

POPULATION DENSITY, HABITAT SELECTION AND CONSERVATION OF *COLEODACTYLUS NATALENSIS* (SQUAMATA: SPHAERODACTYLIDAE) IN AN URBAN FRAGMENT OF ATLANTIC FOREST IN NORTHEASTERN BRAZIL

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ABSTRACT. *Coleodactylus natalensis* is endemic to Atlantic Forest fragments in Rio Grande do Norte state, coastal northeastern Brazil. The main fragment where the species lives is the Parque Estadual Dunas de Natal “Jornalista Luiz Maria Alves”, a Conservation Unit covered predominantly by dunes and surrounded by urban areas. Because of the vulnerability of this species and the importance of the PEDN, we studied the density, spatial distribution and habitat and microhabitat preferences of this population to provide basis for future conservation efforts. We randomly sampled ninety-six 50 m² quadrats in each of the four habitats identified in the study area, finding a mean density of 98.5 ± 75.5 lizards per ha⁻¹, with grouped distribution in the forested habitats and random in others. The species preferentially inhabits the leaf litter of forest habitats at lower elevations, in wetter places and milder temperatures than the mean of our study area. Due to the relatively small density when compared to other Sphaerodactylidae, restricted distribution to forested habitats, and the urban expansion that puts the northeastern Atlantic Forest at constant risk, it is imperative to take conservation measures for this population of *C. natalensis*.

KEYWORDS. Lizard; Fragmentation; Habitat preference; Dunes; Endemism.

INTRODUCTION

The occurrence of a species at a given site depends on specific environmental characteristics, such as shelter availability or microclimatic conditions, suggesting that these variables play an important role in the distribution and abundance of such species (Carvalho Jr. *et al.*, 2008; Miranda *et al.*, 2010). Thus, studies comparing densities among different habitats and microhabitats are essential for understanding ecological patterns and processes in lizards (*e.g.*, Rodda *et al.*, 2001; Van Sluys, 1992; López-Ortiz and Lewis, 2004; Vitt *et al.*, 2005; Quirt *et al.*, 2006; Endriss *et al.*, 2007) and for clarifying relationships within the community in which the lizards belong (Pianka, 1969, 1971). In addition, these are central themes for conservation, serving as a guide in the management of threatened species (Barrows, 2006; Zúñiga-Vega *et al.*, 2007).

The Sphaerodactylidae lizards of the genus *Coleodactylus* are the smallest squamate species in their respective assemblages, inhabiting the leaf litter of New World forests (Freire, 1999; Vitt *et al.*, 2005). Although these lizards depend on mesic environments, due to vulnerability to thermal stress and dehydration (Hedges and Thomas, 2001; López-Ortiz and Lewis, 2004) and their distribution is probably restricted to forested habitats, there are no studies on population densities of the genus in different habitats, and few

studies report on the habitats and microhabitats where these species occur (Vanzolini *et al.*, 1980; Vitt and Zani, 1998; Colli *et al.*, 2002; Vitt *et al.*, 2005).

Coleodactylus natalensis Freire 1999 is regarded as endemic to Atlantic Forest remnants of Rio Grande do Norte (RN) state, Brazil. According to the “Atlas dos Remanescentes Florestais da Mata Atlântica, período 2008-2010” (Atlas of Atlantic Forest Remnants in 2008-2010; Fundação S.O.S. Mata Atlântica and Instituto Nacional de Pesquisas Espaciais, 2010), RN state has only 51,038 ha of remnants, of which 44,251 ha are composed of forest and restinga ecosystems (based on data from 2002). On the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, *C. natalensis* has been assessed as Data Deficient, due to the lack of information regarding range size (Nogueira, 2010).

To settle this absence of information, we recorded subpopulations at three fragments called Zonas de Proteção Ambiental (Environmental Protection Zones), ZPAs, covering 680 ha (ZPA 1; Freire *et al.*, 2010), 1,172 ha (ZPA 2; Freire, 1996; 1999) and 286 ha (ZPA 5), of which two are established Conservation Units (ZPAs 1 and 2), and at the Campus da Universidade Federal do Rio Grande do Norte (Campus of Federal University of Rio Grande do Norte), UFRN, 123 ha mostly composed by urban area (Sales *et al.*, 2009), in Natal municipality; in Pium district

(exact point unavailable), and at Experimental Station Rommel Mesquita de Faria in Empresa de Pesquisas Agropecuárias do Rio Grande do Norte (Agricultural Research Company of Rio Grande do Norte), EMPARN, 79 ha, in Parnamirim municipality (Lisboa *et al.*, 2008); and at Parque Estadual Mata da Pipa (Mata da Pipa State Park), PEMP, in Tibau do Sul municipality (Sousa *et al.*, 2010), 290 ha, as shown in Figure 1. Data for the voucher specimens examined are provided in Appendix I.

Considered one of the smallest lizards in South America, *C. natalensis* lives in leaf litter, preferring shaded forest habitats (Freire, 1996, 1999). Thompson (2004) defines as “rare” the species with restricted geographical distribution and as “elusive” those with low probability of detection in the natural environment; *C. natalensis* can be framed in both, given its endemic distribution, its diminutive size (males measuring 22 mm from rostrum to cloaca and females 24 mm; Freire, 1999) and the ability to become camouflaged amongst the leaf litter. Thus, there may be other undetected populations that could enlarge geographic distribution of the species.

