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Habitat Structural Effect on Squamata Fauna of the Restinga Ecosystem in Northeastern Brazil

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ABSTRACT

In this work, we surveyed data on richness and composition of squamatan reptiles and habitat structural effect in nine areas of restinga ecosystem in the State of Bahia, northeastern Brazil. The "restinga" ecosystems are coastal sand dune habitats on the coast of Brazil. Our main hypothesis is that the Squamata fauna composition along these restinga areas would be modulated by habitat structural. After 90 days of field sampling we recorded approximately 5% of reptile species known in Brazil. The composition of Squamata assemblages varied mainly based on the presence or absence of lizards of the genera *Ameivula and Tropidurus*. Our data showed that habitat structure consistently affected the composition of local Squamata fauna, especially lizards.

Key words: gradient analyses, habitat structure, lizards and snakes, restinga ecosystem, Northeastern Brazil.

INTRODUCTION

The organization of assemblages in terms of species diversity, their abundances and niche relationships among component species is an interesting issue of ecology. Studies on lizard assemblages suggest that sympatric species may segregate primarily for food, activity period and habitat, but the causes of segregation are still unknown (e.g. Pianka 1973, 1986, Schoener 1974, Losos 1994). However, different trends are related with the maintenance of the interactions among sympatric species in the assemblages (Schoener 1968, Pianka 1973, Vitt 1995, Vitt and Carvalho 1995). The nature of these ecological trends varies taxonomically and between locations, indicating that other factors (e.g. phylogeny, biogeography) have important role in determining the composition of the present species in the different assemblages (Losos 1994, Vitt 1995, Vitt et al. 1999).

Many studies have shown that biogeographic factors may be responsible for differences between assemblages and most analyses have provided general explanations based on historical factors (e.g. Haffer 1969, Vanzolini 1988, Losos 1994).

In this context of evolution, phylogeny and biogeography, knowing why some assemblages tend to harbors more species than others is one of the interesting questions in community ecology. In terms of evolution, the patterns of speciation or extinction generally define the set of species available in

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determined areas as a result of environmental differences between regions (Losos 1994).

The "restinga" ecosystem (coastal sand dune habitats), in the coast of Brazil, can be subdivided into different zones, characterized by the local topography and floristic physiognomy (Dansereau 1947, Ormond 1960, Araujo et al. 1998, Cogliatti-Carvalho et al. 2001, 2010). The variation in the composition and structure of vegetation in the restinga along the Brazilian coast is affected by environmental variables such as salinity, salt spray, sand movement, humidity and soil quality (nutrients), as well as variation of groundwater level (Ormond 1960, Franco et al. 1984, Henriques et al. 1986, Pereira et al. 1992). In this context, usually there is an environmental gradient which increases the spatial heterogeneity in the restinga from the beach habitats of restinga (just seaside) towards the more shaded environments with vegetation (Lacerda et al.1993, Cogliatti-Carvalho et al. 2001).

The species of plants along restinga differ in terms of abundance, richness and dominance, and these differences can be translated in habitat types in this environment (Scarano 2002, Araujo et al. 2004, Cogliatti-Carvalho et al. 2010). Thus, the distribution of these habitat types in nature in the restinga plays an important role in the success of the local animals species and may directly affect structural aspects of their assemblages such as richness, abundance and composition of the communities (Rocha and Bergallo 1997).

Herein we analyze parameters of the Squamata fauna including species richness and composition, occurrences and distribution based on standardized surveys in nine restinga ecosystems in the State of Bahia along approximately 1,200 km of Brazilian coast in northeastern Brazil. Our main hypothesis is that the Squamata fauna composition along these restinga areas on the coast of the State of Bahia would be modulated by habitat structured on the local ecosystems.

MATERIALS AND METHODS

We surveyed data of richness and composition of squamatan reptiles, including features of habitat structure in nine areas of the restinga ecosystem along approximately 1,200 km on the coast of the State of Bahia, several of them located within the Central Biodiversity Corridor of the Atlantic Forest domains in Brazil. We studied the following areas: Costa Azul (11°40'28" S and 37°29'03" W) in the municipality of Jandaíra, Baixio (12°07'01" S and 37°42'12" W) in Esplanada, Guarajuba (12°38'03" S and 38°04'32" W) in Camaçari, Abaeté (12°55'42" S and 38°20'09" W) in Salvador, Guaibim (13°17'43" S and 38°57'59" W) in Valença, Boipeba (13°36' S and 38°54'W) in Cairú, Cassange (13°58' S and 38°56'W) in Maraú, Taipe (16°31'S and 39°05' W) in Porto Seguro and Nova Viçosa (17°58'26"S and 39°28'29"W) (Fig. 1).

