Notes on the lizard community at a restinga protected area in the state of Rio de Janeiro, southeastern Brazil.

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Abstract

Restingas are ecosystems of complex types of coastal vegetation inserted in the Atlantic Forest biome which have been subjected to intense human impact and degradation in the last decades. Studies on the ecological factors that shape lizard communities remain as a remarkable initiative of better understanding such complex types of habitats. In this study we analyze the natural history aspects of the lizard community in four areas within Parque Estadual da Costa do Sol, Rio de Janeiro, Brazil. We gathered data on the composition, distribution of species, and microhabitat usage during a short-term fieldwork. For such purposes, we conducted four quarterly field expeditions from May 2012 to January 2013, and data was gathered through the use of time constrained active search. Seven species of lizards were recorded in the area, with a relative abundance of 1.45 individuals/hour. Lizard species abundance was higher in Dunas and Massambaba areas, compared to Área de Proteção Ambiental Pau Brasil (A.P.A. Pau Brasil). Species richness was equal for both rainy and dry seasons. Lizard microhabitat occupancy was categorized into seven ranks that varied between species in each of the four studied areas. The lizard community found within the studied areas is similar to those from previous studies carried out in restinga habitats and dry forests along the Brazilian coast. Our results highlight the importance on the conservation of such areas in order to ensure the viability of lizard populations found therein.

Keywords:

Natural history; microhabitat use; Parque Estadual da Costa do Sol; reptiles; spatial distribution; temporal distribution.

Introduction

Environmental resources are partitioned in three basic ways: temporally, spatially, and trophically; that is, species differ in time, rate and period of activity, habitats exploited, and/or prey ingested (Pianka, 1973). Ectotherm animals have the ability to link their life-history traits to environmental fluctuations, thus spatial and temporal heterogeneity in thermal regimes will generate corresponding variation in body temperatures, rates of feeding, growth, and reproduction (Shine, 2005). This ability turns reptiles to display more spatiotemporal heterogeneity in their life-history traits in comparison to endothermic vertebrates (Shine, 2005).

Microhabitat usage influences the general ecology of lizards, and preferences are pronounced even within subterranean, terrestrial or arboreal species (Pianka, 1973), with the election of particular substrates, perch height, vegetation densities or other aspects of habitat structure (Pianka, 1973; Adolph, 1990; Dias & Rocha 2004; Van Sluys *et al.*, 2004; Vrcibradic & Rocha, 2005). Habitat usage by each lizard species reflects the most appropriate niche that is both thermal and morphologically suitable, and that also suits its behavioral preferences (Adolph, 1990). As for habitat use, distinct temporal distribution also leads to exploitation of different resources, reducing competition among lizard species (Pianka, 1973; Bergallo & Rocha 1993; Hatano *et al.*, 2001). Thus, sympatric lizards are known to usually partition the spatial and temporal resources in a wide variety of habitats and climatic conditions (Bergallo & Rocha 1993; Hatano *et al.*, 2001; Dias & Rocha, 2004).

Restingas are ecosystems of complex types of coastal vegetation inserted in the Atlantic Forest biome (IBGE 2004), characterized by sandy soil and xeric-like vegetation with low canopy profile under high oceanic influence (Assumpção & Nascimento, 2000).

This ecosystem has been subjected to intense human impact and degradation in the last decades (Rocha *et al.*, 2005), thus natural history researches on the living organisms are fundamental for establishing conservation measures in such areas. Although many ecological studies in this sense have been carried out in restinga habitats, (e.g., Costa *et al.*, 1990; Araújo, 1991; Rocha, 2000; Rocha *et al.*, 2000; Rocha *et al.*, 2004; Carvalho *et al.*, 2007; Martins *et al.*, 2012; Rocha *et al.*, 2014), more efforts must be applied to achieve a better understanding of the lizard communities found in these environments, especially those of special concern regarding their conservation. In that sense, studies on the ecological factors of lizard communities remain as a remarkable way of better understanding such complex types of habitats (Rocha *et al.*, 2003). Therefore, the aim of the present study is to provide notes on the natural history aspects of the lizard community at Parque Estadual da Costa do Sol and surrounding areas, gathering data on the composition, distribution of species, and microhabitat usage during the conduction of our study.

Material and Methods

Study area

The Parque Estadual da Costa do Sol (PECS) is a legally protected area inserted in the political region known as Região dos Lagos, in northeastern Rio de Janeiro state, Brazil. The fragments included in the area cover 98.4km² and are subdivided into four macro-areas (Atalaia-Dama Branca, Massambaba, Pau Brasil, and Sapiatiba) covering the municipalities of Saquarema, Araruama, São Pedro da Aldeia, Cabo Frio, Arraial do Cabo, and Armação dos Búzios. Such macro-areas harbor different and complex types of coastal Atlantic Forest vegetation, including forested areas and xeric-like restinga vegetation. In Região dos Lagos, the climate is considered peculiar due to rainfall deficit; annual temperature mean ranges from 18–23°C, while amplitude varies from 9–50°C, and relative air humidity average is around 83% (Bernardes, 1952; Dantas *et al.*, 2001; Bohrer *et al.*, 2009). Both dry and rainy seasons are well established and clearly observable, with the dry season extending from April to September, with rainfall rates varying from 0–300 mm; and rainy season extending from October to March, with rainfall rates ranging from 900 mm to 1,800 mm (fig. 1; this study; Golfari & Mossmayer, 1980; Barbieri, 1984).