The type locality of this species and our study area, the Parque Estadual Dunas de Natal “Jornalista Luiz Maria Alves” (Dunes of Natal State Park, in ZPA 2), PEDN, is a region of sand dunes located on

the northern border of the Atlantic Forest. It has been under pressure as a natural fragment surrounded by urban area, as it is known that, according to IUCN’s Threats Classification Scheme, residential development (housing and urban areas) is the first major cause of species decline (IUCN, 2011).

Other than the morphological description (Freire, 1999) and scattered observations about the frequency with which it occurs in the habitats of the PEDN, recorded during studies on the local Squamate assemblages (Freire, 1996), no substantiated studies have been conducted on this vulnerable and endemic northeastern Atlantic Forest species. Thus, because of the importance of the PEDN as the principal remnant where the species is known to occur, it is imperative to estimate the population density of *C. natalensis* in the area and determine its distribution to provide basis for future conservation efforts.

MATERIAL AND METHODS

Study Area

The PEDN is situated along the 9 km long coastal strip of Natal municipality, in the state of RN (05°48’S to 05°53’S and 35°09’W to 35°12’W; see Figure 2),

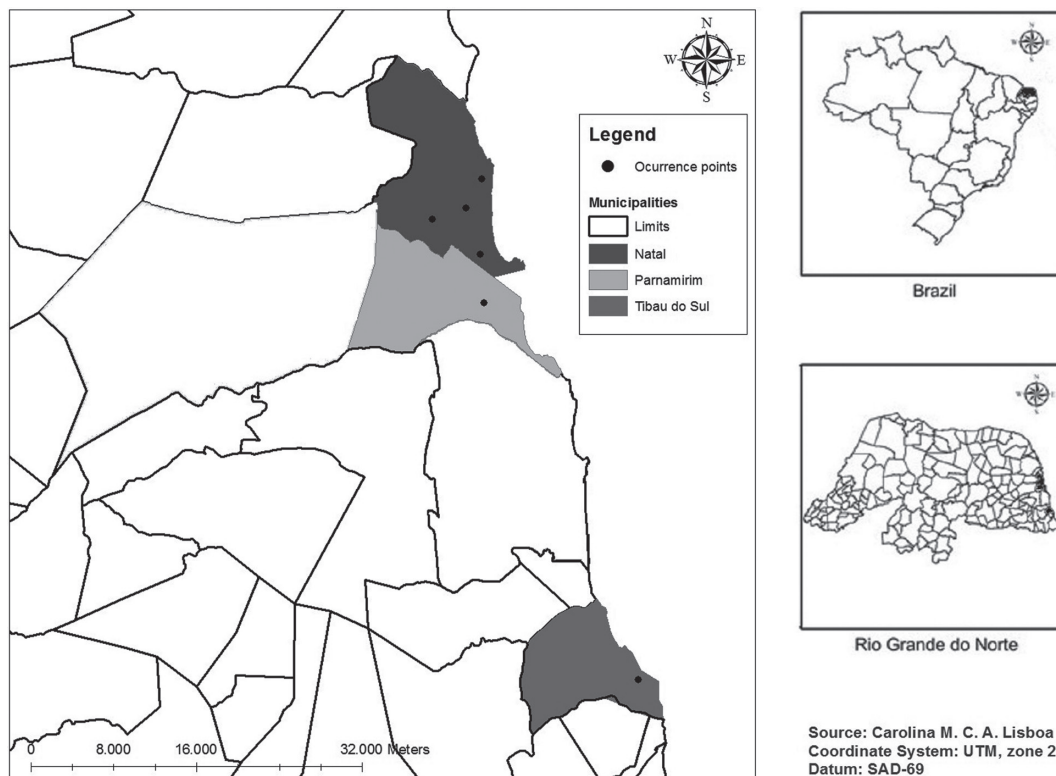


FIGURE 1. Range map of *Coleodactylus natalensis*.

covering an area of 1,172.80 ha. The string of dunes extends in a SE-NW direction, due to the predominantly southeasterly trade winds, and the fine-grain sandy-quartzitic soil is non-consolidated and has low

fertility. Most of these dune formations are fixed by vegetation, characterized floristically as Coastal Forest or Atlantic Forest and Coastal Tableland or Tabuleiro (Carvalho, 2001).

