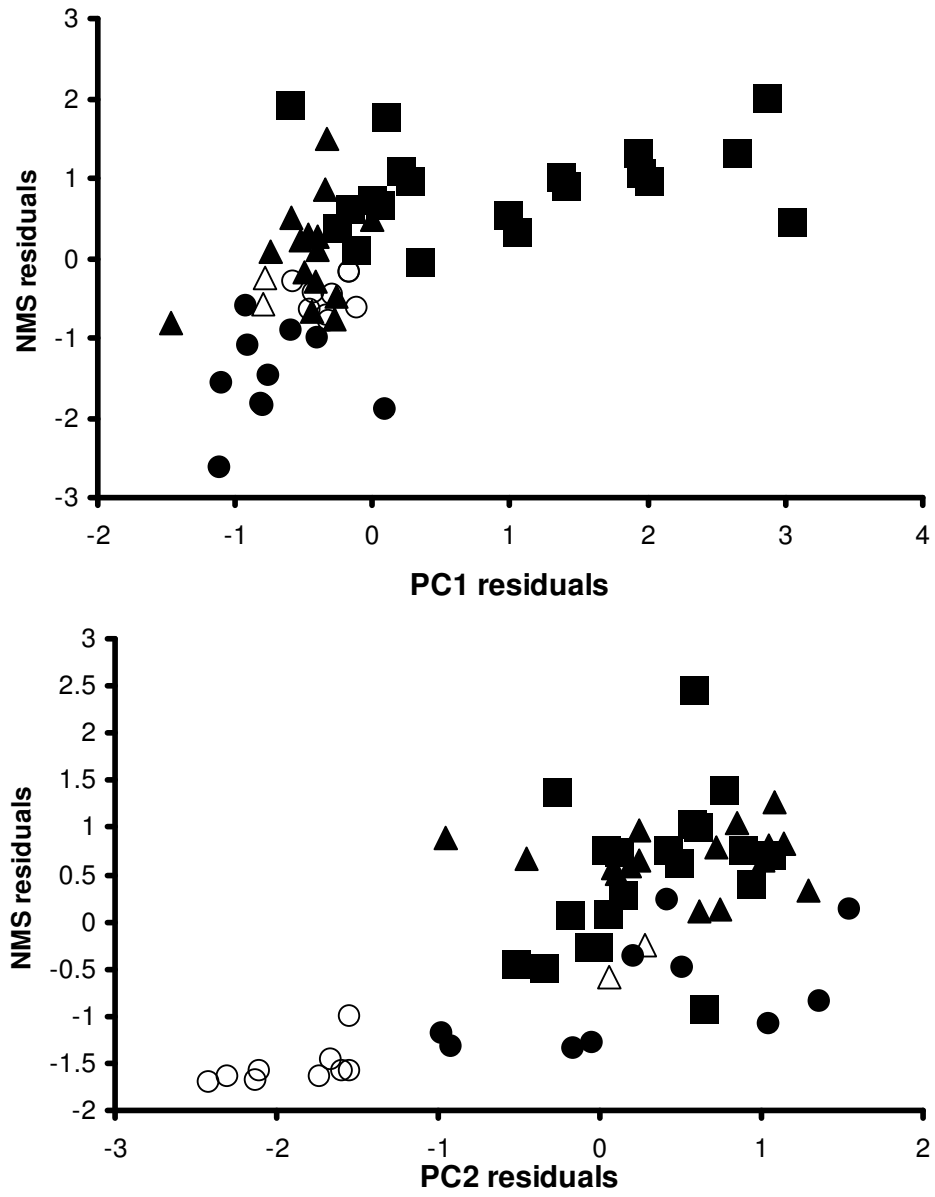


FIG. 3.

