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ARTICLE

Distribution and abundance of Pectoral Antwren (*Herpsilochmus pectoralis*) and Caatinga Antwren (*Herpsilochmus sellowi*) in the Atlantic Rainforest of northeast Brazil

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ABSTRACT: The Pectoral Antwren (*Herpsilochmus pectoralis*) and Caatinga Antwren (*H. sellowi*) are thamnophilids endemic to northeastern Brazil. The Pectoral Antwren is considered an "Endangered" species by the IUCN. The present study aimed at providing data on the distribution, abundance, habitat, and conservation status of these species in Rio Grande do Norte state (RN), Brazil, in order to help define conservation strategies for the species. Thirty-three sites in the Atlantic Forest domain were sampled between November 2005 and March 2008, for a total sampling effort of 414 h. Observations took place mainly between 5:30 h and 12:00 h, and records were based on visual and/or auditory detections. Standardized censuses were conducted in four different phytophysiognomies to determine abundance and density. *Herpsilochmus pectoralis* was found in 73% (n = 24) of the sampled areas, mean density was estimated at 89.1 individuals.km^2 and population size was approximately 13,921 individuals for the state. Available area of occupancy was 156.25 km^2. *Herpsilochmus sellowi* was present in 39% (n = 13) of the areas, with mean density of 60.4 individuals.km^2, estimated population of 7202 and area of occupancy of 119.25 km^2. The population estimate found in this study for *H. pectoralis* is high for a small geographical area, thus demonstrate that BirdLife International information is underestimated. These data widen knowledge of the species at local and national levels, in addition to confirming the importance of *H. pectoralis* in RN state. The low number of protected areas in the region is alarming, given that privately-owned areas face fragmentation, selective deforesting, burnings and significant real estate development.

KEY-WORDS: conservation, density, habitat, population, threatened bird.

INTRODUCTION

The genus *Herpsilochmus* Cabanis, 1847 is exclusively Neotropical and contains 17 species, with the highest diversity in the Amazon Basin (Zimmer & Isler 2003, Remsen-Jr. *et al.* 2014). Twelve species are found in Brazil (Piacentini *et al.* 2015), five of which are endemic to the country: Caatinga Antwren *Herpsilochmus sellowi*, Bahia Antwren *H. pileatus*, Predicted Antwren *H. praedictus*, Aripuana Antwren *H. stotzi* and Pectoral Antwren *H. pectoralis*. Since they are predominantly forest species, they have been threatened by fragmentation and loss of habitat. As a result, some are globally "Endangered" (BirdLife International 2000, 2017). The Pectoral Antwren *H. pectoralis* is a threatened species (IUCN 2004, BirdLife International 2017) distributed locally in semideciduous forest, deciduous forest, and wooded *restinga* (coastal tropical and subtropical moist broadleaf forest) from northeastern Maranhão, east to Rio Grande do Norte and south to Bahia (Cory & Hellmayr 1924, Pinto 1978, Ridgely & Tudor 1994, Sick 1997, Zimmer & Isler 2003, Silva *et al.* 2008, Silveira 2008, BirdLife International 2017). The Caatinga Antwren *Herpsilochmus sellowi* is distributed from the state of Maranhão to Bahia and Minas Gerais with a disjoint population (Whitney *et al.* 2000). Although it has been associated to the Caatinga, it also occurs in the *restinga*, open savannas, as well as in deciduous and nondeciduous forests (Olmos 1993, Whitney *et al.* 2000, Zimmer & Isler 2003, Silva *et al.* 2008). Because information about distribution, ecology and population parameters of these species is scarce, systematic studies are needed to establish conservationist

measures (Zimmer & Isler 2003). Accordingly, this study aims to broaden knowledge on geographic distribution, viable habitat, and estimated regional population of *H. pectoralis* and *H. sellowi* in northeastern Brazil.

METHODS

Thirty-three sites in 16 municipalities located in the Atlantic Forest of Rio Grande do Norte (RN), northeastern Brazil, were sampled between November 2005 and March 2008 (sampling effort of 414 man.h) (Table 1). The study areas are situated on the east coast, between the towns of Maxaranguape and Baía Formosa (Fig. 1). The eastern portion of RN has mean annual rainfall of 1400 mm, and its climate is defined as type "A" according to Köppen's classification system (rain concentrated between February and July) (IDEMA 2002). Sampling locations were chosen based on plant cover identified on satellite images. Forest fragments in the domain of Atlantic Forest in the state which had 50 or more ha were sampled.