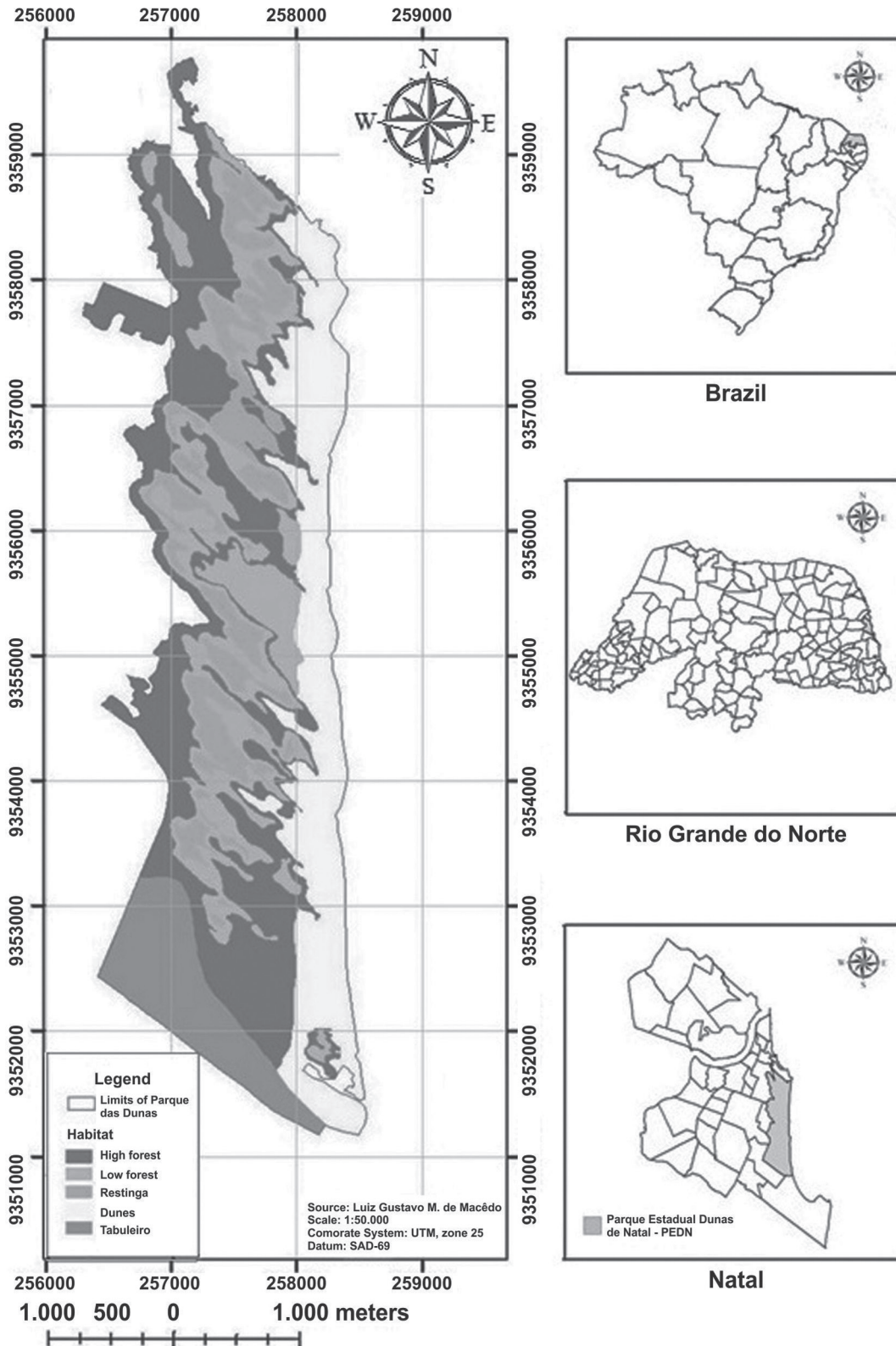


FIGURE 2. Parque Estadual Dunas de Natal location map and estimative of habitats range based on elevation curves.

According to EMPARN (2008, unpublished data), mean temperatures are constant throughout the year, with $26.2 \pm 5.0^\circ\text{C}$ (\pm SD; 1999-2008). Relative humidity remains at $79.4 \pm 3.1\%$ year-round and rainfall is irregular, alternating between periods of drought and high precipitation. The rainy season extends from March to August, with mean monthly rainfall of 212.8 ± 54.3 mm. The dry season extends from September to February, with mean monthly rainfall of 46.3 ± 7.4 mm. The annual mean rainfall is 1,554.3 mm.

Four physiognomic divisions were recognized in the PEDN (see Figure 3), corresponding to the following habitats (Freire, 1996, with modifications): (i) interdune high forest, situated in valleys at least 30 m deep and interspersed with strings of fixed dunes, with trees up to 20 m tall, such as *Caesalpinia echinata* Lam. and *Ficus* spp. (Freire, 1990); (ii) low forest on fixed dunes, dunes covered by arboreal-shrub vegetation between 3 and 7 m high, with a predominance of shrubs and small thin-trunked branched trees, such as *Cordia superba* Cham. and *Eugenia* sp.; *Anthurium affine* Schott and *Hohenbergia* sp. are sparsely distributed in the sub-shrub stratum, not forming clumps (Freire, 1990); (iii) restinga (littoral forest) vegetation, present on the top of dunes (therefore subjected to more sunlight) and characterized by the marked presence of *Anacardium occidentale* L., *Myrcia* sp., *Cereus* sp., and large clumps of the Bromeliaceae species *Aechmea lingulata* (L.) Baker and *Hohenbergia* sp. (Freire, 1990); and (iv) mobile beach (or supra-littoral) dunes, generally without vegetation, or with a thin cover of sand-fixing herbaceous vegetation, sometimes covered with arboreal-shrub vegetation, forming sparse brushland or small valleys between the mobile dunes, where species such as *A. occidentale* L., *Chrysobalanus* sp. and *Pilosocereus* sp. are found (Freire, 1990).