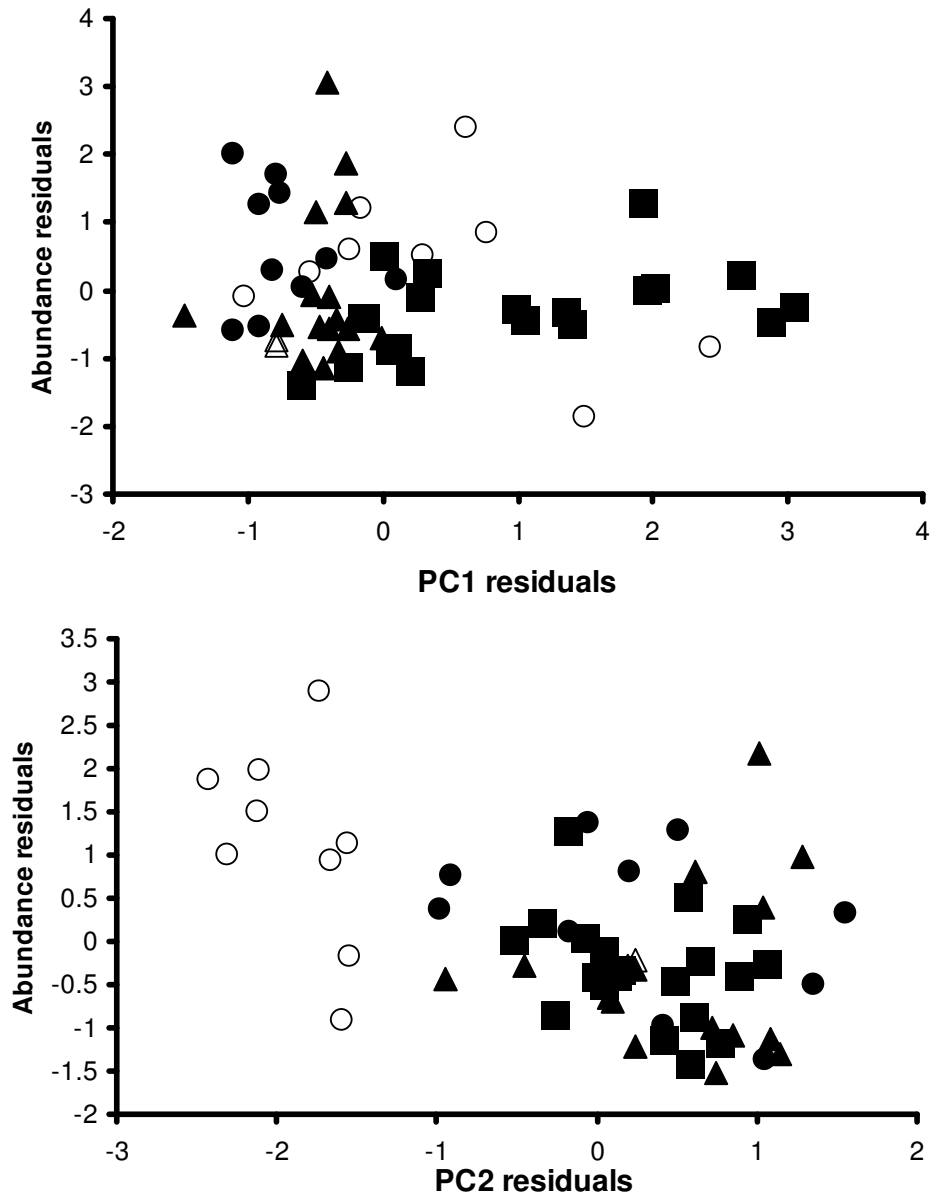


FIG. 4.

