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Estimated population density of and sources of disturbance for the endemic and threatened *Liolaemus lutzae* in a remnant area of its narrow habitat in southeastern Brazil

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Liolaemus lutzae MERTENS, 1938 (Squamata, Liolaemidae) (Fig. 1) is a lizard species which occurs in Brazilian Restingas (coastal sand plains) in the state of Rio de Janeiro. It is presently included as ‘Critically Endangered’ in the Brazilian Red List of Threatened Fauna (MARTINS & MOLINA 2008) and as ‘Vulnerable’ in the global Red List (ROCHA 2000). This is one of the lizard species in the world with a great probability of extinction in the next few decades due to the thermal alteration of its niche caused by climatic changes (SINERVO et al. 2010). *Liolaemus lutzae* has a relatively restricted geographic distribution, occurring in a stretch of approximately 200 km in length of the state’s coast, ranging from the Restinga da Marambaia eastward to Cabo Frio (VANZOLINI & AB’SABER 1968, ROCHA et al. 2009a, b). Individuals of this species are habitat specialists, inhabiting mainly a stretch of sandy beach of few meters wide in the halophilous-psammophilous-reptant vegetation zone of Restingas (ROCHA et al. 2009b, MAIA-CARNEIRO & ROCHA 2013a). Such restriction increases their vulnerability to habitat modifications.

Most Restinga habitats found in the distribution range of *L. lutzae* are currently under intense pressure from human disturbances, which caused a considerable decrease in the total area of this type of habitat in the state of Rio de Janeiro (ROCHA & BERGALLO 1992, ROCHA et al. 2003, 2007, 2009a, b, c). Different disturbance factors in the habitat where *L. lutzae* lives affect its populations, mainly in the shape of destruction of the vegetation cover of Restinga beach habitats (ROCHA & BERGALLO 1992, ROCHA et al. 2003, 2007, 2009a, b, c). For instance, in the Reserva Ecológica de Marapendi, a Conservation Unit in the state of Rio de Janeiro, an estimation of *L. lutzae* population status indicated that there was a considerable decline from 1984 to 1991, mainly because of habitat loss due to human

disturbances (ROCHA & BERGALLO 1992). Herein, we aim (1) to estimate the population density of *L. lutzae* in a remnant area of its narrow habitat in southeastern Brazil, and (2) report sources of disturbance occurring in the Restinga, which might potentially affect populations of this species (see ROCHA et al. 2009a, b).

Restingas are habitats originating from the Quaternary that are characterized by sandy soils with high salt concentrations and a predominance of herbaceous and shrubby vegetation (SUGUIO & TESSLER 1984). Field sampling was conducted in a stretch of Restinga in Praia Grande (22°57’ S, 42°02’ W), municipality of Arraial do Cabo, state of Rio de Janeiro, southeastern Brazil (Fig. 2), near the Área de Pro-



Figure 1. An individual of *Liolaemus lutzae* on a piece of plastic bag (Photo by CFDR).

teção Ambiental da Massambaba. The climate in the Área de Proteção Ambiental da Massambaba is seasonal, with a mean annual precipitation of approximately 800 mm and a mean annual temperature of 25°C (SCARANO 2002).

Data were collected in June, July, and September (dry season), and in November and December (rainy season) of 2011 through visual encounter surveys constrained by time. We delimited a study area measuring approximately 60 m in width by 500 m in length (measured with a measuring tape with a precision of 1 mm). Visual encounter surveys (30 min.) were each performed inside the delimited area at hourly intervals between 08:00 h a.m. and 12:00 h p.m., totalling 1,560 min. of sampling effort (960 min. in the dry season and 600 min. in the rainy season). We recorded the number of lizards sighted during each survey. Although the thermal environment changes seasonally in the study area (SCARANO 2002, MAIA-CARNEIRO et al. 2012, MAIA-CARNEIRO & ROCHA 2013b, c), we searched for lizards under similar weather conditions (always sunny days) in periods of great activity of individuals (see ROCHA 1988, MAIA-CARNEIRO et al. 2012). To determine the conservation status of the study population, we calculated a standardized index of population density by dividing the total number of lizards sighted by the total time (in min-

utes) spent in transects, following ROCHA et al. (2009a). This estimated density index is expressed as individuals found per minute (ind/min). During the study, we recorded sources of disturbance, that we observed in the Restinga, which might affect the *L. lutzae* populations (ROCHA et al. 2009a).