Table 1. Locations sampled in the Atlantic Forest domain in Rio Grande do Norte state, northeast Brazil, with respective geographic coordinates, area size, sampling effort and number of contacts with *Herpsilochmus pectoralis* and *Herpsilochmus sellowi*.

Location and Municipality	Geographic Coordinates and Altitude (in m a.s.l.)	Area (km^2)	Effort (h)	Number of detections	
				H. pectoralis	*H. sellowi*
1. Lagoa do Pacheco, Maxaranguape	05°29'35''S; 35°16'25''W, 34 m	0.88	5	8	10
2. Muriu Militar Area, Ceará Mirim	05°32'44''S; 35°16'38''W, 32 m	6.16	6	14	16
3. Caiana, Ceará Mirim	05°37'08''S; 35°14'04''W, 48 m	3.80	10	0	4
4. Cachoeirinha de Pitangui, Extremoz	05°36'10''S; 35°14'20''W, 15 m	2.00	4	0	0
5. Imbiribeira, Extremoz	05°38'38''S; 35°15'00''W, 38 m	2.90	12	0	11
6. Contenda, Extremoz	05°39'44''S; 35°13'36''W, 34 m	0.90	12	0	0
7. Estivas, Extremoz	05°40'56''S; 35°15'40''W, 34 m	5.28	50	145	126
8. APA Jenipabu, Extremoz	05°42'05''S; 35°12'25''W, 34 m	18.18	22	24	14
9. Guajiru, São Gonçalo do Amarante	05°44'26''S; 35°18'32''W, 45 m	0.60	4	0	0
10. Dunas State Park of Natal, Natal	05°50'12''S; 35°11'40''W, 70 m	11.72	30	203	91
11. Morro do Careca, Natal/Barreira do Inferno Parnamirim	05°53'02''S; 35°09'34''W, 30 m	11.00	12	5	4
12. Mata do Catre Military Area, Parnamirim	05°53'01''S; 35°13'36''W, 49 m	2.15	5	2	0
13. Industrial Park, Parnamirim	05°52'41''S; 35°14'36''W, 28 m	0.88	40	177	17
14. Mata do Jiqui, Parnamirim	05°55'45''S; 35°11'21''W, 39 m	0.79	20	60	0
15. Mata de Jundiaí, Macaíba	05°53'21''S; 35°23'07''W, 56 m	2.70	30	13	48
16. Pium, Nizia Floresta	05°57'30''S; 35°10'23''W, 51 m	0.50	3	2	0
17. Lagoa do Bonfim, Nizia Floresta	06°01'44''S; 35°13'12''W, 37 m	1.10	3	2	0
18. Campo de Santana, Nizia Floresta	06°04'42''S; 35°06'30''W, 30 m	10.80	3	28	0
19. Golani, Nizia Floresta	06°07'44''S; 35°13'40''W, 90 m	1.10	6	34	0
20. Mendezinho I, São Jose de Mipibu	06°01'52''S; 35°16'10''W, 70 m	1.00	3	6	0
21. Mendezinho II, São Jose de Mipibu	06°01'39''S; 35°16'32''W, 53 m	0.76	5	2	1
22. Manimbu, São Jose de Mipibu	06°07'54''S; 35°13'44''W, 90 m	1.70	2	24	0
23. Areal, Senador Georgino Avelino	06°08'27''S; 35°06'13''W, 26 m	1.70	2	3	0
24. Urucará, Ares	06°09'50''S; 35°13'30''W, 52 m	2.90	16	2	0
25. Baldum, Ares	06°11'12''S; 35°13'09''W, 40 m	4.70	4	4	0
26. Mata do Bastião, Tibau do Sul	06°13'46''S; 35°04'08''W, 21 m	0.50	5	2	0
27. Ecological Sanctuary of Pipa, Tibau do Sul	06°13'35''S; 35°03'56''W, 60 m	0.80	20	52	2
28. Limoal, Goianinha	06°14'16''S; 35°13'19''W, 21 m	11.40	3	4	0
29. Fazenda Bom Jardim, Goianinha	06°18'25''S; 35°14'03''W, 90 m	6.46	5	0	0
30. APA Piquiri-Una, Timbó, Espírito Santo	06°22'30''S; 35°17'17''W, 44 m	10.50	12	0	20
31. RPPN Mata Estrela, Baía Formosa	06°22'25''S; 35°01'24''W, 64 m	20.39	36	40	0
32. Mata da Bela, Baía Formosa	06°25'12''S; 35°07'04''W, 21 m	1.00	15	0	0
33. Mata da Paraíba, Canguaretama	06°26'47''S; 35°07'26''W, 71 m	1.70	9	0	0