The data were obtained in each restinga during the dry seasons (September to February) in 2003, 2004 and 2005; the sampling periods involved 10 consecutive days in each of the nine areas studied during which we made an intensive survey of the local Squamata fauna. In each locality we surveyed the Squamata fauna establishing 20 systems of pit-fall traps, each of them composed of five plastic buckets - one central of 60 L associated with four of 20 L and arranged in an "X" way with a central bucket connected to each of the four peripheral buckets by a 5 m long fence. Each system of pitfall trap was placed at a distance of at least 150m from each other, following the environmental gradient in the restinga, from coastline (seashore) towards inland, where there were more shaded environments. Additionally, 12 glue traps (with 0.08 m^2 dimension each) were used in the surroundings of each pitfall trap system, which were established on the ground or on the base of bromeliads. Thus, each pit-fall system with the set of glue traps constituted one sampling unit. All traps were checked daily between 7:00 to 18:00. We also carried out an intensive active search constrained by time in different areas of the restinga. We systematically

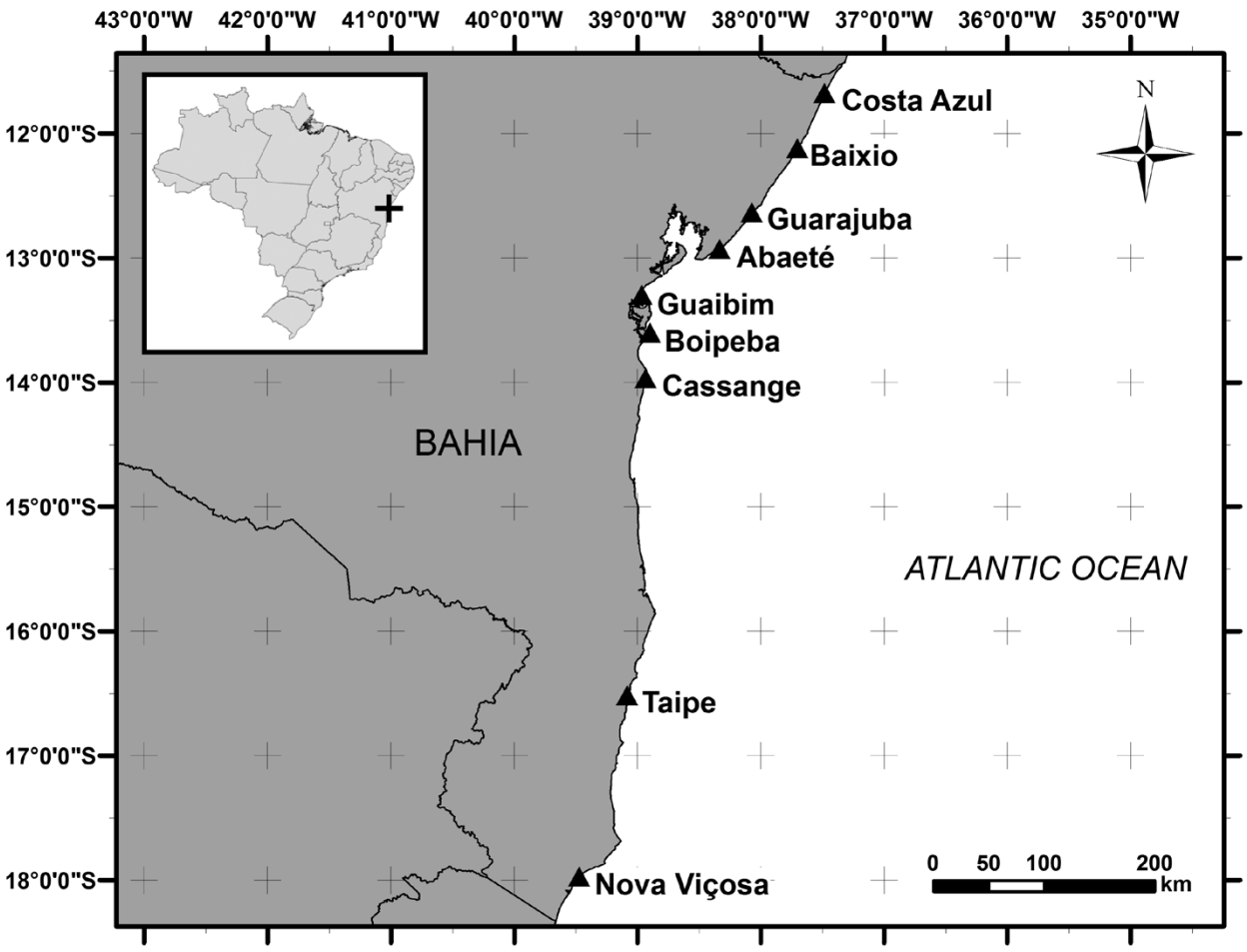

Fig. 1 - Sampled localities of nine restinga ecosystems along in the coast of the State of Bahia, northeastern Brazil.

moved at a slow walking pace in different transects (about 30 min. each) from coastline towards inland along which we searched for Squamata reptiles in the different environments of the restinga.