Analysis of data obtained in this study revealed that the estimated density index of the population of *L. lutzae* in Praia Grande was 0.11 ind/min. A comparison between this result and the data collected by ROCHA et al. (2009a) indicates that the population in the Restinga of Praia Grande has maintained its population size, suggesting a locally stable population, and its maintenance under the status 'in risk of extinction' (estimated population density in 2006/2007 = 0.12 ind/min; see ROCHA et al. 2009a). This study was conducted near an area (Área de Proteção Ambiental da Massambaba) which is exposed to a higher level of human pressure compared to other Restingas in the same region, mainly due to urbanization processes and some associated consequences (ROCHA et al. 2009c), which also affect its surroundings. The area that we surveyed during this study in Praia Grande is relatively distant from some sources of disturbance (see ROCHA et al. 2009a, b), which might be responsible for the apparent local stability over

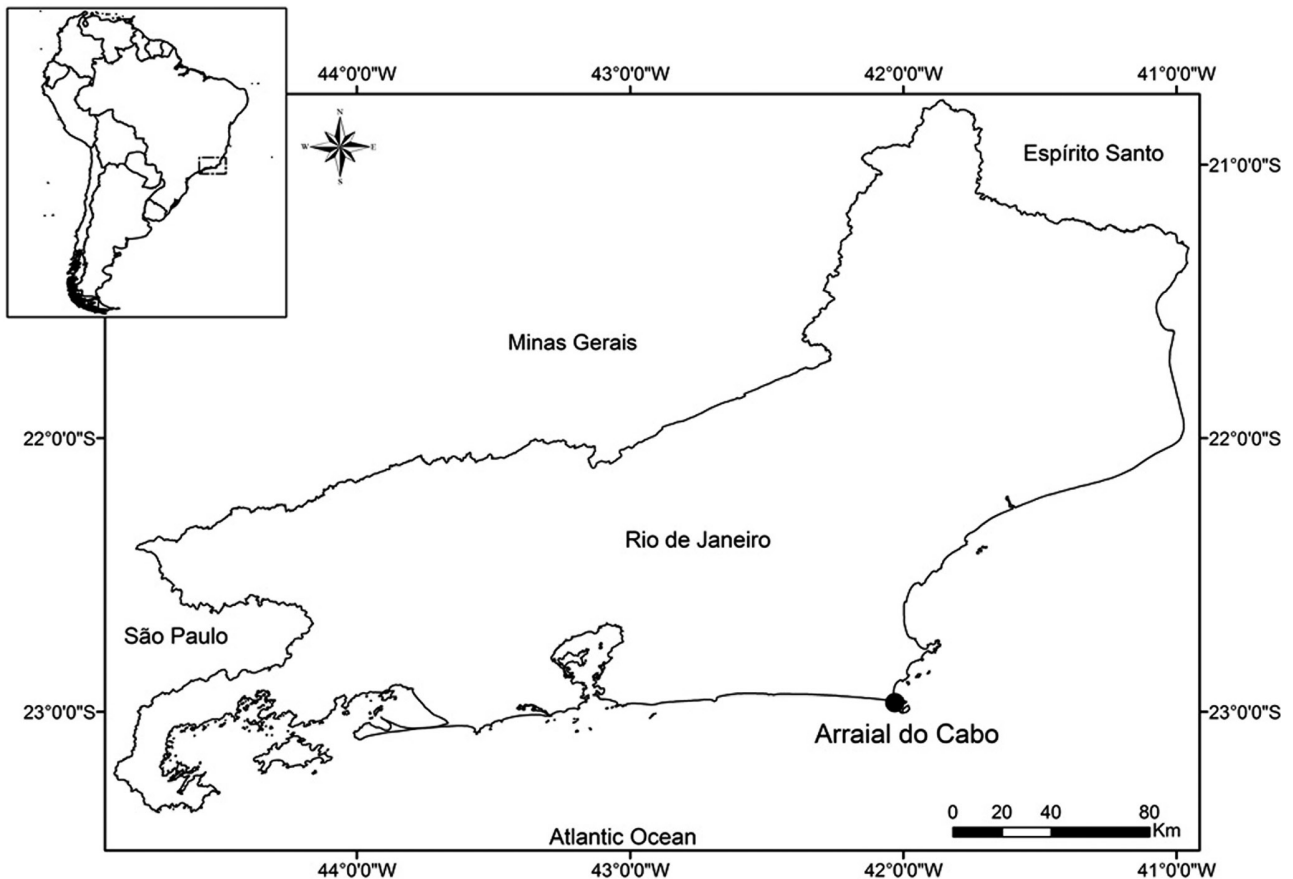


Figure 2. Map showing the study area (black dot) situated in the municipality of Arraial do Cabo, state of Rio de Janeiro, southeastern Brazil.