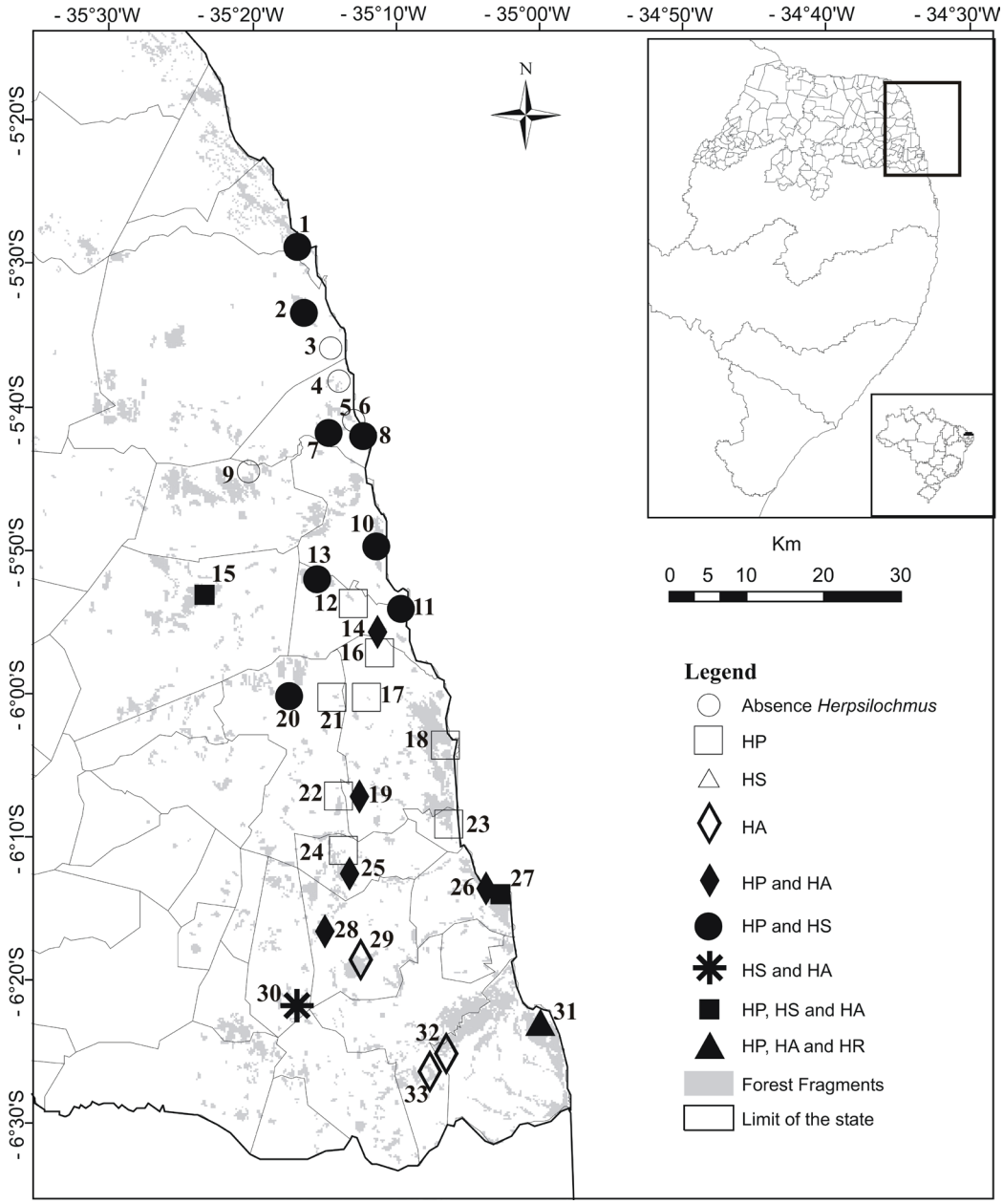

Figure 1. Geographic distribution of *Herpsilochmus* spp. in the Atlantic Forest of Rio Grande do Norte state, northeast Brazil. White circle means absence of *Herpsilochmus*; black circle indicates syntopy between *H. pectoralis* (HP) and *H. sellowi* (HS); white triangle indicates records of *H. sellowi*; black triangle indicates sympatry between *H. pectoralis*, *H. atricapillus* (HA) and *H. rufimarginatus* (HR); black square indicates syntopy between *H. pectoralis*, *H. sellowi* and *H. atricapillus*; white square indicates the presence of *H. pectoralis*; white diamond indicates the presence of *H. atricapillus*; black diamond indicates syntopy between *H. pectoralis* and *H. atricapillus*; asterisk indicates syntopy between *H. sellowi* and *H. atricapillus*. Areas: 1. Lagoa do Pacheco, 2. Muriu Militar Area, 3. Caiana, 4. Cachoeirinha de Pitangui, 5. Imbiribeira, 6. Contenda, 7. Estivas, 8. APA Jenipabu, 9. Guajiru, 10. Dunas State Park of Natal, 11. Morro do Careca, 12. Mata do Catre Military Area, 13. Industrial Park, 14. Mata do Jiqui, 15. Mata de Jundiai, 16. Pium, 17. Lagoa do Bonfim, 18. Campo de Santana, 19. Golani, 20. Mendezinho I, 21. Mendezinho II, 22. Manimbu, 23. Areal, 24. Urucará, 25. Baldum, 26. Mata do Bastião, 27. Ecological Sanctuary of Pipa, 28. Limoal, 29. Fazenda Bom Jardim, 30. APA Piquiri-Una, 31. RPPN Mata Estrela, 32. Mata da Bela and 33. Mata da Paraíba.

We searched for the species along trails and/or roads in the study areas, mainly between 5:30 h and 12:00 h and sometimes between 14:00 h and 17:00 h. Records were based on visual (aided by 8 × 21 binoculars) and auditory detections. The following information was recorded at each observation: species observed, number of individuals, habitat, and presence of congener species. The following tape recorders were used to document information: Sony (DAT) TCD-D8 equipped with a Sennheiser-ME-66 microphone, which were archived at Wikiaves digital repository. Geographic coordinates and altitudes were obtained with Magellan 315 or Garmin 12 GPS.

At Mata de Jundiaí, Industrial Park, Estivas and Dunas Park, areas which represent different vegetation types, anthropic impacts and/or are conservation units under integral protection, we defined 1-km transects to estimate abundance and density of *H. pectoralis* and *H.*