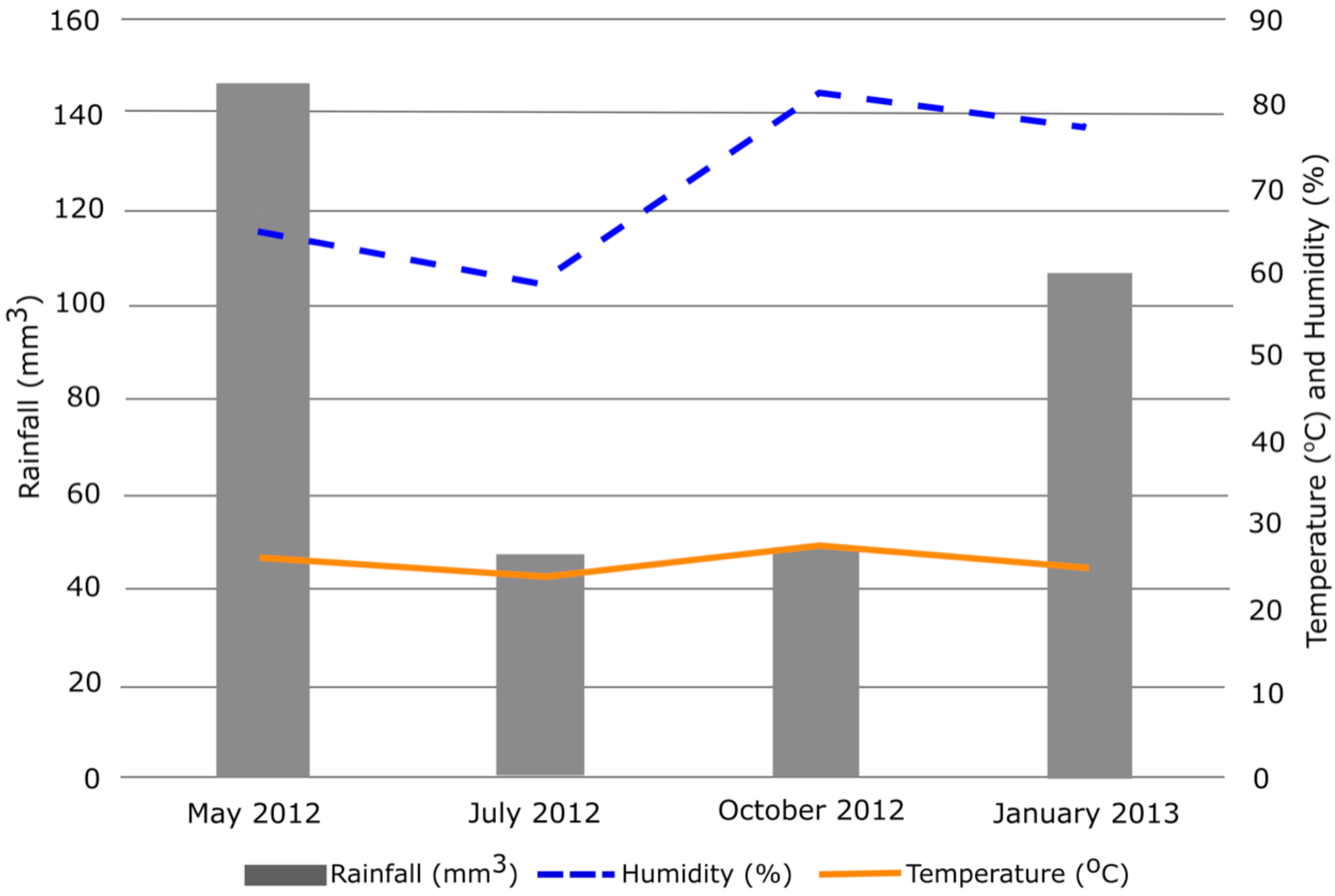

Figure 1. Averages of abiotic variables gathered in the present study during May 2012 to January 2013 in four sites at Parque Estadual da Costa do Sol (PECS) and surroundings. Rainfall data were obtained through a meteorological station located at Arraial do Cabo municipality (INMET, 2013).

We sampled four sites with distinct environmental patterns – mainly vegetation, solar input, water availability and substrate (fig. 2) – as follows:

Dunas (22°54'43"S; 42°02"45W, WGS84): Located in the municipality of Cabo Frio, this area corresponds to the second sand dune system parallel to ocean. Most of the area is covered by sandy soil with high solar input, and no leaf litter. The vegetation occurs sparsely in blotches of restinga vegetation, shrubby in its most, being composed by bromeliads, cacti, and arboreal species with low profile (1–2 m) which acts as refugee for species. In depressed areas, temporary and even permanent ponds occur, being surrounded by herbaceous vegetation. The microhabitats investigated in this area were sand, bromeliads, trunks, branches, and leaves (see data analysis).