Field Work and Sampling Methods

Four 12-day excursions were made, two in the dry season (December to February 2006 and September to November 2007) and two in the rainy season (March to June and July to August 2007). Observations and collections were made along each one of four preexisting public trails per excursion, with all trails sampled in each excursion and season. The trails used varied in length from 1,370 to 2,427 m.

To assess the population density and distribution of *C. natalensis* in each habitat type at the PEDN,

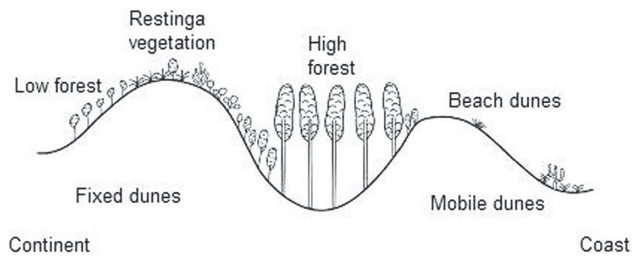


FIGURE 3. Spatial distribution and schematic profile of habitats observed in Parque Estadual Dunas de Natal, Natal, RN, Brazil.

we used the stratified sampling method (Sutherland, 1996) in which the study area is divided into subareas (habitats) and random samplings are carried out in each one. We stratified the area using modifications of the physiognomic division established by Freire (1996), classifying areas into the four habitat types previously mentioned. Thus, we randomly selected quadrats of 1 m \times 50 m (50 m² in transect area), previously divided and numbered individually, using the Random Number Generator Pro 1.72 software (©Segobit Software, 2000-2008). Six quadrats were delimited with a metric tape in each of the four habitats along each of four preexisting trails making the sampling uniform in all habitats.

The quadrats were inspected by turning over the leaf litter in the morning (from 0800 h to 1200 h) and in the afternoon (from 1400 h to 1800 h), alternating between habitats and times whenever possible. As the quadrats had varying amounts of litter, search time varied between them. Specimens were collected manually and individually isolated in plastic bags until all specimens in the quadrat were counted, being released at the collection point after counting. Only 41 of these specimens were weighted, using a digital scale with 0.001 g resolution, to estimate biomass. These specimens were randomly chosen in equal number per habitat during the study period and released after being weighted.

A set of environmental variables was measured to determine preferences and distribution of the population: habitat type (classified as above); microhabitat, identified as leaf litter, under decomposed trunks, under bromeliads, on bare sand or within fallen termite nests; incidence of direct sunlight, shade or filtered sunlight at the collection point; temperature and moisture of air and substrate at the point where the individuals were first observed and at random points along the trails, with a thermohygrometer placed 30 cm above ground and within the litter or sand; leaf litter depth, with a 0.1 mm precision ruler; and elevation using a GPS.

Estimates and Statistical Analyses

Starting from the premise that habitats differ according to dune elevation (Freire, 1999), we estimated the area of each habitat. We used the ArcGis 9.1 software (©Environmental Systems Research Institute – ESRI Inc., 2005) to construct schemes of different elevation levels in area and, consequently, of the area covered by the characteristic vegetation of each habitat (Figure 2). The total area of the PEDN was estimated at 1,132.78 ha and the area of each habitat is shown on Table 1. The coastal tableland area (109.23 ha) was not included in this study for being a military zone, despite being a threatened habitat in which *C. natalensis* also occurs.

Estimates of population density were made by calculating the mean number of individuals per quadrat (individuals/50 m²) in each habitat, then multiplying each mean by the estimated area of that habitat. To assess how this population is distributed (aggregate,

random or uniform pattern) we performed Chi-square (χ^2) tests between the observed and expected frequencies according to Poisson's distribution (Krebs, 1999), using the Ecological Methodology 6.1 software (©Krebs, 1999).

Student's t-tests were used to determine differences of environmental variables between collection points of specimens and random points taken from each habitat in equal quantity using Random Number Generator Pro 1.72 software (©Segobit Software, 2000-2008), as well as to test if there were changes in specimen occurrence between the dry and rainy seasons. An ANOVA was performed to test differences between habitat use, and a Tukey's HSD test, a *posteriori*, was used to verify which habitats showed a significant difference in specimen occurrence. Data analyses were carried out using Statistica 7.1 software (©StatSoft Inc., 2005); all the means \pm SD were reported and the mean difference was significant at $\alpha = 0.05$.