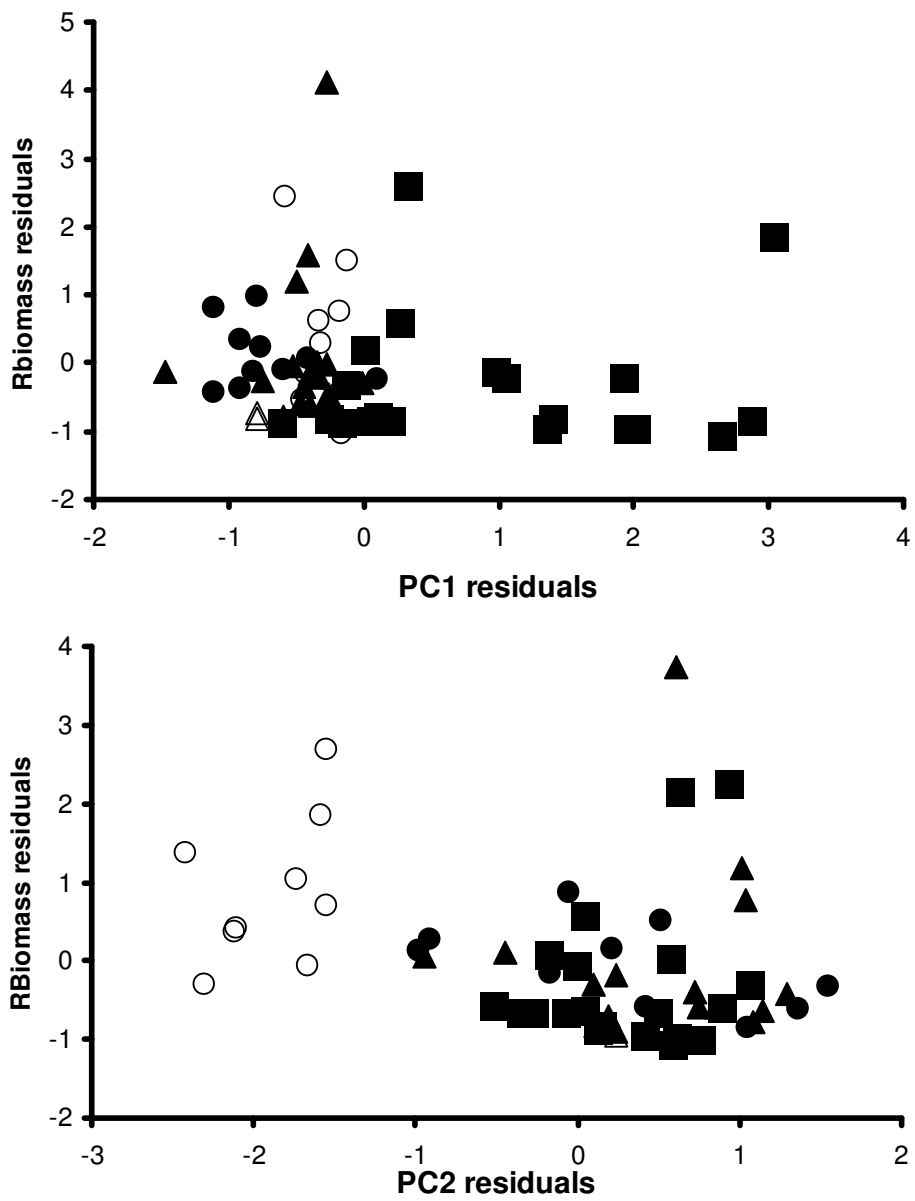


FIG. 5

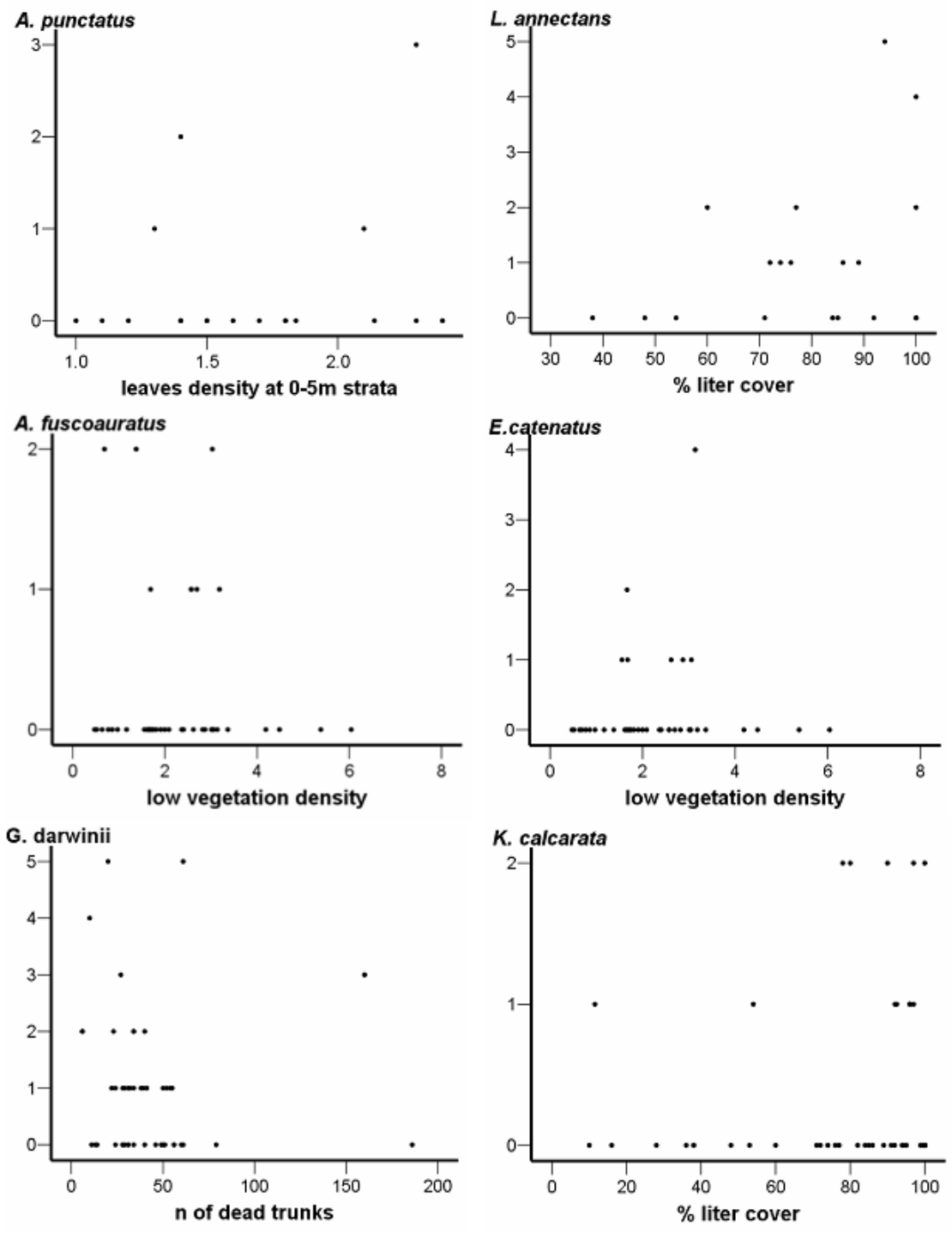


FIG. 6

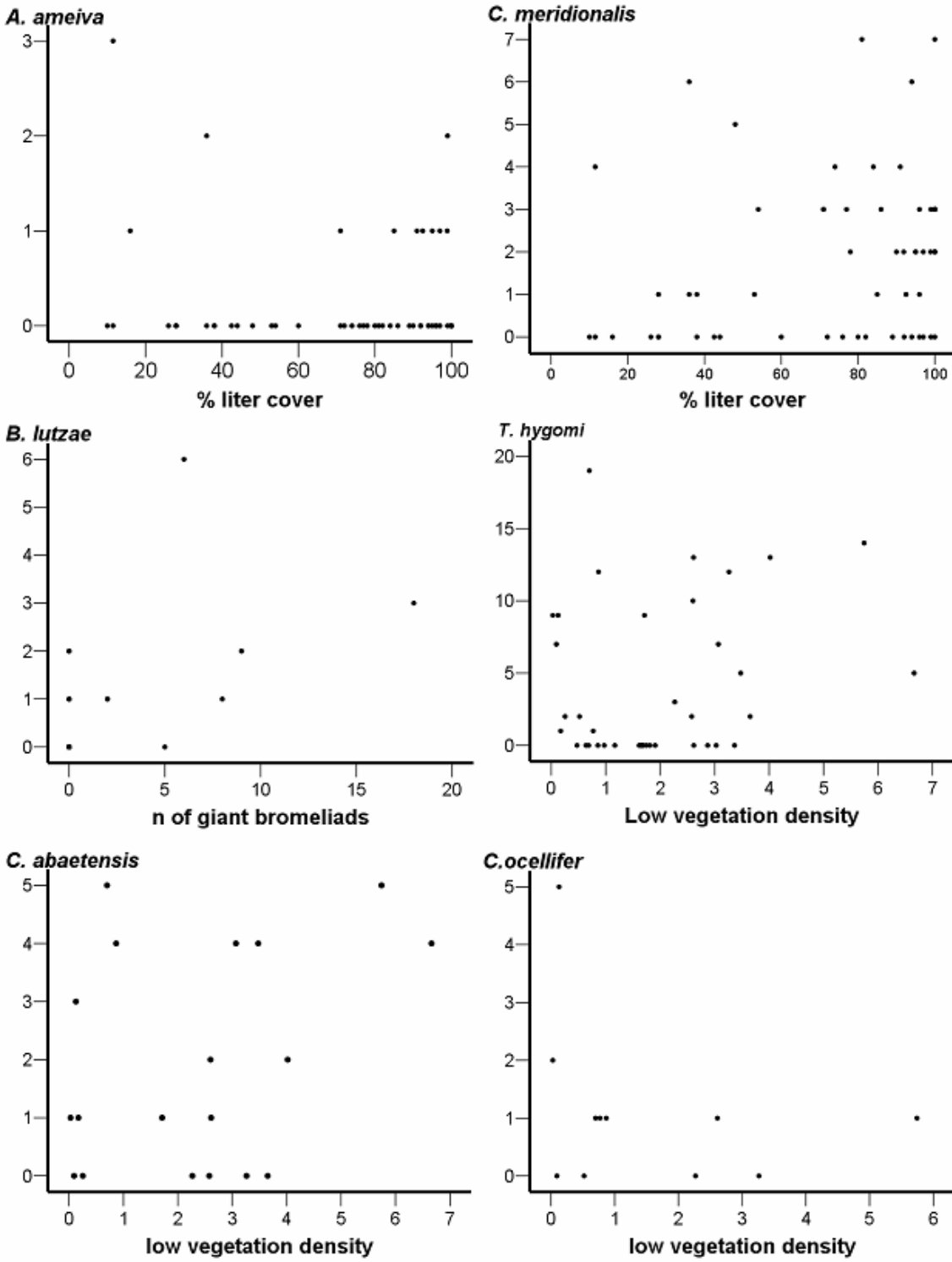


FIG. 7



## **Conclusão geral.**

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Hábitat, composição, densidade e biomassa de lagartos relacionaram-se do seguinte modo com variações na estrutura do hábitat: a densidade da vegetação nos estratos de 10-15 m e de mais de 15 metros estiveram negativamente relacionados com a distribuição de lagartos heliófilos, ao tempo que a falta de cobertura vegetal se relacionou negativamente com a presença de espécies de florestas. As características fisiológicas das espécies parecem estar por trás da ocorrência de um determinado subconjunto de espécies na escala de uma parcela. A presença de determinados micro-hábitats parece ser necessária para o estabelecimento das espécies de lagarto associadas com este mas não esta intimamente ligada com sua abundância. Densidade e biomassa no nível de assembléia parecem estar governadas, então, pelas diferentes densidades e biomassas específicas das espécies com tendências funcionais mais extremas dentre aquelas que coexistem em um determinado tipo de hábitat. Apesar da reduzida área de estudo, este trabalho apresenta informação básica e importante para a conservação de várias espécies de lagartos da Mata Atlântica.