A.P.A. Pau Brasil (22°48'S, 41°56'W WGS84): Located in the municipality of Armação dos Búzios, the area encompasses the largest remnant of Semidecidual Forest in the region. It is covered by low relief profile, sloped near the coast, arboreal vegetation, with canopy layers reaching 3–7 m and dense understory composed by woody vines, cacti, bromeliads, and herbaceous species with dense and thick leaf litter. Solar input is relatively low in comparison to other areas due to high canopy cover, and high density of vegetation, which rarely exhibits large open areas (Bohrer *et al.*, 2009), except for those affected by human deforestation. At A.P.A. Pau Brasil, the microhabitats investigated were bromeliads, leaf litter, trunks, branches, leaves, and ground, as well as some disturbed areas, such as human habitations and roads.

Massambaba: Located in the Municipality of Arraial do Cabo (22°56'S, 42°05' W WGS84), the area consists of a narrow sandy stripe between the Atlantic Ocean and Lagoa de Araruama, composed of low sandy dunes with predominance of restinga halophilous-psamophilous reptant vegetation. It is covered by sparsely distributed and moderate-size patches of bush vegetation, bromeliads, cacti, and succulent species, yet not reaching 1.5 m high, except by arboreal exotic species as casuarina trees (*Casuarina equisetifolia* Forst. & Forst.) (Maia-Carneiro *et al.*, 2012). Out of clusters of vegetation, the soil is mostly composed by sand with high solar input. Temporary or permanent water bodies are absent in these open areas. The investigated microhabitats were sand, bromeliads, leaf litter (among clusters of vegetation), trunks, branches, leaves, and some demolished houses, herein considered as disturbed areas.

Peró: Located in the municipality of Cabo Frio (22°51′ S, 41°58′ W WGS84), the area is between the two fragments of A.P.A Pau Brasil. It corresponds to beach cliffs fragments with elevation ranging from 0.5–4 m above sea level. To the mainland, and after the beach stripe, the sandy soil supports only herbaceous and shrubby vegetation formed by low profile woody plant species with succulent leaves. Cacti and bromeliads can also be found in abundance. Large patches of arboreal vegetation are observed near sandy dunes region with arboreal species reaching 1.5–2 m. Out of the patches of vegetation, the soil is mostly sandy, but with occurrence of grass and low-profile vegetation, and high solar input (Cordeiro, 2005). The microhabitats investigated were sand, bromeliads, leaf litter, trunks, branches, and leaves.

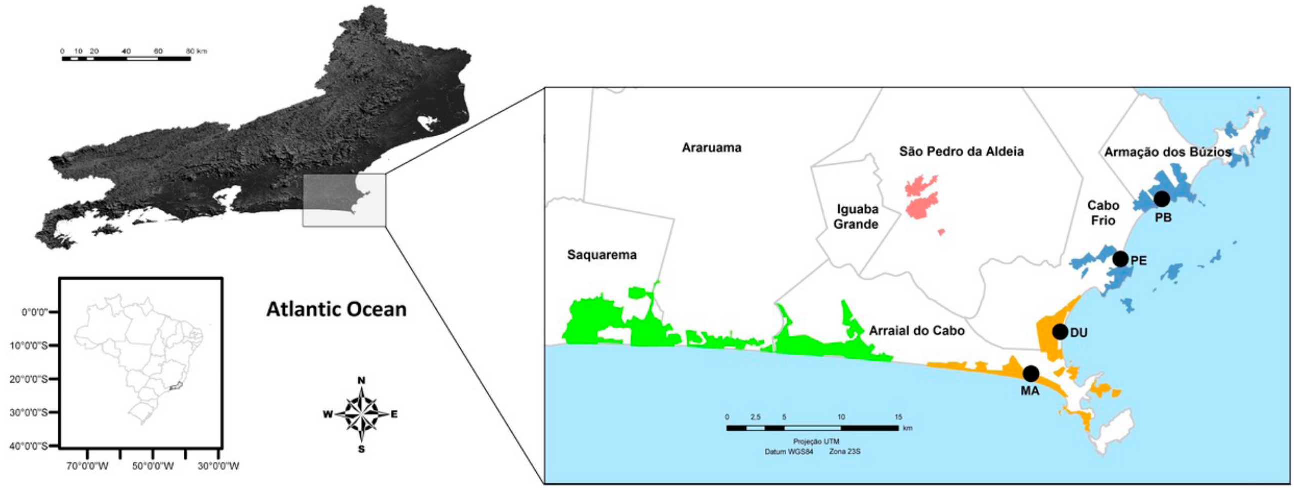

Figure 2. Studied areas and delimitation of the Parque Estadual da Costa do Sol (colored in green, orange, blue and pink). Green: Massambaba; orange: Atalaia-Dama Branca; blue: Pau-Brasil; pink: Sapiatiba, Rio de Janeiro state, Brazil. Legend: MA – Massambaba; DU – Dunas; PE – Peró; PB – A.P.A. Pau Brasil. Municipalities are provided inside grey limits.