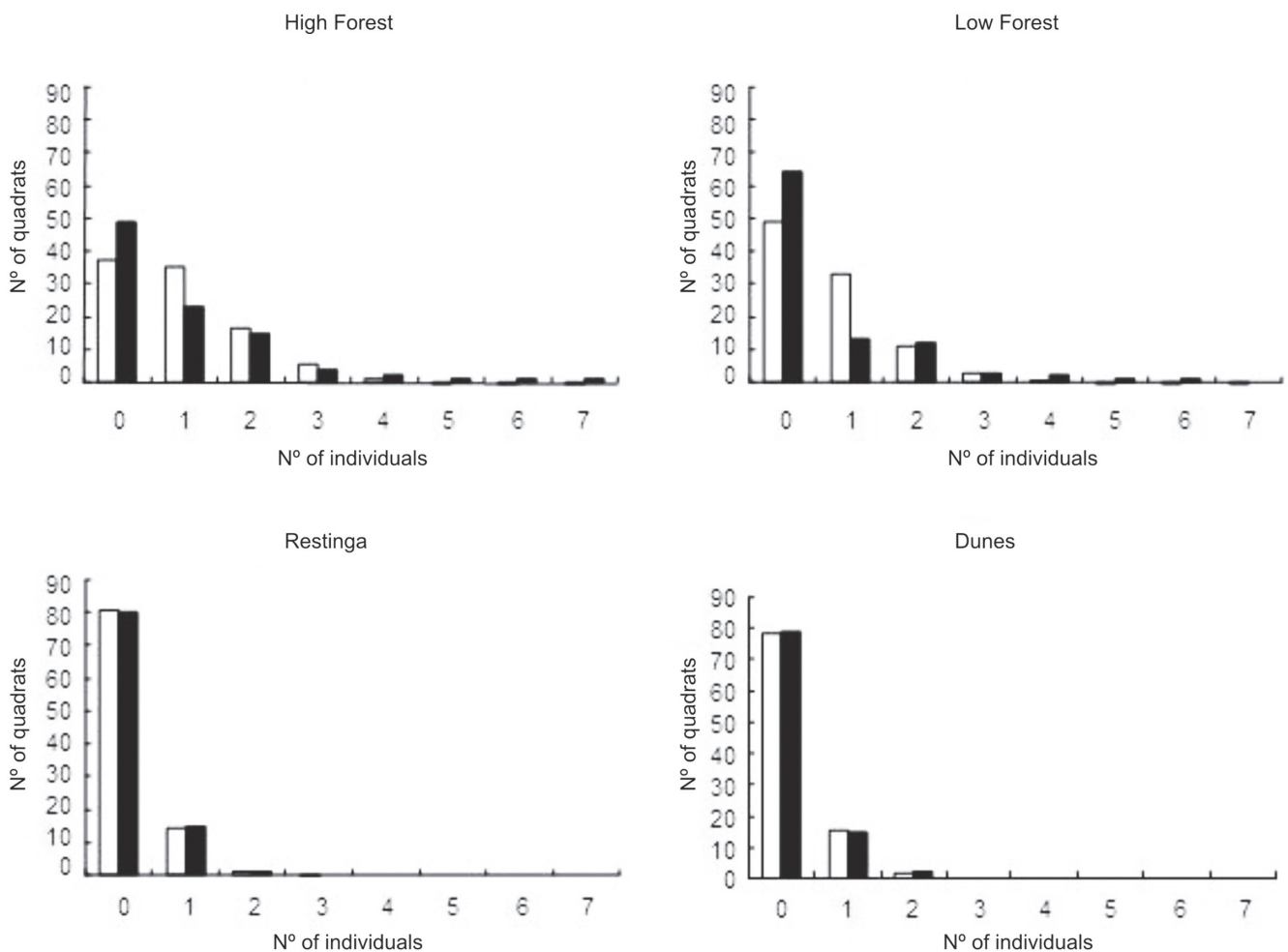


FIGURE 4. Expected frequency (white bars; Poisson's distribution – Krebs, 1999) and observed frequency (black bars) of *Coleodactylus natalensis* per quadrat (50 m²) in Parque Estadual Dunas de Natal habitats, Natal, RN, Brazil.

TABLE 1. Estimated mean values and variances of *C. natalensis* per quadrant (50 m²), estimated absolute area and number of specimens per habitat and per hectare of the Parque Estadual Dunas de Natal.

Estimated values	High forest	Low forest	Restinga	Dunes
Mean specimens per quadrant (σ^2)	0.94 (1.83)	0.67 (1.44)	0.17 (0.16)	0.19 (0.20)
Area (ha)	394.71	225.66	134.53	268.64
Specimens per habitat	74,207	30,240	4,570	10,200
Specimens per hectare	188	134	34	38
Biomass per hectare (kg ha ⁻¹)	0.031	0.022	0.005	0.006

TABLE 2. Comparisons of habitat variables at collection points of specimens of *C. natalensis* and random points in the Parque Estadual Dunas de Natal. The values shown are means \pm SD. N is the number of points. *Statistically significant P-values.