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## **Anexo e apêndices.**

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## Anexo. Guia para autores do “*Journal of Herpetology*”.

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### Instructions to Authors

#### **Suitable Topics**

The Journal of Herpetology accepts manuscripts on the biology of amphibians and reptiles, with emphasis on behavior, biochemistry, conservation, ecology, evolution, morphology, physiology, and systematics. Papers on captive breeding, new techniques or sampling methods, limited natural history observations (i.e., isolated behavioral or morphological descriptions that are not placed in a broader ecological or comparative context), geographic range extensions, and essays are generally not suitable. Consult the Editor prior to submitting a paper if you have doubts as to its suitability.

#### **Where to Submit**

As of 1 January 2006, all submissions to the Journal of Herpetology must be made using our web-based [submission site](#). Questions about submission using this site should be addressed to the Editor, Geoff Smith ([smithg@denison.edu](mailto:smithg@denison.edu)).

Note that registration is required to access this site, however, you do not need to be a member of SSAR to access the site or to submit a manuscript (although we encourage you to consider [joining SSAR](#)).

Do not submit papers to the Managing Editor or to any of the Associate Editors.

#### **What to Submit**

Details about how to submit your manuscript can be found on the [submission site](#). However, please note that figures will be uploaded separately from the text and should not be incorporated into the document containing the text and tables.

#### **Style and Formatting**

Submitting a manuscript in the correct format for the Journal is essential in minimizing turnaround time and reducing costs to the Society. Manuscripts not in the correct style may be returned to the author before being sent for peer review. Thus, please be sure to follow the instructions below very carefully, especially the "[Ten Commandments](#)". Consult a recent issue of the Journal for additional style guidance.

**Line Numbers** - To facilitate and speed electronic review, please use line numbers for your manuscript.

**Title Page** -- [Sample Title Page](#) appears at the close of these instructions. Please follow the format precisely. DO NOT abbreviate states, postal codes, etc. Email addresses are required (especially during the publication process).

**Abstract** -- An abstract is required for all papers (including Shorter Communications). It should represent a concise statement of the objectives and results of the paper. Statistical results are not needed.

**Main Body** -- All manuscripts (including Shorter Communications) should consist of the following sections: Introduction (no heading), Materials and Methods, Results, Discussion, Acknowledgments, Literature Cited, Appendices, and Figure Legends (grouped together). Submissions formatted as Shorter Communications (eight or fewer pages of text) should follow the same sequence, including section headings and a brief Abstract.

**In-text References** -- Cite references in the text in chronological order, using a semicolon to separate citations. Use "et al." for three or more authors (example; Smith, 1975; Jones and Jones, 1987; Brown et al., 1990). Papers accepted for publication should be cited as Smith (in press). Unpublished manuscripts (including manuscripts submitted for publication) should be cited as A.A. Smith (unpubl.

data), and should not be placed in the Literature Cited (include all names and initials for multi-authored unpublished data).

Be very careful that all references cited in the text (including tables and figure legends) are included in the Literature Cited. Failure to check this properly may result in a significant publication delay.

**Literature Cited Format** -- The Literature Cited is one of the largest sources of errors. Note that it is now policy that all journal titles be spelled out in their entirety (i.e., no abbreviations). Please be sure that all entries in the Literature Cited also appear in the text (and vice-versa), and that the format instructions below are adhered to carefully:

**Article in a Journal**

Smith, A. T. 1992. Ecology of rattlesnakes in Florida. *Journal of Herpetology* 26:100-105.

**Book**

Smith, A. T., and J. Jones. 1995. *Physiology of Amphibians and Reptiles*. McGraw-Hill Inc., New York (page numbers not needed when entire book is the citation).

Be sure to include the state and country (unless U.S.A.) with each book entry unless it is given in the name of the publisher (e.g., Arizona Game and Fish, etc.). **Capitalize the first letter of each significant word in book titles.**

**Chapter in a Book**

Smith, A. T. 1994. Systematics of frogs and toads. In J. Black and M. Lee (eds.), *Systematics of Amphibians and Reptiles*, pp. 52-65. Univ. of Kansas Press, Lawrence.

**Works "in press"**

Cite these IN TEXT by following the author's name with "(in press)", and in the Literature Cited section as follows:

Smith, J. Q. (in press). Things my uncle never said about snakes. *Journal of Ethnography*.

**Dissertation or Thesis**

Smith, A. T. 1991. Behavioral Ecology of Turtles. Unpubl. Ph.D. Diss. (or Thesis), Univ. of Kansas, Lawrence. (Use state name if not obvious from the university name, and include country if not U.S.A.).

**Multiple Citations** -- Multiple citations for the same author should be organized as follows: single citations first, two-author citations second (in alphabetical order), three or more authors third (in chronological order). NOTE: This represents a style change from previous issues.

Smith, A. T. 1992. Ecology of rattlesnakes in Florida. *Journal of Rattlesnake Ecology* 26:100-105.

---- 1993. Ecology of turtles in Louisiana. *Journal of Herpetology* 27:91-99.

Smith, A. T., and B. Black. 1991. Systematics and morphology of snakes. *Journal of Ophidology* 25:100-105.

Smith, A. T., and J. Jones. 1989. Diamondback terrapins in Louisiana. *Bulletin of the Society for Aquatic Critter Study* 23:234-236.

Smith, A. T., W. White, and J. Jones. 1989. Mating behavior in Gila monsters. *Herpetologica* 23:230-234.