sellowi. A 1-h standardized census was conducted at dawn on each sampling day (onset at 5:30 h). We recorded the number of individuals observed, taking care not to attribute more than one detection to the same individual during the same sampling effort. Mean abundance was obtained by dividing the number of detections per species by the number of observation days at each location. In order to estimate population density of the *H. pectoralis* and *H. sellowi* in areas, we used the linear transect method (Buckland *et al.* 1993, Thomas *et al.* 2002). This requires following the premises of decreasing order of importance: animals directly on the line are always detected, animals are detected in their initial position, before any movement caused by the presence of the observer, perpendicular distances are measured correctly, and detections are independent events (Buckland *et al.* 1993, Thomas *et al.* 2002). Density was calculated using the Distance 6.0 software and models were selected according to Akaike's Information Criterion (AIC). The selected model to estimate density was half-normal with cosine adjustment. The density and effective width were represented by coefficient of variation (%CV) and confidence interval 95% (CI). Density was estimated using the formula D = N/(2*EW*L), where: D = density (individuals/km^2), N = number of sightings, EW = effective width of the sample area (in km) and L = total number of km surveyed (Buckland *et al.* 1993).

Viable habitat was estimated for populations of *H. pectoralis* and *H. sellowi*, based primarily on similar plant cover. In order to accomplish this we compared satellite images of potential species distribution areas. To estimate viable areas we disregarded any cultivated area, those in the process of regeneration or subjected to strong anthropic pressure. We used Landsat images from 2002 (INPE 2007) and Ortofoto images from 2006 of the Rio Grande do Norte coast (IDEMA 2007). Areas with adequate habitat were divided into quadrants of 500 × 500 m to verify which quadrants were occupied by each of the species. The analyzes of adequate habitats and area of occupancy by species was performed inArcGIS 9.0 software.