Habitat Variables	Occurrence points of specimens	N	Random points	N	Student's t-test
Air temperature (°C)	27.18 \pm 1.94	199	27.78 \pm 2.21	289	t = -3.1; df = 486; p < 0.05*
Substrate temperature (°C)	27.41 \pm 1.99	192	28.21 \pm 2.49	287	t = -3.7; df = 477; p < 0.05*
Air moisture (%)	73.52 \pm 8.56	199	70.35 \pm 9.56	290	t = 3.7; df = 487; p < 0.05*
Substrate moisture (%)	79.06 \pm 7.87	191	76.01 \pm 9.72	290	t = 3.6; df = 479; p < 0.05*
Leaf litter depth (cm)	4.05 \pm 1.94	200	3.59 \pm 1.85	285	t = 2.6; df = 483; p < 0.05*
Elevation (m)	66.85 \pm 18.88	195	73.40 \pm 25.34	365	t = -3.1; df = 558; p < 0.05*

TABLE 3. Mean values of environmental variables measured at the collection points of *C. natalensis* in the different habitats of the Parque Estadual Dunas de Natal. The values shown are means \pm SD. N is the number of points. *Statistically significant P-values.

Habitat Variables	High forest	N	Low forest	N	Restinga	N	Dunes	N	ANOVA
Air temperature (°C)	27.1 \pm 1.9	94	27.2 \pm 1.7	69	26.7 \pm 2.4	16	27.3 \pm 2	16	F _{3,191} = 0.3, p > 0.05
Substrate temperature (°C)	27.3 \pm 1.9	92	27.3 \pm 1.6	64	27.2 \pm 3	16	27.6 \pm 2.5	16	F _{3,184} = 0.1, p > 0.05
Air humidity (%)	73.2 \pm 8.7	94	75.2 \pm 7.9	69	71.5 \pm 9.3	16	70.9 \pm 9.2	16	F _{3,191} = 1.7, p > 0.05
Substrate moisture (%)	79 \pm 7.6	92	80.2 \pm 7.1	63	78.6 \pm 9.5	16	76.6 \pm 9.8	16	F _{3,187} = 0.9, p > 0.05
Leaf litter depth (cm)	4.1 \pm 1.5	97	3.7 \pm 1.9	72	2.6 \pm 1	16	6.6 \pm 2.8	16	F _{3,197} = 15.6, p < 0.001*
Elevation (m)	62.1 \pm 17.5	96	74.9 \pm 13.3	64	80.7 \pm 21.6	17	50.2 \pm 19.7	18	F _{3,191} = 17, p < 0.001*

RESULTS

We recorded 205 specimens in the 384 quadrats inspected (96 quadrats per habitat). The inspections lasted a mean of 25.8 \pm 17 min per quadrat, totaling 165 man-hours of field work, performed by a single collector (CMCAL). Specimens were recorded in only 112 quadrats (29.2%), 47 of these in the high forest (42%), 32 in the low forest (28.5%), 16 in restinga vegetation (14.3%) and 17 in beach dune vegetation (15.2%). In the remaining 272 quadrats (70.8%) no individuals were recorded.

Using the mean number of *C. natalensis* per quadrat in each habitat multiplied by the mean area of each habitat type within the study site, we estimated the occurrence of individuals per habitat and per hectare, as shown in Table 1. Thus, we obtained an estimate of 119,217 individuals for PEDN, with a mean of 98.5 \pm 75.5 individuals ha⁻¹.

The mean weight of the specimens was 0.168 \pm 0.05 g (0.05-0.279 g; N = 41). The mean biomass, weighted by the area of the respective habitat, was approximately 0.019 kg ha⁻¹. High forest habitat

had the highest mean biomass and restinga had the lowest value, as shown in Table 1.

The frequency distributions of the number of individuals per quadrat in the different habitats of PEDN and their respective expected frequencies, according to Poisson's distribution (Krebs, 1999), were obtained (Figure 4). When compared to the expected frequencies, the observed frequencies were significantly different only for the high forest and the low forest ($\chi^2 = 184.34$ for the high forest; $\chi^2 = 202.32$ for the low forest; df = 95 and p < 0.05 in both), indicating a grouped distribution pattern for the individuals in these habitats. On the other hand, the non-significant data for the restinga and the dunes ($\chi^2 = 90.29$ for the restinga; $\chi^2 = 97.21$ for the dunes; df = 95 and p > 0.05 in both), suggest a random distribution pattern of individuals in these habitats.

Distribution per habitat showed a greater number of individuals recorded for the high forest (98; 47.8%), followed by the low forest (71; 34.6%), beach dunes (19; 9.3%) and restinga vegetation (17; 8.3%). Therefore, 82.4% of the specimens were found in forested areas. The occurrence of specimens was significantly

different between the forested and non-forested habitat ($F_{3,380} = 14,983$, $p < 0.001$). High and low forest habitats did not differ between one another, nor did the non-forested restinga and dune areas.

Of the five microhabitats used by *C. natalensis* in the PEDN, leaf litter was the most commonly used (195 occurrences; 95.6%), followed by bare sand (4; 2%), trunks decomposing on soil (3; 1.4%), fallen termite nests (1; 0.5%) and Bromeliaceae on soil (1; 0.5%). The mean leaf litter depth of records was 4.0 ± 1.9 cm (0-12 cm; $N = 200$), and varied according to Figure 5, with a greater occurrence in deeps between 3 and 4 cm.

Most lizards recorded were in a filtered sun microhabitat (111 specimens; 55.5% of total specimens), followed by shade (86; 43%) and only three (1.5%) were first seen in direct sunlight.