Data collection

Fieldwork was carried out quarterly from May 2012 to January 2013, resulting in four field expeditions, being the fieldworks of May and July considered within the dry season and those of October and January within the rainy season (see "Study area" season characterization). Each expedition lasted four days, one for each site, using the method of time constrained active search in three different periods of the day: morning (beginning about two hours after the sunrise), crepuscular (half an hour before the sunset), and nocturnal (two hours after the sunset). The method consisted of a team of five researchers investigating available microhabitats (e.g., emergent vegetation, bromeliads, burrows, tree trunks, rock logs) during a period of 1 hour. For each specimen recorded we collected information on the microhabitat usage. Total effort applied was 15 person-hour per area, 60 person/hour per field expedition, and 240 person/hour considering all sampling period. A pilot fieldwork was carried out in October 2011, with the same methodology. The specimens recorded on the pilot expedition and individuals recorded by other methods (e.g., occasional encounters) were accounted only for generating the species list and microhabitat usage analyses, but not for abundance. Species with diurnal habits registered at night were not considered for activity data, as we were not available to distinguish whether activity was researcher-induced or not. Therefore, activity was considered mostly when individuals were foraging, thermoregulating or feeding. Air temperature and relative humidity were taken on the beginning and the end of the field work using a digital thermohigrometer to nearest 0.1°C and 0.1%, respectively. Rainfall rates were obtained through a meteorological station located at Arraial do Cabo municipality (INMET, 2013), which is the closest station from most sampled localities and thus we assume it has experienced similar climatic conditions.

Voucher specimens were collected according to licenses for scientific activities issued by ICMBio and INEA, fixed following the standard procedures of McDiarmid (1994), and deposited at the reptile collections of Museu Nacional / Universidade Federal do Rio de Janeiro (MNRJ) (Appendix 1). Non-euthanized specimens were released in the same area of collection at the end of each day. Examined specimens are listed in Appendix 1. Specimens were classified following the nomenclature adopted by Uetz *et al.* (2018) and identified by direct comparisons with literature data and specimens in the reptile collections of MNRJ.

Data analysis

According to field observations and microhabitat usage recorded for individuals, seven categories of microhabitats were selected to account for spatial distribution: sand (SA), bromeliads (BR), leaf litter (LL), trunks and branches (TR), leaves (LE), disturbed area (DA), and ground (GR). A specimen was considered occupying a habitat when recorded or captured on it.

We applied chi-square tests in order to test the preferences for certain types of microhabitats by *Tropidurus torquatus* (Wied, 1820) (Tropiduridae). The test was applied only for this species because sample size for other species was very small (see table 2), and statistical analysis would be subjected to sampling biases. We considered results significant when $p < 0.5$.

Two Mabuyidae species are known to occur in sympatry along the restingas of southeastern Brazil (Vrcibradic & Rocha 1996, 2002a,b): *Brasiliscincus agilis* (Raddi, 1823) and *Psychosaura macrorhyncha* (Hoge, 1946). Because the identification and distinction of both taxa are hampered by visual record solely, specimens that were not captured were not identified to species level. Therefore, "Mabuyidae spp." is represented by both *B. agilis* (presence confirmed by collected specimens) and *P. macrorhynca* (presence confirmed by photographs). However, readers must be aware that when referring to Mabuyidae spp. for abundance, microhabitat use, and temporal and spatial distribution, it might refer to (1) both *B. agilis* and *P. machrorhyncha*, (2) only *B. agilis*, or (3) only *P. macrorhyncha*. These possibilities reflect the fact that most mabuyid specimens were recorded only by visual records.

Results

Seven lizard species were recorded in the area, distributed in Anguidae (1 sp.): *Ophiodes fragilis* (Raddi, 1826); Gekkonidae (1 sp.): *Hemidactylus mabouia* (Moreau de Jonnès, 1818); Liolaemidae (1 sp.): *Liolaemus lutzae* Mertens, 1938; Mabuyidae (2 spp.): *Brasiliscincus agilis* (Raddi, 1826) and *Psychosaura macrorhyncha* (Hoge, 1946); Teiidae (1 sp.): *Ameiva ameiva* (Linnaeus, 1758); and Tropiduridae (1 sp.): *Tropidurus torquatus* (Wied, 1820). *Ophiodes fragilis* was recorded through a single carcass found by occasional encounter.

Field expeditions resulted in an abundance of 1.45 individual/hour. During the dry season, lizard abundance was 1.03 individual/hour, and during the rainy season 1.86 individual/hour (see abundance data in Table 1).