The captured lizards were marked by toe clipping and released at the capture site to avoid registering a same individual twice and thus preserving the independence of data. The snakes and amphisbaenians (as well as 20 lizards of each species) were euthanized with ether, fixed with 10% formalin, preserved in alcohol as voucher specimens and deposited in the Museu de Zoologia da Universidade Federal da Bahia (MZUFBA). Recaptured lizards were not included in the analyses. All Squamata were collected under the IBAMA-RAN permit 056/02, 001/04 and 161/04).

We estimated some parameters of the habitat structure as an index of environmental heterogeneity along sampling units to evaluate the effect of features of the local environment of the restinga on the corresponding Squamata fauna surveyed. We established plots (3 x 3 m) with a 50m distance from each other, between each system of pitfall traps. In each plot we measured the occurrence or not of bromeliads and palm trees and registered their abundances, the vegetation height (m) and frequency of clearings (represented by the space of uncovered ground in meters between bushes).

The species richness of Squamata was estimated by the Jackknife index for the construction of rarefaction curve (Krebs 1989) considering

data from pooled sampling methods. To evaluate the effect of environmental heterogeneity between the areas we used the analysis of variance (ANOVA) and Bonferroni test (Zar 1999), as further examination of significance for differences between pairs of restingas. The relationship between richness and abundance of Squamata species and variables of environmental heterogeneity measured was performed using multiple regression analysis (Zar 1999).

We calculated the rate of species co-occurrence (C-score) (Stone and Roberts 1990), and the significance was tested by comparing them with null communities using the software ECOSIM (Gotelli and Entsminger 2001).

The multidimensional scaling (MDS) was applied to evaluate the similarity between restinga areas in terms of composition of Squamata species and of environmental heterogeneity and Biplot ordination analysis to describe which variables interfered in the data ordination (Kenkel and Orlóci 1986, Minchin 1997).

RESULTS

After 90 days of field sampling, corresponding to 1800 systems of pitfall traps sampling plus 495h/man of visual search, we captured 1101 individuals of 36 squamatan species: 20 (55.5%) were lizards, 14 (39%) snakes and two (5.5%) amphisbaenians (Table I).

TABLE I

Composition and abundance of 36 Squamata species from nine restinga ecosystems studied along the coast of the State of Bahia, northeast Brazil. Study areas abbreviations: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

Squamata species	Study Areas								
	CA	BX	GJ	ABT	GB	BP	CS	TA	NV
Lizards									
Ameivula abaetensis	26	15	08	23					
Ameivula nativo						05	02	18	03
Ameivula ocellifera	18	12	08	07					
Kentropyx calcarata					03	02	06	02	04
Ameiva ameiva			01		01	02	06	05	04
Salvator merianae	01					01			
Tropidurus hygomi	77	171	158	141					
Tropidurus torquatus					21	11	98	67	26
Polychrus marmoratus					01				
Iguana iguana	01	01							
Psycosaura macrorhyncha	08	07	06	02		02	08		01
Psycosaura agmosticha	02								
Brasiliscincus agilis							02		
Phyllopezus lutzae	01		05	01		01	01		
Coleodactylus meridionalis	01	06	03				02		
Gymnodactylus darwinii						07	09	06	08
Hemidactylus mabouia	01			01				01	06
Micrablepharus maximiliani		01							01
Ecpleopus gaudichaudi									15
Leposoma annectans								02	
Dryadosaura nordestina	01								
Amphisbaenians									
Amphisbaena alba	01	01							
Amphisbaena pretrei				01					

TABLE I (continuation)

Squamata species	Study Areas								
	CA	BX	GJ	ABT	GB	BP	CS	TA	NV
Snakes									
Boa constrictor						02			
Phimophis guerini	01		01						
Sibynomorphus neuwiedi	01								
Oxyrhophus trigeminus		01							
Chironius exoletus					01				
Chironius bicarinatus	01			01	03		01		
Chironius flavolineatus					01				
Philodryas olfersii				01		01			01
Philodryas nattereri			01						
Philodryas patagoniensis		02							
Spilotes pullatus	01								
Tantilla melanocephala							01		01
Leptophis ahethulla					01				
Thyphlops brongersmianus						02			

Among the nine studied restinga areas, Costa Azul was the richest with 15 species of Squamata (10 lizards, 01 snake and 04 amphisbaenians). The lowest richness was found in Taipe with 07 species of reptiles (only lizards) (Table I). The rarefaction curve showed the species richness in the studied areas (Fig. 2).