the period between the two studies. Indeed, in portions of Restinga in Praia Grande that are influenced heavily by human activities, it appears that there are lower numbers of *L. lutzae* individuals. It was found to be a significant statistical trend that Restingas with a high number of sources of degradation would harbour lower population densities of *L. lutzae* (ROCHA et al. 2009a), which might also occur in different portions of the same Restinga.

Typically, estimations of the population density of *L. lutzae* have been carried out mainly during the rainy season (ROCHA & BERGALLO 1992, ROCHA et al. 2009a), the period when *L. lutzae* adults are reproductively active (ROCHA 1992, 1998a), to reduce the possible influence of seasonality on observed lizard abundance. However, we conducted our surveys during both the dry and rainy seasons and found the estimated density indices to be similar (dry season: 0.11 ind/min; rainy season: 0.10 ind/min). Therefore, although changes in thermal environments influence the activity of *L. lutzae* (ROCHA 1988, MAIA-CARNEIRO et al. 2012, MAIA-CARNEIRO & ROCHA 2013b, c), the analysis of our data suggested that seasonality had no influence on the density of individuals (based on the number of lizards sighted per minute). This result suggests that population density estimates of *L. lutzae* might be performed independently of the season, i.e., during the dry and/or the rainy season.

Different sources of disturbance were reported to occur in the habitat where *L. lutzae* lives in Praia Grande: trampling of vegetation by people trying to gain access to the beach area, planting of exotic plant species that replace the original vegetation, and littering on the vegetation (ROCHA et al. 2009a, b). All of these were also seen during the execution of the present study. In addition, we also recorded sources of disturbance that were not listed for Praia Grande by ROCHA et al. (2009a, b): (1) traffic of vehicles on sand dune vegetation, (2) burning of vegetation in some portions of the beach habitat, and (3) trampling of vegetation by domestic animals, all of which might represent sources of mortality for the lizards. In the Reserva Ecológica de Marapendi, a population decrease of 65% of *L. lutzae* was attributed to the wide range of human disturbances imposed on the beach habitat, leading to the loss of vegetation (ROCHA & BERGALLO 1992). There, among the main disturbances identified, the traffic of vehicles appeared to be one of the most relevant impacts that were locally affecting lizards (ROCHA & BERGALLO 1992). These problems started to be solved when a program for the environmental recovery of the area was implemented (ROCHA et al. 2009d). The recovery and conservation of the vegetation of the beach habitat is important for *L. lutzae*, because plants in these areas are important sources of food, shelter, and microhabitats for thermoregulation for these lizards (ROCHA, 1989, 1991, 1996, 1998b) and are therefore fundamental to the survival of individuals. In this context, we recommend the implementation of programs for environmental recovery in areas where *L. lutzae* occurs and also where it has become extinct in order to create a basis for carry-

ing out future relocation programs (see SOARES & ARAÚJO 2008, ROCHA et al. 2012) for the recovery and conservation of this species and natural processes in which it partakes.

To avoid the additional loss of populations of *L. lutzae* (see ROCHA et al. 2009a, b), it will be important to develop and adopt practices that focus on the recovery and conservation of remnant habitats that enable individuals to survive, in the manner as has been shown to be successful in the Reserva Ecológica de Marapendi (see ROCHA et al. 2009d). This should be undertaken mainly in areas exposed to higher degrees of pressure from human disturbances and where *L. lutzae* is currently locally extinct. These areas must have priority in relocation programs (see SOARES & ARAÚJO 2008, ROCHA et al. 2012) for this species. Such practices might help to conserve the habitat and its whole set of local ecological processes and therefore favour the long-term persistence of *L. lutzae* populations.

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