Species	May/12			Jul/12			Oct/12				Jan/13			
	PE	MA	PB	PE	MA	PB	PE	DU	MA	PB	PE	DU	MA	PB
Ameiva ameiva	6	-	-	-	-	-	5	1	-	1*	-	-	-	-
Hemidactylus mabouia	10	7	-	4	2	-	3	-	1	1	6	3	3	2
Liolaemus lutzae	-	16	-	-	-	-	-	2	5	-	-	-	-	-
Mabuyidae spp.	2	1	-	2	1	-	3	-	1	-	4	-	-	-
Tropidurus torquatus	-	6	-	-	16	-	2	43	46	-	1	70	21	-

Table 1. Number of individuals registered at Parque Estadual da Costa do Sol and surroundings with the active search methodology, from May 2012 to January 2013, in the four sites studied, at Rio de Janeiro state, Brazil. Legend: PE – Peró; DU – Dunas; MA – Massambaba; PB – A.P.A. Pau Brasil. *Specimen found dead.

Appendix 1

Analyzed specimens

BRAZIL: Rio de janeiro: Ameiva ameiva (n = 1): Cabo Frio, MNRJ 23376; Brasiliscincus agilis (n = 2): Cabo Frio, MNRJ 23375, MNRJ 23617; Hemidactylus mabouia (n = 5): Cabo Frio, MNRJ 22919-23; Tropidurus torquatus (n = 5): Arraial do Cabo, MNRJ 22925-27, 22934; Cabo Frio, MNRJ 22933.

Regarding species richness, Peró, Dunas and Massambaba accounted for four species each, with *Hemidactylus mabouia* being recorded in all macro-areas. At A.P.A. Pau Brasil, in turn, only *H. mabouia* and *Ameiva ameiva* were recorded. Considering richness differences among seasons, no differences were found, with all species being recorded in both seasons. When analyzing each area distinctively, Dunas, Peró and A.P.A. Pau Brasil were richer in the rainy season, but differences were not fount for Massambaba. No lizard species was recorded in A.P.A. Pau Brasil in the dry season.

The major diversity (n=6) of used microhabitats was recorded in Massambaba macro-area, while Peró, Dunas and A.P.A. Pau Brasil accounted for four different categories. The microhabitats occupied by each species are represented in Figure 3. *Ameiva ameiva* and *Tropidurus torquatus* were mostly found on the sand, while *Liolaemus lutzae* used exclusively this habitat. *Hemidactylus mabouia* was mostly found on bromeliads and Mabuyidae ssp. on leaf litter. The chi-square tests revealed a significant preference of *T. torquatus* for sand ($n = 281$, $\chi^2 = 814.9$) and leaf litter ($n = 281$, $\chi^2 = 40.2$) microhabitats.