The collection points over all habitats, on average, exhibited more mesic conditions (lower air and substrate temperature, higher air and substrate moisture), deeper leaf litter, and lower sea level elevations than the randomly chosen points in the PEDN. These differences were significant for all variables (see Table 2), as well as the specimen occurrence in quadrats between dry and rainy seasons ($t = -3.4$, $df = 382$, $p < 0.001$), with more occurrences observed during the rainy season. ANOVAs on the mean values of environmental variables in each habitat showed differences only for leaf-litter depth and collection point elevation (see Table 3).

DISCUSSION

The mean estimated density of *C. natalensis* in the PEDN was 98.5 individuals ha^{-1} , although it varied among the habitats (34 to 188 ha^{-1}), with the occurrence of a grouped distribution pattern in forested habitats. These density numbers differ from the high population densities that are relatively common within the Sphaerodactylidae: *Sphaerodactylus macrolepis* from the British Virgin Islands presents the largest density found to date in terrestrial vertebrates ($52,800$ ha^{-1} , Rodda *et al.*, 2001); *Gonatodes antillensis* ($4,200$ ha^{-1} , Bennett and Gorman, 1979) on the Caribbean island of Bonaire; *S. vicenti* (up to $5,625$ ha^{-1} ; Steinberg *et al.*, 2007) on St Vincent and *S. parvus* ($52,000$ ha^{-1} ; Nava *et al.*, 2001) on Anguilla, both in the West Indies; *S. sputator* and *S. sabanus* ($1,757$ and 195 ha^{-1} respectively; Hensley *et al.*, 2004) on St. Eustatius, Netherlands Antilles. However, the population density of lizard species on islands is generally

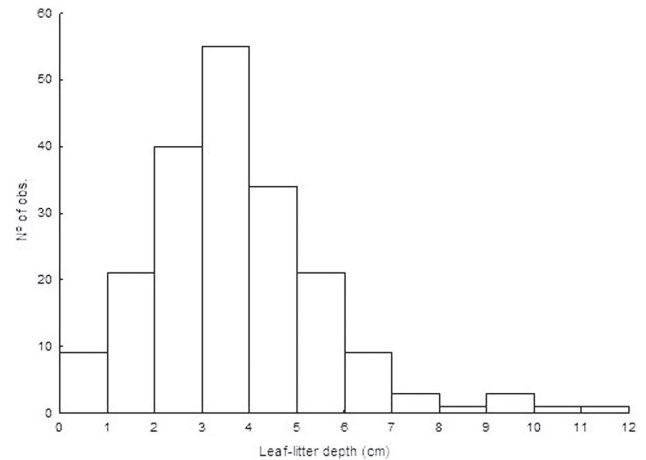


FIGURE 5. Mean depth of leaf-litter in collection points of the specimens of *Coleodactylus natalensis* ($N = 200$) in Parque Estadual Dunas de Natal, Natal, RN, Brazil.

higher than that of continental species (Buckley and Jetz, 2007). Moreover, many population density studies have focused on areas chosen for their high abundance of the target species (Rodda *et al.*, 2001).

Buckley and Jetz (2007) estimate that on the continent, all lizard species studied occur at a mean density of 158 ± 56 individuals ha^{-1} , whereas on islands this mean is $1,920 \pm 574$ individuals ha^{-1} . Thus, the estimated mean density of *C. natalensis* agrees with mean population densities of continental lizards. Although many variables (including quality of habitat and microhabitat, predator-refuges or prey abundance) could be affecting its density, small terrestrial vertebrates have higher densities in their respective assemblages (Rodda and Dean-Bradley, 2002), and given that *C. natalensis* is the smallest vertebrate found in the PEDN, a greater abundance of this species in relation to other species would be expected (see Freire, 1996).

In PEDN, *C. natalensis* preferentially occupies forest habitats, in more humid areas with milder temperatures, without direct sunlight and with thick leaf litter. This preference for mesic habitats is shared by other species of *Coleodactylus* in different biomes (Vanzolini, 1980; Vitt and Zani, 1998; Colli *et al.*, 2002; Vitt *et al.*, 2005) and by other small Sphaerodactylidae (Hensley *et al.*, 2004; López-Ortiz and Lewis, 2004; Steinberg *et al.*, 2007), probably due to their high rates of water loss, resulting from their vulnerability to thermal stress and dehydration, related to small body size, relatively large surface to volume ratio and diurnal activity (Hedges and Thomas, 2001; López-Ortiz and Lewis, 2004), limiting them to inhabit these areas (MacLean, 1985; Steinberg *et al.*, 2007). This dependence of mesic environments may

restrict their distribution to forested habitats that are in continuous reduction due to human activities.

Although there is a clear preference for forest habitats, the fact that *C. natalensis* has been found in more open habitats was reported by Freire (1996, 1999). Indeed, the first studies suggested that the distribution of *Coleodactylus* species was limited to forested areas (Vanzolini, 1957, 1968), but some populations have been recorded in open areas, such as mesic regions of the Caatinga (Vanzolini, 1980; Vanzolini *et al.*, 1980) and restingas (Freire, 1996; Dias *et al.*, 2003).