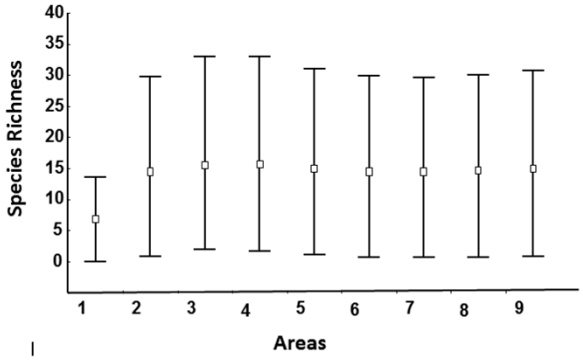

Fig. 2 - Rarefaction curve showing the species richness estimate by Jackknife index in nine restinga ecosystems studied on the coast of the State of Bahia, Brazil.

The analysis of co-occurrence (C-score) suggests that the distribution of species was not random in the Squamata assemblages studied (C-score obtained = 2.80; simulated C-score = 2.63; P = 0.001; 1000 permutations), since the rate of co-occurrence of the species was significantly greater than expected.

The species composition of Squamata assemblages varied mainly as a result of the presence or absence of lizards of the genus *Ameivula and Tropidurus*. The MDS (*stress* = 0.284, R^2 = 0.998) showed that three of the restinga areas located in the northern portion of the coast of the State of Bahia (Baixio, Guarajuba and Abaeté), were comparatively more similar in terms of lizard species composition. Similarly, the same analysis showed that three restinga areas located in the southern portion of the State of Bahia (Guaibim, Boipeba and Nova Viçosa), presented comparable similarity in terms of lizards species (Fig. 3). The Biplot analysis showed that the lizards *Ameivula abaetensis*, *A.nativo, A.ocellifera, Tropidurus hygomi and T. torquatus* were responsible for grouping the nine studied restinga areas into two distinct groups (Fig. 4 and 5).

The restinga of Costa Azul had the highest values of mean abundance of bromeliads and of palm trees (9.7 ± 10.7 and 4.5 ± 6.3 respectively) whereas the restinga of Baixio had the highest mean frequency of clearings (0.56 ± 0.37) and the lowest mean value for vegetation height (1.6 ± 1.24 m) (Table II).

The habitat stucture differed significantly between the nine areas: ANOVA, vegetation height $F_{8, 216}$ = 13.442, P <0.01; frequency of clearings

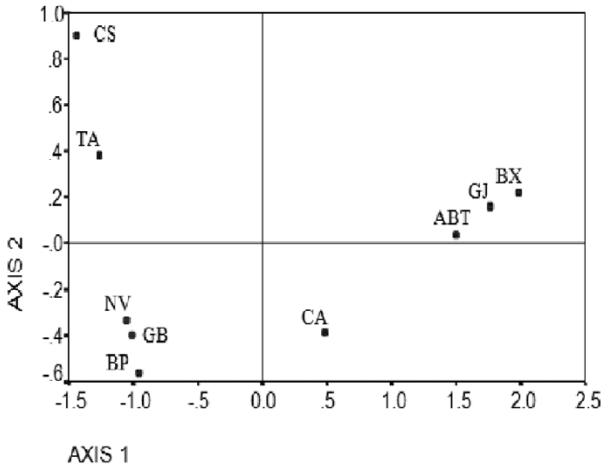

Fig. 3 - Multidimensional Scaling (MDS) comparing Squamata species composition among the nine restinga ecosystems studied on the coast of the State of Bahia, Brazil: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

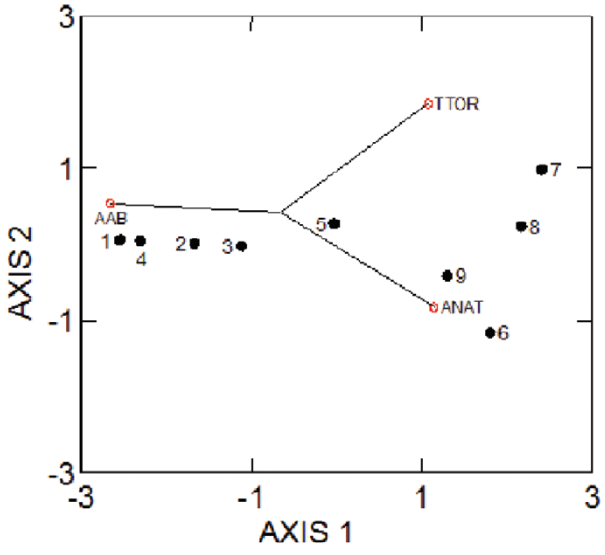

Fig. 4 - Biplot of Squamata species x studied areas of restinga ecosystems on the coast of the State of Bahia, Brazil, using three lizards species, *Ameivula abaetensis* (AAB), *Ameivula nativo* (ANAT) and *Tropidurus torquatus* (TTOR) as correspondence analysis factors: 1 = Costa Azul; 2 = Baixio; 3 = Guarajuba; 4 = Abaeté; 5 = Guaibim; 6 = Boipeba; 7 = Cassange; 8 = Taipe; 9 = Nova Viçosa.