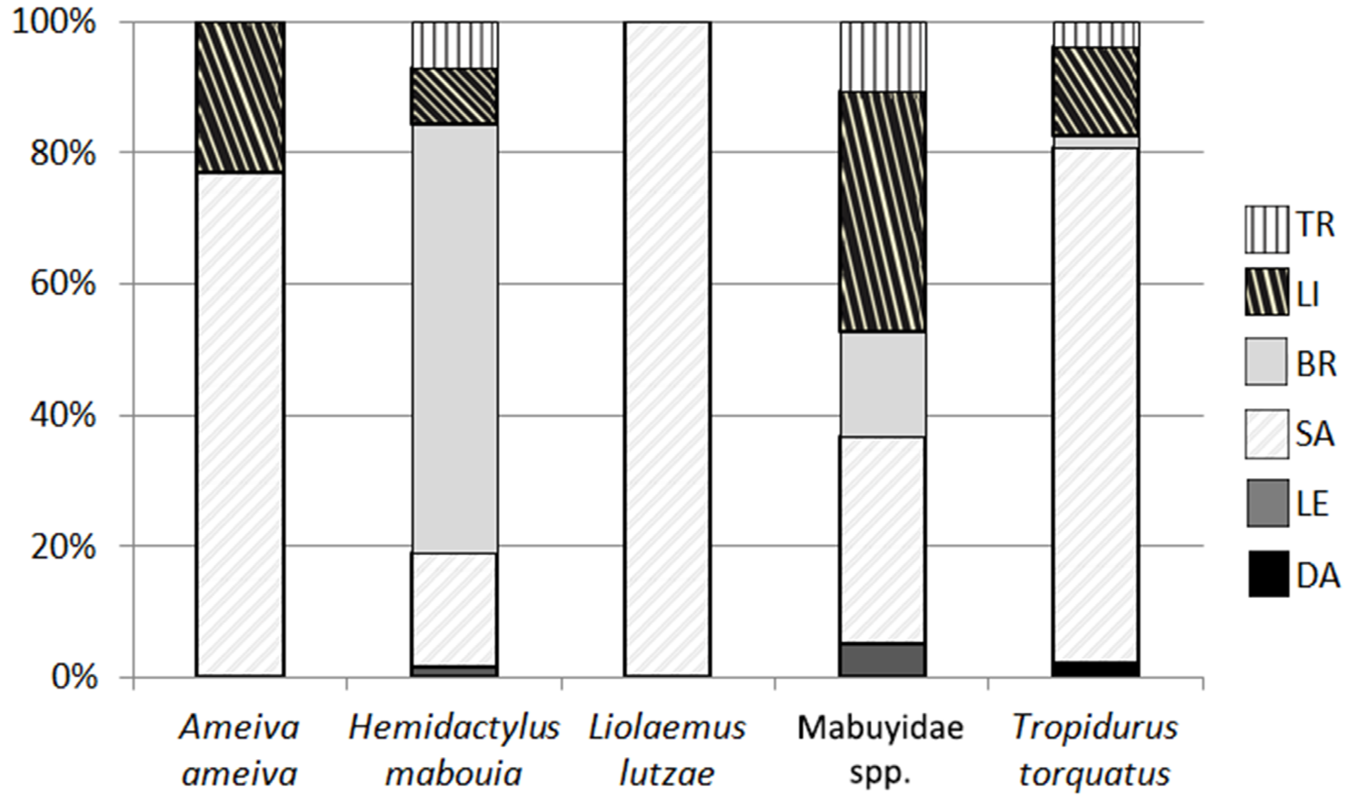

Figure 3. Percentage of microhabitats occupied by each species at Parque Estadual da Costa do Sol and surroundings, Rio de Janeiro state, Brazil. Legend: DA – disturbed area; LE – leaves; TR – trunks and branches; LL – leaf litter; BR – bromeliads; SA – sand.

Regarding lizards' time of activity within PECS and surrounding areas, we recorded all taxa in the morning, one taxon at sunset and two at night. Lizard abundance decreased from morning to night, with only fifteen records at night (*vs.* 288 in the morning and 39 at sunset). Records for *Tropidurus torquatus* and Mabuyidae in sunset and night were not included as time of activity considering we were not able to assess rather individuals dislocation were researcher induced of not. However, data for the total number of individuals are provided below. The most abundant species, *Tropidurus torquatus*, was recorded active in the morning, even though we found 7 individuals dislocating at sunset (4.7%) and at night (1.6%). *Hemidactylus mabouia* was also found during the three periods, with 4.7% (*n* = 2) of specimens recorded in the morning, 62.8% (*n* = 27) at sunset, and 32.5% (*n* = 14) at night. Mabuyidae spp. had twelve individuals recorded in the morning (85.7%), and two at night (14.3%). Finally, *Ameiva ameiva* and *Liolaemus lutzae* were found only during the morning. Species time of activity did not change according to different macro-areas within PECS (table 2).

Summarized natural history aspects are shown in table 3.

	Peró			**Dunas**			**Massambaba**			**A.P.A.**		
	M	**S**	**N**	**M**	**S**	**N**	**M**	**S**	**N**	**M**	**S**	**N**
Ameiva ameiva	11	-	-	1	-	-	-	-	-	1*	-	-
Hemidactylus mabouia	1	15	7	-	4	-	-	6	7	1	2	-
Liolaemus lutzae	-	-	-	2	-	-	21	-	-	-	-	-
Mabuyidae spp.	10	-	1**	-	-	-	2	-	1**	-	-	-
Tropidurus torquatus	3	-	-	158	5	-	78	7	4**	-	-	-

Table 2. Number of individuals registered at each active search/area during all fieldwork at Parque Estadual da Costa do Sol and surroundings, Rio de Janeiro state, Brazil. Legend: M – morning; S – sunset; and N – night. *Specimen found dead. **Registers not included in the "time activity" analyses – individuals of *Tropidurus torquatus* and Mabuyidae registered at sunset and night were found dislocating, thus we were not able to assess whether dislocation was an active pattern or researcher induced.

Species	Activity	Area				Habit	Micro-habitat
		Peró	Dunas	Massambaba	APA		
Ameiva ameiva	Diurnal	x	x		x*	Terrestrial	SA, LI
Hemidactylus mabouia	Crepuscular and nocturnal	x	x	x	x	Terrestrial, Bromelicolous	SA, BR, LI, LE, TR
Liolaemus lutzae	Diurnal		x	x		Terrestrial	SA
Mabuyidae spp.	Diurnal and nocturnal	x		x		Terrestrial, Bromelicolous	SA, BR, LI, LE, TR
Ophiodes fragilis	*				x	Terrestrial	*
Tropidurus torquatus	Diurnal	x	x	x		Terrestrial	DA, SA, BR, LI, TR

Table 3. Natural history aspects of lizard species registered at Parque Estadual da Costa do Sol, Rio de Janeiro state, Brazil. Legend: SA – sand; LI – leaf litter; GR – ground; BR – bromeliads; LE – leaves; TR – trunks and branches; DA – disturbed area, *specimens found dead.