Smith, A. T., A. Black, and J. Jones. 1995. Temperature relationships in garter snakes. *Bulletin of the Gartersnake* 29:30-34.

In general, so-called "gray literature" references (meeting abstracts, unreviewed reports to government agencies) should NOT be listed in the Lit. Cit. If citations of such reports is deemed essential, sufficient information should be provided so that the readers can locate the reference independently. The Editor will act to remove citations deemed unwarranted.

**Tables** - Tables will be uploaded as separate files (XLS or DOC formats).

Tables should be double-spaced and each table should be numbered consecutively and placed on its own page. Do not use vertical lines. The legend of the table should be concise but sufficiently detailed

so the table can be understood without reference to the text. The legend should appear on the same page as the table. Avoid footnotes whenever possible.

**Figure Headings** -- Figure headings should be placed on a single page and numbered in the order in which they are cited in the text.

**Figures** - Figures should be uploaded as separate files (one per figure). The following formats are supported by our submission site: TIF, EPS, PDF, or JPG formats. Further details are available on the submission site.

Figures with multiple parts should have each part labeled with a capital letters (e.g., A,B,C, ...) and all parts of the figure should be submitted on a single page.

Abbreviations -- Common abbreviations are given below:			
sec	min	h	yr
km	L (for liter)	mL	g
df	N	SD	SE
	P	CV	

Spell out week, month, day, and mean.

**Animal Care and Permits:** The Society feels strongly that all animals used in research should be treated humanely and ethically. SSAR, ASIH, and HL have jointly compiled Guidelines for Use of Live Amphibians and Reptiles in Field Research," which outlines appropriate treatment of amphibians and reptiles used in field research, and all contributors to the Journal are expected to comply with these guidelines. In addition, the Journal requires a statement in the Acknowledgments indicating that authors have complied with all applicable institutional Animal Care guidelines, and that all required state and federal permits have been obtained.

**Voucher Specimens** The Journal of Herpetology requires that all submissions from researchers reporting results of phylogenetic reconstruction and taxonomic decision be supplemented by in-text (if a shorter communication) or appendix (if a major paper) reference to voucher specimens. Such reference must include an acceptable acronym (e.g. Copeia 1985:802-832; Copeia 1988:280-282) for the permanent collection(s) in which the voucher(s) resides and inclusive catalogue numbers for all specimens utilized. When tissue or DNA samples are utilized, reference to an identifiable carcass deposited in a permanent museum collection is required. Rationale for this decision appears in Molecular Phylogenetics and Evolution 17:129-132.

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## The Ten Commandments of Style and Formatting

- 1) Please follow Crother et al. (2000; Herp. Circular 29, SSAR) for all scientific and standard English names ("common names"). Be sure to capitalize "common names" (e.g., Common Snapping Turtle).
- 2) Double-space ALL parts of the ms (yes, even the title page and Lit. Cit.) and number all pages of the manuscript.
- 3) Do not right-justify any portions of the text. Leave a 1.5" left margin and a 1" margin elsewhere.
- 4) Use italics or underline (be consistent) for Latin names, addresses on title page, and subheadings only. Do not italicize any other words.
- 5) Do not boldface any portion of the text.
- 6) Do not use footnotes in the tables or in the text.
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## Sample Title Page

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LRH: Lewis Smith (spell out name if only one author)

L. Smith and J. Clark (use initials and last name for two authors)

L. Smith et al. (use for more than two authors)

Shorter Communications (if less than 8 pages of text)

RRH: Ecology of timber rattlesnakes

Shorter Communications (if less than 8 pages of text)

Ecology and Reproduction of the Timber Rattlesnake (*Crotalus horridus*) in  
Kansas

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Key Words: Snakes, *Crotalus*, Ecology, Reproduction

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Apêndice I: variáveis ambientais utilizadas durante o estudo. Abreviaturas: Pci rank = posição da parcela na ordenação de componentes principais realizada com os descritores de hábitat; 0-5m, 5-10m, 10-15m, +de15m = estratos da vegetação; brom gig=bromélias gigantes; brom= bromélias; tron=troncos podres; rsom= rochas sombreadas; rexp=rochas expostas; %fol=cobertura pelo folhoso; dens veg = densidade da vegetação.