$F_{8, 216} = 6.27$, $P < 0.01$; number of bromeliads $F_{6, 170} = 3.018$, $P < 0.01$ and number of palm trees $F_{6, 170} = 6.257$, $P < 0.01$ (Appendices 1-4).

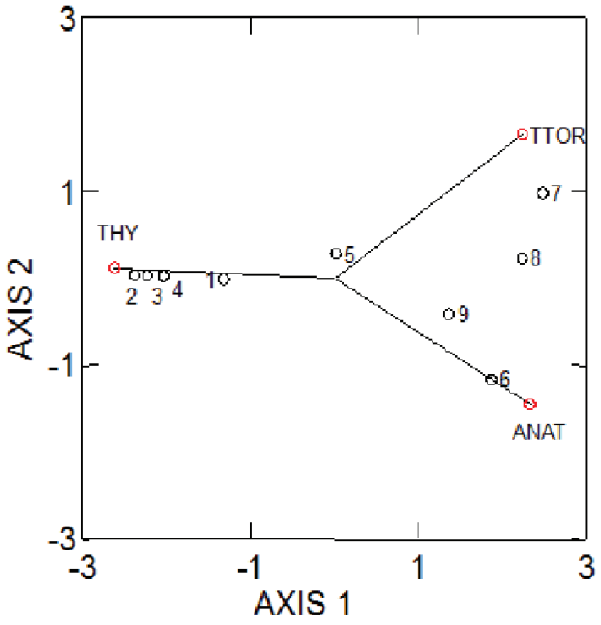

Fig. 5 - Biplot of Squamata species x studied areas of restinga ecosystems on the coast of the State of Bahia, Brazil, using three lizards species *Ameivula nativo* (ANAT) and *Tropidurus torquatus* (TTOR) and *Tropidurus hygomi* (THY) as correspondence analysis fators: 1 = Costa Azul; 2 = Baixio; 3 = Guarajuba; 4 = Abaeté; 5 = Guaibim; 6 = Boipeba; 7 = Cassange; 8 = Taipe; 9 = Nova Viçosa.

The multidimensional scaling (MDS) showed that the restinga of Boipeba, Taipe and Nova Viçosa (*stress* = 0.111, $R^2 = 0.956$) were comparatively more similar in terms of the complexity of habitat structure, and that the restinga of the Costa Azul was the most different among the other eight studied restinga areas (Fig. 6).

The multiple regression analysis showed that the richness of Squamata species was significantly affected ($R^2 = 0.941$, $N = 9$, $P < 0.05$) by parameters of habitat structure of the restinga. However, only frequency of clearings explained an additional portion of the variation in species richness after factoring out the effect of the other variables of heterogeneity analyzed ($P = 0.039$).

Appendices 5 and 6 show the significance levels between abundance of Squamata species and the vegetation height and frequency of clearings in each restinga. These two variables significantly

TABLE II
Mean, standad deviation (with range within parentheses) of vegetation height, frequency of clearings, bromeliads and palm trees of nine areas of restinga ecosystems studied along the coast of the State of Bahia : CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

Study Areas	Environmental Variables			
	Vegetation height (m)	Frequency of clearings	Bromeliads	Palm trees
CA	3.7 ± 2.07 (0.3 – 8.0)	0.09 ± 0.13 (0.0 – 0.4)	9.7 ± 10.7 (0 – 35)	4.5 ± 6.3 (0 – 21)
BX	1.6 ± 1.2 (0.2 – 5.0)	0.56 ± 0.37 (0.0 – 1.0)	3.1 ± 6.3 (0 – 40)	0.8 ± 1.9 (0 – 9)
GJ	1.25 ± 1.5 (0.0 – 6.0)	0.38 ± 0.45 (0.0 – 1.0)	4.3 ± 9.3 (0 – 40)	0.6 ± 1.6 (0 – 7)
ABT	1.8 ± 2.18 (0.0 – 7.0)	0.24 ± 0.33 (0.0 – 1.0)	1.7 ± 3.7 (0 –13)	0.4 ± 1.4 (0 – 6)
GB	5.6 ± 2.17 (0.1 – 8.0)	0.09 ± 0.28 (0.0 – 1.0)	0.87 ± 1.8 (0 – 6)	0.26 ± 0.61 (0 – 2)
BP	3.5 ± 2.5 (0.3 – 9.0)	0.3 ± 0.4 (0.0 – 1.0)	2.7 ± 11.7 (0 –55)	1.1 ± 1.7 (0 – 5)
CS	5.2 ± 3.2 (0.15 – 10.0)	0.08 ± 0.23 (0.0 –1.0)	0.71 ± 1.6 (0 – 7)	3.6 ± 5.5 (0 – 16)
TA	4.7 ± 2.2 (0.5 – 9.0)	0.08 ± 0.2 (0.0 – 0.69)	2.2 ± 6.9 (0 – 30)	0.19 ± 0.69 (0 – 3)
NV	4.0 ± 2.5 (0.0 – 8.0)	0.16 ± 0.37 (0.0 – 1.0)	2.9 ± 5.4 (0 – 20)	1.5 ± 2.2 (0 – 8)