Discussion

The lizard community is composed by seven lizard species (families Anguidae, Gekkonidae, Liolaemidae, Mabuydae, Teiidae and Tropiduridae), resembling the composition of other studies conducted in restinga habitats along the southeastern coast of Brazil (e.g., Costa *et al.*, 1990; Martins *et al.*, 2012; Rocha *et al.*, 2014). However, species richness (n=7spp.) found herein is lower than that found in most of the studies (Araújo, 1991; Rocha, 2000; Rocha *et al.*, 2000; Rocha *et al.*, 2004; Carvalho *et al.*, 2007).

Considering data gathered from herpetological collections and fieldwork, 15 lizard species are known for Região dos Lagos, and eight at PECS (Martins *et al.*, submitted). From the eighth species not included in the present work, one (*Enyalius brasiliensis*) was registered by one of the authors by occasional encounter. The use of additional and diverse data collection methods (such as pitfall traps) as well as long-term studies in the area may increase knowledge on the species richness of PECS. The present work, however, did not aim to make an inventory of lizard species, but to gather notes on ecological factors affecting the lizard community, such as temporal and spatial distribution of species.

According to previous studies (Costa *et al.*, 1990; Araújo, 1991; Rocha, 2000; Rocha *et al.*, 2000; Rocha *et al.*, 2004; Carvalho *et al.*, 2007), *Tropidurus torquatus* and *Ameiva ameiva* may be the only species that occur in nearly all restingas in southeastern Brazil (except for *T. torquatus* in Martins *et al.*, 2012). Also, *T. torquatus* was the most abundant species in all areas within PECS, except for A.P.A. Pau Brasil, and such findings seem to result from the considerable generalization of several aspects of the species ecology, such as diet, activity and reproductive traits (Araújo, 1984; Bergallo & Rocha, 1993; Rocha & Bergallo, 1994; Gandolfi & Rocha, 1998; Teixeira-Filho *et al.*, 2003), which probably allow *T. torquatus* to maintain a high population size in restingas (Rocha & Bergallo, 1994). The low abundance (n = 14) of Mabuyidae spp. recorded in this study is most likely to be due to sampling effort and biases. Some species of this family occur on the ground level, as *Brasiliscincus agilis*, which occupy especially the leaf litter (Vrcibradic & Rocha, 1996), where they remain sheltered, and adopt both active and sit-and-wait foraging strategies (Vrcibradic & Rocha, 1996). This species could probably be better sampled through pitfall traps (e.g., Martins *et al.*, 2012).

Regarding abundance differences among the studied areas, Dunas and Massambaba had the highest values, with 49% and 36% of total abundance, respectively. These areas seem to exhibit high similarities of soil composition and vegetation, which allow both Mabuyidae spp. and *Tropidurus torquatus* to increase their population number (and thus increase total abundance of species). The high prevalence of cacti in Dunas and Massambaba may also influence the exclusive record of Mabuyidae spp., because *Brasiliscincus agilis* and *Psychosaura macrorhyncha* are frequently associated to such vegetation (Vrcibradic & Rocha, 2002a,b).

The area of A.P.A. Pau Brasil exhibits a distinguishable climate, flora, and soil composition in comparison to the other studied areas. Although it is composed of a higher variety of habitats and microclimates — which could allow the occurrence of a more complex biota (Rocha *et al.*, 2004) — the abundance (n = 4) and richness (n = 2; *Hemidactylus mabouia* and *Ameiva ameiva*) found herein was extremely low. Most likely, vegetation complexity present in A.P.A. Pau Brasil may have hampered the visual encounter of lizard species that occupy different microhabitats, and additional sampling with the use of combined methods (such as pitfall traps) might prove more effective in this area. Alternatively, low abundance in the area might have been caused by low abundances of individuals due to microhabitat preference (e.g. *Tropidurus torquatus*). Therein forested areas may still harbor species such as *Ophiodes fragilis* (Costa *et al.*, 2009), found only in this area through a deceased individual, and *Polychrus marmoratus*

(Linnaeus, 1758) (Polychrotidae) (Mattison, 1999), previously registered in the area by one of us (R. Pontes; occasional encounter, 2013).

Tropidurus torquatus was found in five different categories of microhabitat, and was the only species found in disturbed areas. Species of the *Tropidurus torquatus* group are known to be microhabitat generalists and can even occur in areas altered by human activities (Rodrigues, 1987; Van Sluys *et al.*, 2004). Besides *T. torquatus*, *Hemidactylus mabouia* and Mabuyidae spp. occupied five categories of microhabitats. The gekkonid *H. mabouia*, although widely distributed in Brazil, is an alien species, native from central and east Africa (Carranza & Arnold, 2006; Rödder *et al.*, 2008). This species is relatively abundant in disturbed environments of several biomes and has also been found in bromeliads in previous works (Vanzolini, 1968). The high number of microhabitats occupied by the species in the present study, which has already been reported by other authors (e.g., Carvalho *et al.*, 2007), corroborate the idea of the species being very adaptable and an effective colonizer (Meshaka, 2000; Carranza & Arnold, 2006; Rocha *et al.*, 2011), especially in open areas such as *restingas* (Telles *et al.*, 2015, Rocha *et al.*, 2011). In Brazil, *H. mabouia* competes with native lizard species, such as *Gymnodactylus darwinii* (Teixeira, 2002), and could even lead to local extinction or population reduction of some species.