Parcela	PC1 rank	PC2 rank	0-5m	5-10m	10-15m	+ de 15m	brom gig	brom	tron	rsom	rexp	%fol	Àgua	dens veget	cobertura	Latitude	Longitude
C1	<b>2.51098</b>	<b>0.44949</b>	1.60	2.80	2.60	1.80	0	0	31	21	0	76.0	1	3.18	1113324.33	-12.50797	-38.04579
C2	<b>0.43899</b>	<b>0.60315</b>	1.70	2.80	1.30	1.00	0	0	60	0	0	86.0	1	1.99	1117628.00	-12.50416	-38.04593
C3	<b>-0.07792</b>	<b>0.58179</b>	2.40	1.50	1.30	1.00	0	0	50	0	0	72.0	1	2.56	1119218.20	-12.50341	-38.05000
C4	<b>0.86646</b>	<b>0.93332</b>	2.14	2.75	2.03	1.00	0	2	41	0	0	100.0	1	3.05	1115846.20	-12.50211	-38.05042
C5	<b>0.37807</b>	<b>0.57082</b>	1.80	2.90	1.30	1.00	0	9	24	29	0	94.0	1	4.18	1005320.90	-12.50151	-38.05596
C6	<b>1.14211</b>	<b>0.13145</b>	1.40	2.40	2.30	1.20	0	0	34	0	0	74.0	0	4.48	1123376.60	-12.24030	-38.03900
C7	<b>1.1739</b>	<b>-0.51728</b>	1.00	1.80	2.90	1.20	0	0	34	0	0	84.0	0	2.08	1119934.30	-12.50757	-38.03720
C8	<b>1.82444</b>	<b>-0.3433</b>	1.20	1.80	3.10	1.50	0	0	56	0	0	100.0	0	2.81	1132872.70	-12.50524	-38.03756
C9	<b>1.36768</b>	<b>-0.18967</b>	1.40	1.80	2.60	1.40	0	0	51	0	0	100.0	0	3.13	1110092.60	-12.50346	-38.03754
C10	<b>2.72572</b>	<b>0.57877</b>	1.84	2.58	2.36	2.04	0	0	61	0	0	100.0	0	5.38	1134934.80	-12.50142	-38.03880
C11	<b>1.11373</b>	<b>0.03449</b>	1.50	2.10	3.10	1.00	0	0	186	0	1	100.0	1	1.71	1106165.30	-12.51669	-38.04058
C12	<b>1.50401</b>	<b>-0.08175</b>	1.40	2.30	2.90	1.30	0	0	54	30	0	77.0	0	2.36	1024046.70	-12.51848	-38.04388
C13	<b>0.06857</b>	<b>0.40953</b>	1.80	2.20	1.10	1.00	0	0	39	0	0	91.9	0	3.00	1119361.90	-12.51760	-38.04838
C14	<b>0.80503</b>	<b>-0.02222</b>	1.10	2.60	1.90	1.10	0	0	79	0	0	85.0	0	1.55	1118586.90	-12.51924	-38.04450
C15	<b>1.44421</b>	<b>1.05744</b>	2.30	2.90	2.10	1.30	0	4	46	77	0	38.0	1	1.37	1067191.10	-12.52477	-38.04052
C16	<b>0.65735</b>	<b>0.76368</b>	2.30	2.30	2.10	1.00	0	0	38	0	0	89.0	0	6.04	1055191.10	-12.51753	-38.05147
C17	<b>-0.10065</b>	<b>-0.28203</b>	1.30	1.70	1.30	1.00	0	0	55	64	0	60.0	1	3.03	1105334.70	-12.52759	-38.04138
C18	<b>-0.045</b>	<b>0.11216</b>	1.50	2.20	1.00	1.00	0	18	52	0	0	48.0	1	2.40	1089578.80	-12.52702	-38.04272
C19	<b>0.48366</b>	<b>0.89022</b>	2.10	2.70	1.40	1.00	0	0	41	0	0	54.0	1	2.57	1114918.80	-12.52693	-38.04444
C20	<b>0.23763</b>	<b>0.02693</b>	1.40	2.20	1.50	1.00	0	9	49	3	0	71.0	1	2.69	1098443.20	-12.52697	-38.04532
S1	<b>-0.2972</b>	<b>-0.97269</b>	2.00	1.44	1.00	1.00	0	5	29	0	0	91.0	0	1.68	1129671.8	-12.56010	-38.04664
S2	<b>-0.01259</b>	<b>-0.46655</b>	2.40	2.00	1.00	1.00	0	6	40	0	0	99.0	0	1.61	1130419.50	-12.55875	-38.04521
S3	<b>-0.46648</b>	<b>1.12576</b>	2.00	1.00	1.00	1.00	0	59	34	32	0	96.0	0	1.67	1158407.60	-12.56330	-38.03995
S4	<b>0.1548</b>	<b>0.71879</b>	2.00	2.30	1.00	1.00	0	4	34	0	0	100.0	0	2.87	1198063.90	-12.56397	-38.03930
S5	<b>0.06544</b>	<b>0.18035</b>	1.30	2.40	1.00	1.00	0	19	23	0	0	90.0	0	1.66	1127723.50	-12.56576	-38.03867

Parcela	PC1 rank	PC2 rank	0-5m	5-10m	1015m	+ de 15m	brom gig	brom	tron	rsom	rexp	%fol	água	dens veget	cobertura	Latitude	Longitude
S6	0.36286	0.23485	1.40	3.0	1.00	1.00	0	0	31	0	0	100.0	0	1.167	1147759.40	-12.57007	-38.03519
S7	0.64269	0.09322	2.30	3.0	1.30	1.00	0	0	40	0	0	100.0	0	3.36	1177380.40	-12.56817	-38.02882
S8	-	0.4948	2.00	1.9	1.00	1.00	0	0	13	39	0	82.0	1	0.85	980127.60	-12.56944	-38.04111
S9	0.30096	1.2989	2.25	2.8	1.00	1.00	6	0	20	24	0	98.9	1	1.80	1067595.00	-12.57489	-38.04134
S10	0.52199	0.23432	2.00	3.4	1.00	1.00	0	5	10	10	0	78.0	1	1.90	1076138.20	-12.56556	-38.04181
S11	0.3526	1.04488	2.11	2.8	1.00	1.00	0	9	160	0	0	36.0	0	2.62	1124286.50	-12.56860	-38.03812
S12	0.19709	1.09256	1.80	2.6	1.00	1.00	0	5	50	0	0	28.0	0	3.03	1125528.00	-12.56732	-38.03741
S13	-0.30497	1.01369	1.80	1.5	1.00	1.00	0	0	61	192	64	11.5	0	0.69	1115164.70	-12.57151	-38.03830
S14	-0.45653	0.61234	2.20	1.0	1.00	1.00	0	0	6	0	0	95.0	0	0.64	1150702.70	-12.57305	-38.03772
SO15	-0.53331	0.07143	2.20	1.1	1.00	1.00	0	0	6	75	9	96.0	0	1.65	1031568.70	-12.57325	-38.03911
SO16	-0.87328	0.2263	1.40	1.1	1.00	1.00	0	6	16	60	0	81.0	1	0.52	767977.70	-12.56846	-38.03767
S17	-0.55696	0.09855	1.70	1.1	1.20	1.00	0	7	32	0	0	71.0	1	0.77	941205.00	-12.57046	-38.03326
S18	-	0.84498	3.30	1.0	1.00	1.00	0	0	50	0	0	100.0	0	1.75	1123915.60	-12.56978	-38.03333
P1	-0.3859	0.06694	2.00	2.6	1.00	1.00	0	1	56	0	0	100.0	0	0.97	1081916.60	-12.56921	-38.03120
P2	-0.18684	0.74657	1.90	2.3	1.00	1.00	0	0	32	0	0	38.0	1	0.47	871701.00	-12.57217	-38.03417
P3	-1.09381	-1.00144	1.80	1.1	1.00	1.00	2	787	11	0	0	53.0	1	1.71	516740.56	-12.56913	-38.00620
PO4	-0.51504	0.50419	2.70	1.0	1.00	1.00	9	403	14	0	0	97.0	1	3.07	1049648.50	-12.56981	-38.00708
PO5	-0.56334	0.20013	2.40	1.1	1.00	1.00	9	917	24	0	0	92.5	1	6.66	984648.10	-12.57184	-38.00837
P6	-1.25743	-1.58356	1.30	1.0	1.00	1.00	2	1124	4	0	0	44.0	0	2.61	443749.00	-12.57228	-38.00778
PO7	-1.38511	-1.76808	1.30	1.0	1.00	1.00	0	867	0	0	0	42.5	0	0.70	318514.70	-12.57006	-38.00576
P8	-0.73763	-0.17994	2.20	1.0	1.00	1.00	0	97	28	5	0	92.0	1	3.48	874991.60	-12.56795	-38.00554
P9	-1.13529	-1.62451	1.00	1.0	1.00	1.00	0	1000	4	0	0	28.0	0	2.27	589748.90	-12.56810	-38.00449
PO10	-0.64305	-0.06004	2.20	1.1	1.00	1.00	0	105	29	7	0	97.0	1	4.02	923935.50	-12.56656	-38.00452
PO11	-0.91152	-0.93868	1.50	1.0	1.00	1.00	5	16	31	3	0	80.0	1	2.60	765559.45	-12.56489	-38.00352
PO12	-1.45443	-1.5783	1.70	1.0	1.00	1.00	0	661	2	0	0	36.0	0	0.09	215589.00	-12.57067	-37.99909
P13	-1.43702	-1.69812	1.50	1.0	1.00	1.00	0	1010	1	0	0	28.0	0	0.03	250130.10	-12.56864	-37.99828
P14	-1.71811	-2.4668	1.00	1.0	1.00	1.00	0	394	0	0	0	11.5	0	0.87	18090.20	-12.57003	-38.00074
P15	-0.4333	0.41019	2.50	1.4	1.00	1.00	0	8	22	0	0	95.0	1	0.25	971988.50	-12.56915	-38.00270
S6	0.44621	1.55763	2.70	3.0	1.00	1.00	18	6	27	0	0	96.0	1	2.58	1115979.40	-12.56824	-38.00178
S7	0.96968	1.36911	2.70	2.7	1.30	1.30	0	7	28	0	0	94.0	1	3.65	1097805.20	-12.56708	-38.00081