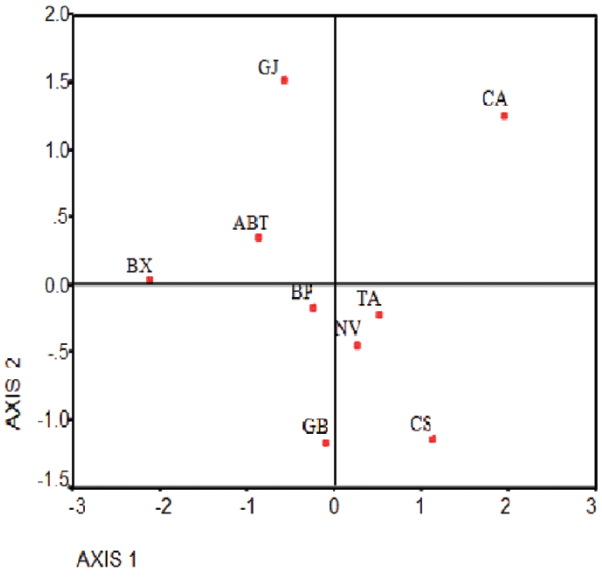

Fig. 6 - Multidimensional Scaling (MDS) comparing the attributes, frequency of occurrence of bromeliads and palm trees, vegetation height and frequency of clearings between the nine restinga ecosystems studied on the coast of the State of Bahia, Brazil: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

affected the distribution of some lizards species such as the lizard *Ameivula ocellifera* and *A. nativo and Tropidurus torquatus*, whose abundances were positively affected by the occurrence of areas with high proportion of clearings. The abundance of *Tropidurus hygomi* was positively and significantly affected by vegetation height and frequency of clearings. *Ecpleopus gaudichaudi*, the most abundant reptile species in Nova Viçosa, had its abundance positively and significantly affected by vegetation height. In this study, the number of bromeliads and palm trees did not vary significantly among restingas studied and therefore had no significant effect on the abundance of Squamata species.

DISCUSSION

The restinga areas located in the north and south of the State of Bahia were comparatively different in terms of lizards species, and habitat structure may have been the main cause of this difference. The genera *Ameivula* and *Tropidurus* were responsible for major differences in species composition of the Squamata assemblages.

The pooled richness (Gama diversity) of Squamata in restinga ecosystems in the State of Bahia recorded 36 species or, approximately 5% of reptile species known for Brazil. This is indicative that the restingas of the State of Bahia reserve a considerable portion of Brazilians´ biological diversity and emphasizes the importance of conservation of these ecosystems. It was possible to obtain the first records of occurrence of *Ecpleopus gaudichaudi* (gymnophthalmids) (Dias and Rocha 2013) for

the State of Bahia, extending the species known distribution from the State of Espírito Santo and first records for *Psycosaura agmosticha* for restinga ecosystem (Dias and Rocha 2013). This species is a typical species of the semiarid Caatinga domain (Rodrigues 2000).

Populations of snakes and amphisbeaenians species were relatively less abundant when compared to lizard species. For this reason, most of the information obtained in this study was related to lizards' species.

Our data are suggestive that aspects of structure of vegetation (as vegetation height or occurrence of clearings) affected the richness and abundance of lizard species, by supposedly creating different microhabitat opportunities for particular lizard species, since some species are favored by more closed habitats whereas other are favored by more opened portions of habitat (Rocha and Bergallo 1997). Vegetation can affect patterns of local species diversity and abundance in reptile assemblages, and vegetation height is the variable which has been demonstrated as being the most important in affecting the distribution of vertebrates species in restinga ecosystem (e.g. Rocha and Bergallo 1997, Cerqueira and Freitas 1999, Sawchik et al. 2003, Dias and Rocha 2004, 2007). The vertical increase in the height of vegetation tend to increase the diversity of flora and fauna of its surroundings (Pereira et al. 2001, Assis et al. 2004, Rocha et al. 2004).