Coleodactylus natalensis is a shaded habitat species, but has been more frequently found in areas with filtered sunlight than its congeneric species in the Amazon region (except *C. septentrionalis*; Vitt *et al.*, 2005). Incidence of direct sunlight onto the soil and the absence or scarcity of leaf litter may be factors that restrict the occupation by this species, since temperature and humidity did not vary significantly between the habitats in PEDN.

The differences in number of occurrences between seasons may be indicative of reproductive peaks during the rainy season, as observed in *Sphaerodactylus nicholsi* (López-Ortiz and Lewis, 2004). Indeed, we found slightly higher percentages of females with eggs (21.6% in the rainy season; 16.2% in the dry season) and of offspring (19.6% in the rainy season; 16.25% in the dry season) during the rainy season.

Threat assessment

The association of this species with rare forest habitats and their relatively low density in PEDN serves as a warning of a likely risk of extinction, since the species is endemic to small forest fragments surrounded by urban areas. Thus, they have a very restricted geographic distribution in a highly threatened ecosystem, affecting mainly habitat loss due to urban expansion along the northeast coast of Brazil. These facts call for the urgent inclusion of *C. natalensis* in lists of endangered species and the adoption of conservation measures, such as monitoring projects, in the areas of occurrence.

Based on IUCN criteria (IUCN, 2001), we evaluated the known area of occupancy of *C. natalensis*, which is in continuous decline, and further studies are necessary. The total area of fragments in which the species is confirmed to occur is about 2,600 ha, of which 2,142 ha are effectively protected by Conservation Units. The area of occupancy where species can possibly occur in RN state is about 44,000 ha (Fundação

S.O.S. Mata Atlântica and Instituto Nacional de Pesquisas Espaciais, 2010), mostly composed of unprotected fragments. By having less than 500 km² (50,000 ha; see range map, Figure 1) of severely fragmented forest, dunes and restinga habitats, *C. natalensis* could be included in “Endangered EN B2ab(ii)” IUCN Red List category, until new studies are performed.

RESUMO

Coleodactylus natalensis é um lagarto endêmico de fragmentos de Mata Atlântica no Estado do Rio Grande do Norte, na costa nordeste do Brasil. O principal fragmento com conhecida ocorrência da espécie é o Parque Estadual Dunas de Natal “Jornalista Luiz Maria Alves”, uma Unidade de Conservação coberta predominantemente por dunas e cercado por área urbana. Devido à vulnerabilidade da espécie e à importância do PEDN, estudamos a densidade, distribuição espacial e as preferências de habitat e microhabitat dessa população, para fornecer bases para futuros esforços de conservação. Amostramos aleatoriamente 96 quadrantes de 50 m² em cada um dos quatro habitats identificados na área de estudo, encontrando uma densidade média de indivíduos de $98,5 \pm 75,5$ ha⁻¹, com distribuição agrupada nos habitats de maior densidade e randômica nos demais. A espécie habita preferencialmente o folhiço de habitats de mata, em pontos mais úmidos, com temperaturas mais amenas, folhiço mais denso e menores altitudes em relação à média da área de estudo. Devido à densidade relativamente baixa, distribuição restrita a ambientes florestados e à expansão urbana que põe a Mata Atlântica nordestina em constante risco, é imperativo que sejam tomadas medidas conservacionistas para esta população de *C. natalensis*.

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APPENDIX I

Specimens examined

Brazil: State of Rio Grande do Norte, RN: Natal: Parque Natural Municipal Dom Nivaldo Monte: CHBEZ 1790-1791; CHBEZ 1792; CHBEZ 1810-1811; CHBEZ 2339; CHBEZ 2500; CHBEZ 2532; CHBEZ 2548; Natal: Parque Estadual Dunas de Natal: CHBEZ 645-648; CHBEZ 1000; CHBEZ 1039; CHBEZ 1092; CHBEZ 1134-1135; CHBEZ 1824-1829; CHBEZ 1830-1835; CHBEZ 1836-1838; CHBEZ 1839-1841; CHBEZ 1920-1924; CHBEZ 1925-1937; CHBEZ 1938-1945; CHBEZ 1946-1947; CHBEZ 1948-1951; CHBEZ 1964-1966; CHBEZ 2261-2262; CHBEZ 2631-2632; CHBEZ 2639-2640; CHBEZ 2702-2703; Natal: Ponta Negra, Zona de Proteção Ambiental 5: CHBEZ 2277; Natal: Campus Central da Universidade Federal do Rio Grande do Norte: CHBEZ 2066; Parnamirim: Mata do Jiqui, Empresa de Pesquisas Agropecuárias do Rio Grande do Norte – EMPARN: CHBEZ 1120; CHBEZ 1199; CHBEZ 1343; CHBEZ 1504; CHBEZ 1793; CHBEZ 1845-1846; Parnamirim: Distrito de Pium: CHBEZ 1269; CHBEZ 2499; Tibau do Sul: Distrito de Pipa: Parque Estadual Mata da Pipa: CHBEZ 2419-2425; CHBEZ 2509-2520; CHBEZ 2771-2781; CHBEZ 2913-2916.