Parcela	PC1 rank	PC2 rank	0-5m	5-10m	1015m	+ de 15m	brom gig	brom	tron	rsom	rexp	%fol	água	dens veget	cobertura	Latitude	-37.99996
P16	-1.63594	1.04664	1.00	1.0	1.00	1.00	0	449	0	0	0	16.0	0	3.26	98687.60	-12.57268	-38.00035
PO17	-1.69503	-2.34805	1.40	1.0	1.00	1.00	0	635	0	0	0	26.0	0	5.74	5799.40	-12.57173	-38.00265
PO18	-1.60881	-2.14348	1.20	1.0	1.00	1.00	0	822	2	0	0	10.0	0	0.13	107831.40	-12.56899	-38.00064

Apêndice II. Dados de fauna.a. Abundância. Abreviaturas: Abu = Abundância, NMS = posição da parcela no eixo NMS de composição; Bog = *Bogertia lutzae*; Col = *Coleodactylus meridionalis*; Gym = *Gymnodactylus darwini*; Hem = *Hemidactylus mabouia*; Phy = *Phyllopezus polcaris*; Ame = *Ameiva ameiva*; CnA = *Cnemidophorus abaetensis*; CnO = *Cnemidophorus ocellifer*; Ken = *Kentropyx calcarata*; Tup = *Tupinambis merianae*; Dry = *Dryadosaura nordestina*; Lep = *Leposoma annectans*; TrH = *Tropidurus hygomi*; TrS = *Tropidurus semitaeniatus*; Str = *Strobilurus torquatus*; AnF = *Anolis fuscoauratus*; AnP = *Anolis punctatus*; Eny = *Enyalius catenatus*; Pol = *Polychrus marmoratus*; Mab = *Mabuya macrorhyncha*, Mic = *Micrablepharus maximiliani*. C = Camurujipe; S = Sapiranga; P = Praia do Forte. O = hábitat aberto.

Parcela	NMS	Abu	Col	Bog	Gym	Hem	Phy	Ame	CnA	CnO	Ken	Tup	Dry	Lep	Mic	TroH	TrS	Str	AnF	AnP	Eny	Pol	Mab
C1	-1.91	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
C2	-0.7	4	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C3	-1.91	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
C4	-0.43	10	7	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
C5	-0.79	12	6	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
C6	-0.67	5	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C7	-0.51	6	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C8	-0.71	6	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
C9	-0.72	13	3	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	4	0	0
C10	-0.18	3	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
C11	-0.36	4	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
C12	-0.69	6	3	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
C13	-0.48	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C14	-0.12	5	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
C15	-1.15	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0
C16	-1.44	2	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C17	-1.43	4	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0
C18	-0.52	7	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C19	-0.61	7	3	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
C20	-0.58	8	3	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	2	0	0	0
S1	-0.54	7	4	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
S2	-0.4	8	3	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
S3	-1.06	4	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0

	NMS	Abu	Col	Bog	Gym	Hem	Phy	Ame	CnA	CnO	Ken	Tup	Dry	Lep	Mic	TroH	TrS	Str	AnF	AnP	Eny	Pol	Mab
S4	-0.47	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
S5	-0.31	8	2	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0
S6	-0.48	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S7	-0.25	5	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
S8	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S9	-0.02	15	2	6	5	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S10	-0.3	8	2	0	4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
S11	-0.41	12	6	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
S12	-1.02	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
S13	-0.22	22	4	0	5	0	1	3	0	0	1	0	0	0	0	0	6	0	2	0	0	0	0
S14	0.04	14	2	2	2	0	2	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3
SO15	-0.25	6	1	0	2	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
SO16	0.26	9	7	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
S17	-0.03	8	3	0	2	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
S18	-0.51	4	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P1	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P2	-1.47	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P3	1.11	12	1	1	0	0	0	0	1	0	0	0	0	0	0	9	0	0	0	0	0	0	0
PO4	0.69	18	2	2	0	0	0	1	4	0	1	0	0	0	0	7	0	0	0	0	0	0	1
PO5	0.74	15	1	2	1	0	0	1	4	0	1	0	0	0	0	5	0	0	0	0	0	0	0
P6	1.61	16	0	1	0	0	0	0	1	1	0	0	0	0	0	13	0	0	0	0	0	0	0
PO7	1.67	26	0	1	0	0	0	0	5	1	0	0	0	0	0	19	0	0	0	0	0	0	0
P8	1.47	11	0	0	0	0	0	0	4	0	1	0	0	0	0	5	0	0	0	0	0	0	1
P9	1.41	4	0	0	0	0	0	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0
PO10	1.5	18	0	0	0	0	0	0	2	0	2	0	0	0	0	13	0	0	0	0	0	0	1
PO11	1.48	14	0	0	0	0	0	0	2	0	2	0	0	0	0	10	0	0	0	0	0	0	0
PO12	0.91	9	1	0	0	0	0	0	0	0	0	1	0	0	0	7	0	0	0	0	0	0	0
P13	1.55	15	0	2	0	0	0	0	1	2	0	0	0	0	0	9	0	0	0	0	0	0	1
S4	1.61	20	0	2	0	1	0	0	4	1	0	0	0	0	0	12	0	0	0	0	0	0	0
S5	0.11	5	2	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0