Our data showed differences in the lizards assemblages in the coast of Bahia according to their species components. The restinga of the north coast (with the exception of Costa Azul) had the lowest species richness when compared to those of the southern portion of the state. These areas also differed in terms of vegetation structure, especially regarding vegetation height and frequency of clearings; two environmental variables which clearly affected the patterns of spatial heterogeneity within the ecosystem.

It has been suggested that there are some distributional limits for most lizard species registered for restinga along the eastern coast of Brazil (Vanzolini 1988). In the limit of approximately 19° S there is a break in the distribution of many species, resulting in considerable differences in species composition northwards and southwards of this limit (Vanzolini 1988). The interruption occurrence of many species near this latitude has been attributed to climatic variation, especially temperature zonation (Vanzolini 1988). Heyer (1988) argued the existence of a gradient of rainfall and temperature regimes in the Atlantic Forest Domain from North towards South, whereas Rocha (2000) suggested a region enclosing the northern portion of the State of Espírito Santo and southern portion of the State of Bahia as limits of different coastal climatic regimes that could affect several reptile species, resulting in differences in the local component of reptile assemblage. Another factor out as being important with regards to influencing reptile fauna distribution in the Atlantic Forest is the presence of the large Doce river, which seems to also influence southern and northern geographic limits of the distribution for many species (Rocha 2000). According to a theory (Jakson 1978), this region was considered a Pleistocene refuge area between the north of the State of Espírito Santo and the south of the State of Bahia which currently coincides with several breaks in the distribution of some lizard species (e.g. genus *Enyalius and Strobilurus*) leading to geographical differences in species distribution.

Our study showed that three lizard species of the genus *Ameivula* were found along the coast of the State of Bahia. However, some segregation in distribution among these species were noticed: *Ameivula abaetensis and A. ocellifera* had a distribution restricted to the northern coast and *A. nativo* to the southern coast. Similarly, the genus *Tropidurus* had two species distributed in the same area, with *T. hygomi* occurring only in the northern portion of coastal restingas while *T. torquatus* occurred in the southern portion of the coast. Amongst these five species *Ameivula abaetensis, A. nativo* and *Tropidurus hygomi* are known to occur only in restinga and thus, are endemic to this ecosystem.

On the other hand *T. torquatus and A. ocellifera* occur widely in other Brazilian ecosystems such as the Atlantic Forest (*sensu stricto*), the Cerrado, the Caatinga and rocky fields (Vanzolini et al. 1980, Vitt 1991, 1995, Vitt and Carvalho 1995).

These lizards of the genera *Ameivula* and *Tropidurus* occur in simpatry in restinga ecosystem with other lizards such as *Ameiva Ameiva, Psycosaura macrorhyncha and Brasiliscincus agilis* with a general trend of lizards of genera *Ameivula and Tropidurus* being usually more abundant when compared to the former species. In part, this seems to result from the fact that *Ameivula* and *Tropidurus* lizards have their occurrences mainly associated to open habitats which is the condition predominant in restinga ecosystem (Rocha and Bergallo 1997, Rocha 2000), whereas sympatric lizards in the other genera prefer more shaded environments in restinga (Vrcibradic and Rocha 1996, Rocha and Bergallo 1997, Zaluar and Rocha 2000). In fact the species *A. Ameiva, P.macrorhyncha and B. agilis* were more abundant in southern restinga of the State of Bahia and may probably result from the fact of these restinga areas being dominated by comparatively taller vegetation with lower frequency of clearings.

The occurrence of some lizard species in specific microhabitats has been shown to be directly related to the type use of preferred substrate (Barbault and Maury 1981, Shenbrot et al. 1991). However, the natural condition of substrate interacts with other factors such as vegetation height, presence of open and closed habitats and seasonal environmental conditions, affecting the distribution of the organisms in the local assemblage (Rocha 1991, Kikuchi and Uieda 2005). Among the restinga ecosystems in the State of Bahia, those in the north portion had comparatively higher frequency of extensions of bare sand and open areas, which potentially favored the occurrence of some lizards species that prefer more opened habitats such as the *T. hygomi*, *Ameivula ocellifera* and *A. abaetensis*. Conversely, in these more opened areas some species such as *Ameiva ameiva, Kentropyx calcarata and Gymnodactylus darwinii* were less frequent, presumably as a result of the lower availability of shaded habitats.

The restinga ecosystems from the southern portion differed from those of the northern portion of the State of Bahia by having comparatively more extensions with shaded areas, taller vegetation (approximately 5m) and consequently, more extensions of soil surface covered by leaf litter. In these areas lizard assemblages tended to be composed by lizards species that preferentially use these types of habitat structure and therefore, in general, differed in the richness, composition and frequency from those restinga of the northern portion of the State of Bahia. The vegetation structure was an important factor for determining Squamata assemblage along the coast of the State of Bahia, and some lizards species were particularly indicative of the local habitat structural complexity.