The mabuyids *Psychosaura macrorhyncha* and *Brasiliscincus agilis*, on the other hand, are native species commonly found in sympatry in coastal areas of southeastern Brazil (Vrcibradic & Rocha, 1996, 2002a,b). These species are known to differ considerably in the use of microhabitat, with *P. macrorhyncha* being mostly found in bromeliads, while *B. agilis* uses mainly leaf litter on the ground (Vrcibradic & Rocha, 1996). *Ameiva ameiva* was found in two types of microhabitat: sand and leaf litter, being most correlated with the sand. These results corroborate previous findings that *A. ameiva* is usually found on the ground, hardly climbing off in search of prey (Vitt & Colli, 1994). *Liolaemus lutzae*, found only in the sand stripes close to the sea at Massambaba and Dunas, is a lizard with restricted and specialized habits and a relatively small geographic distribution, being endemic from restingas of Rio de Janeiro state (Rocha, 2000; Rocha *et al.*, 2005; Rocha *et al.*, 2009). Most of the restinga areas where *L. lutzae* inhabits, including those here studied, have been under intense anthropogenic disturbance (Rocha *et al.*, 2005), leading to the decline of several populations of the species, resulting in its inclusion as a "critically endangered" taxon in the state of Rio de Janeiro (Bergallo *et al.*, 2000; Rocha *et al.*, 2009), and critically endangered in Brazil (Rocha, 2000). The occurrence of *L. lutzae* within the area of PECS and surroundings highlights the importance of this protected area to ensure the maintenance of these populations. The only recorded individual of *O. fragilis* was found dead along the trail, and by this reason it was not possible to point its microhabitat occupancy. However, previous studies have indicated the species with cryptozoic habits, occurring in grassy and herbaceous vegetation (Montechiaro *et al.*, 2011). The heterogeneous distribution of lizard species within the habitats strengthens the role of differentiated and structurally complex environments in the maintenance of species richness, as also demonstrated by other studies (Rambaldi & Oliveira, 2003; Carvalho *et al.*, 2007).

Although sample sizes were small for *Ameiva ameiva* and *Liolaemus lutzae* in the present study, the exclusiveness of these species in the morning period corroborates previous ecological studies (see Vitt & Colli, 1994; Rocha, 1995). *Tropidurus torquatus* and Mabuyidae spp. were found during the day, as previously recorded for the species (Carvalho *et al.*, 2007). *Hemidactylus mabouia* was mostly found in the sunset and at night, with also some individuals recorded during the morning (n = 2). The individuals recorded in the morning were, however, inactive and sheltered in bromeliads. Notwithstanding, although this species has traditionally been taken as nocturnal (see Rocha & Anjos, 2007; Rocha *et al.*, 2011), other authors have already found both diurnal and nocturnal activity for *H. mabouia*, when daily temperatures are low (Hatano *et al.*, 2001; Carvalho *et al.*, 2007).

Activity and seasonality are often intrinsically associated to species belonging to the herpetofauna given their metabolic dependence on sunlight, warmth and precipitation regime (Zug *et al.*, 2001). However, unlike temperate environments, the seasonality is less marked in the tropical region, presenting temperature and rainfall regimes relatively constant over the hydrological cycles (Crump & Scott, 1994). The atypical seasonal panorama found during the study period (rainy season with lower rainfall indexes when compared to the dry season) associated to the less marked seasonality may have led to higher abundances of *Liolaemus lutzae* and *Hemidactulys mabouia* in the dry season than in the rainy season, and for a similar species abundance of *Ameiva ameiva* in both seasons. Rocha (1998) argues that *L. lutzae* reproduces seasonally, with individuals recruitment and increase of food availability occurring in the months between January and May. We only recorded specimens in May (n = 16; dry season) and October (n = 5; rainy season). Considering species population trends, another possibility for the higher abundance of individuals in the dry season may be probably directly associated to the recruitment and food availability in May. Although the *A. ameiva* population seems to increase in the rainy season (Colli, 1991), this species appears to adapt its reproductive cycle according to rainfall rate, and reproduction is continuous when water is available throughout the year or where rainfall is unpredictable (Colli 1992), which seems to be the present case. Despite *A. ameiva* being considered as one of the most abundant species in restingas (Silva & Araujo, 2008), we registered a relatively low abundance of the species in the study area. Thus, more focused and long-term studies are still necessary in order to provide additional data regarding our results. Several ecological factors along with restinga formation history as well as data on lizard species competition and space-partition are still needed to achieve a greater understanding for the ecological determinants and historical factors of the variation between areas in lizard communities. The remarkable increase of *T. torquatus* abundance in the rainy season (180 registers in the rainy *vs*. 66 in the dry) is much likely associated to species recruitment between February and May (Kiefer, 2003, Silva & Araujo, 2008). Also, higher temperatures during the rainy season may have significantly influenced the total abundance of the lizard community of PECS.

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