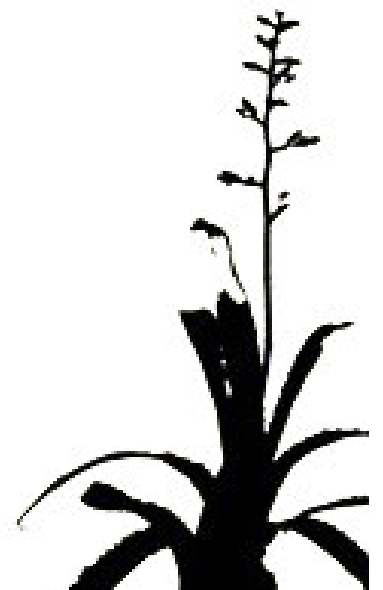


Parcela	Biom	Col	Bog	Gym	Hem	Phi	Ame	CnA	CnO	Ken	Tup	Dry	Lep	Tro	Tro	Str	AnF	AnP	Eny	Pol	Mab	
P15	21.77	0	5.93	0	0	0	0	0	0	0	0	0	15.84	0	0	0	0	0	0	0	0	0
P16	11.82	2.14	0	0	0	0	7.31	0	0	0	0	0	2.37	0	0	0	0	0	0	0	0	0
PO17	49.93	0	0	3.70	0	5.82	0	0	0	0	0	0	33.86	0	0	0	0	0	0	6.55	0	
PO18	103.13	5	0	0	0	0	41.18	4.57	0	0	0	0	52.38	0	0	0	0	0	0	0	0	0
PO19	101.32	0	0	0	0	0	23.45	9.82	0	0	0	0	64.19	0	0	0	0	0	0	3.86	0	



## Apêndice fotográfico

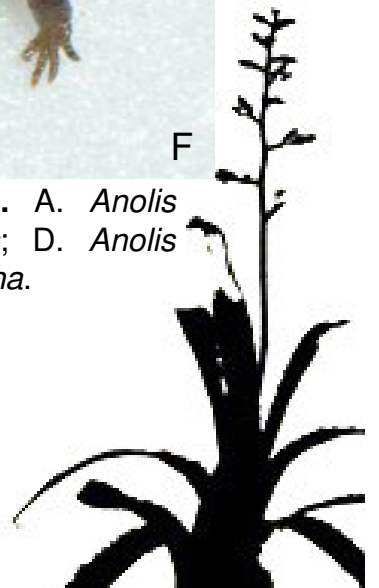
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**Espécies de lagartos amostradas durante os estudo I. A. *Anolis punctatus*; B. *Leposoma annectans*; C. *Enyalius catenatus*; D. *Anolis fuscoauratus*; E. *Strobilurus torquatus*; F. *Dryadosaura nordestina*.**

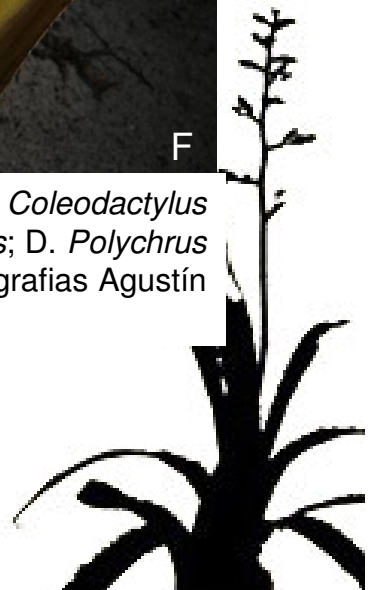
Fotografias: Agustín Camacho.





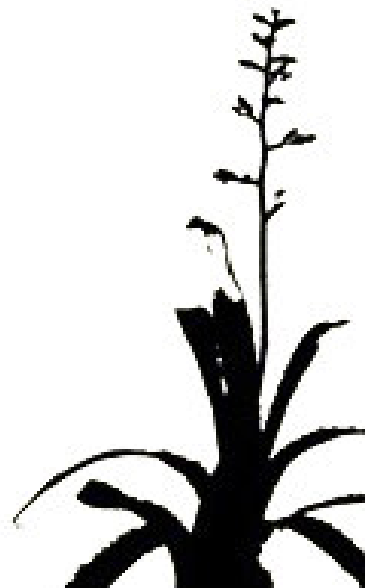


**Espécies de lagartos amostradas durante os estudo II.** A. *Coleodactylus meridionalis*; B. *Gymnodactylus darwinii*; C. *Phyllopezus polycaris*; D. *Polychrus marmoratus*; E. *Mabuya macrorhyncha*; F. *Bogertia lutzae*. Fotografias Agustín Camacho.





**Espécies de lagartos amostradas durante os estudo III.** A. *Tropidurus semitaeniatus*; B. *Tropidurus hygomi*; C. *Cnemidophorus abaetensis*; D. *Cnemidophorus ocellifer*. Fotografias: Agustín Camacho.







**Principais tipos de ambiente amostrados durante o estudo.** A =Mata fechada em Camurujipe; B= Afloramento rochoso em Sapiranga; C = Restinga em Praia do Forte; D = Borda de mata com bambuzal em Camurujipe. Fotos: Agustín Camacho





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