The variation in species composition of Squamata in restinga ecosystems in the State of Bahia may also have been affected by historical factors of regional formation. However, we believe that environmental factors have great importance in the distribution patterns of species observed. The merit of this study lies in trying to estimate and especially emphasize environmental factors that may be important in the establishments of relevant patterns of species distribution.

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RESUMO

Neste trabalho, pesquisamos os dados de riqueza e composição de répteis Squamata e o efeito estrutural do habitat em nove áreas do ecossistema de restinga no Estado da Bahia, nordeste do Brasil. Os ecossistemas de "restinga" são habitats costeiros de dunas de areia na costa do Brasil. Nossa hipótese principal é que a composição da fauna de Squamata ao longo das áreas de restinga seria modulada pela estrutura do habitat. Após 90 dias de pesquisa em campo registramos aproximadamente 5% das espécies de répteis conhecidas no Brasil. A composição das assembleias de Squamata variou principalmente com base na presença ou ausência dos gêneros de lagartos *Ameivula* e *Tropidurus*. Nossos dados mostraram que a estrutura do habitat afetou significativamente a composição da fauna local de Squamata, especialmente os lagartos.

Palavras-chave: Análise de gradiente, estrutura do habitat, lagartos e serpentes, ecossistema de restinga, vegetação, Nordeste do Brasil.

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APPENDICES

Appendix 1

Values of the significant probability of Bonferroni test for vegetation height in analysis of variance (ANOVA) for differences between pairs of restingas: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

Study Areas	Study Areas								
	CA	BX	GJ	ABT	GB	BP	CS	TA	NV
BX									
GJ	0.007								
ABT									
GB		<0.001	<0.001	<0.001					
BP			0.011						
CS		<0.001	<0.001	<0.001					
TA		<0.001	<0.001	<0.001					
NV		<0.001	<0.001	0.009					

Appendix 2

Values of the significant probability of Bonferroni test for frequency of clearings in analysis of variance (ANOVA) for differences between pairs of restingas: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

Study Areas	Study Areas								
	CA	BX	GJ	ABT	GB	BP	CS	TR	NV
BX	<0.001								
GJ									
ABT		0.025							
GB		<0.001							
BP									
CS		<0.001							
TA		<0.001	<0.001						
NV		<0.001							

Appendix 3

Values of the significant probability of Bonferroni test for number of bromeliads in analysis of variance (ANOVA) for differences between pairs of restingas: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

Study Areas	Study Areas								
	CA	BX	GJ	ABT	GB	BP	CS	TR	NV
BX									
GJ									
ABT	<0.001								
GB	<0.001								
BP									
CS									
TA	<0.001								
NV	<0.001								

Appendix 4

Values of the significant probability of Bonferroni test for number of palm trees in analysis of variance (ANOVA) for differences between pairs of restingas: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

Study Areas	Study Areas								
	CA	BX	GJ	ABT	GB	BP	CS	TR	NV
BX									
GJ	<0.001								
ABT									
GB	<0.001								
BP	<0.001								
CS			0.018		0.011				
TR	<0.001								
NV	<0.001								

Appendix 5

Values of the significant probability of the Regression analysis between vegetation heigh and abundance of Squamata species in restinga ecosystems: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

LIZARDS SPECIES	STUDY AREAS								
	CA	BX	GJ	ABT	GB	BP	CS	TA	NV
Ameivula abaetensis				0.03					
Ameivula ocellifera									
Ameivula nativo									
Tropidurus hygomi	0.009			0.002					
Tropidurus torquatus								0.01	
Psycosaura macrorhyncha									
Gymnodactylus darwinii									0.004
Hemidactylus mabouia									0.001
Ecpleopus gaudichaudii									0.05

Appendix 6

Values of the significant probability of the Regression analysis between frequency of clearing and abundance of Squamata species in nine restinga ecosystems studied in coastal Bahia state, Brazil: CA = Costa Azul; BX= Baixio; GJ= Guarajuba; ABT= Abaeté; GB= Guaibim; BP= Boipeba; CS= Cassange; TA= Taipe; NV= Nova Viçosa.

LIZARDS SPECIES	RESTINGAS								
	CA	BX	GJ	ABT	GB	BP	CS	TA	NV
Ameivula abaetensis									
Ameivula ocellifera	0.02	0.002							
Ameivula nativo						0.003	<0.001	0.01	
Tropidurus hygomi		<0.001	0.002						
Tropidurus torquatus					<0.001		<0.001	0.001	
Psycosaura macrorhyncha							0.025		
Gymnodactylus darwinii									
Hemidactylus mabouia									
Ecpleopus gaudichaudii									