To estimate population size of *H. pectoralis* and *H. sellowi* on the east coast of RN, occupancy area was multiplied by the means of density between the different plant physiognomies and an estimate of density, considering the whole study area. The first population estimate is a more conservative estimate, where we multiplied the mean density between the physiognomies by the occupancy area by each species. The second population estimate multiplied the density found throughout the study area by the occupancy area by each species.

Descriptive statistical analyses (mean, standard deviation, minimum and maximum values) are reported. Non-parametric analysis of variance (Kruskal-Wallis test) was performed to test for abundance differences of both species among the habitats. The significance level was set at 5% for all analyses.

RESULTS

Herpsilochmus pectoralis was recorded in 24 (73%) of the 33 locations sampled. Distribution limits in the state were north (Lagoa do Pacheco, Maxaranguape), south (private reserve - RPPN Mata Estrela, Baia Formosa) and west (Mata de Jundiaí, Macaiba) (Fig. 1). *Herpsilochmus sellowi* occurred in 13 (39%) of the 33 locations studied (Fig. 1). The distribution limit of *H. sellowi* in the north coincided with that of the previous species (Fig. 1). Syntopy between *H. pectoralis* and *H. atricapillus* occurred in six fragments, and between *H. atricapillus* and *H. sellowi* in a single area (Fig. 1). These three species only occurred together in Mata de Jundiaí, Ecological Sanctuary of Pipa and RPPN Mata Estrela. *Herpsilochmus pectoralis*, *H. atricapillus* and *H. rufimarginatus* were found jointly in the southernmost part of the state (RPPN Mata Estrela) (Fig. 1). There were several observations of mixed-species flocks containing *H. pectoralis* and *H. atricapillus*, and rare observations of flocks containing *H. pectoralis* and *H. sellowi*. Other species often observed in mixed-species flocks with *Herpsilochmus* were Planalto Slaty-Antshrike *Thamnophilus pelzelni*, White-fringed Antwren *Formicivora grisea*, Pearly-vented Tody-tyrant *Hemitriccus margaritaceiventer*, Chivi Vireo *Vireo chivi* and Gray-eyed Greenlet *Hylophilus amaurocephalus*.

Between 2005 and 2008, a total of 856 detections of *H. pectoralis* and 364 of *H. sellowi* were recorded (Table 1). Abundance of *H. pectoralis* were different among habitats. They were higher in semideciduous forest (Industrial Park = 35.4 individuals.day) and lower for deciduous forest (Mata de Jundiaí = 2.6 individuals.day) (H = 19.3, df = 3, P < 0.001) (Table 2). There were also varying abundance in the different plant physiognomies for *H. sellowi* (H = 15.1, df = 3, P < 0.001) (Table 2). The total number of contacts with *H. pectoralis* and *H. sellowi* in linear transects was 68 and 46, respectively, where a total of 80 km were covered. The density varied between the plant physiognomies from 53.03 to 142.12 individuals.km^2 for *H. pectoralis* and from 40.49 to 76.57 individuals.km^2 for *H. sellowi* (Table 2). The estimates for all study areas were 103.51 individuals.km^2 for *H. pectoralis* and 57.28 individuals.km^2 for *H. sellowi*.

Estimated suitable habitat for *H. pectoralis* on the eastern coast of RN was 504.7 km^2. The most representative plant formations were semideciduous forest (216.5 km^2), *restinga* (114.3 km^2), deciduous

forest (98.1 km^2) and open savannas (75.8 km^2). The only full-protection conservation area in the study region is the Dunas State Park of Natal, which contains 9.55 km^2 suitable for the species, corresponding to 2% of the total area considered likely to be inhabited. There are also sustainable-use conservation areas accounting for 10% (49.07 km^2) of the estimated area. These environmental protection areas (APA Jenipabu and APA Piquiri-Una, *n* = 2) represent 6% (28.68 km^2) and RPPN Mata Estrela 4% (20.39 km^2) of the estimated area. We also underscore the importance of military areas (Muriu Military Area and Mata do Catre Military Area, *n* = 2), which are well preserved and represent 2% (8.31 km^2) of the estimated area. The area of occupancy was 156.25 km^2 (*n* = 625 quadrants) and 119.25 km^2 (*n* = 477 quadrants) for *H. pectoralis* and *H. sellowi*, respectively.

Based on the combination of area of occupancy (156.25 km^2) and mean density per plant physiognomy (mean density 89.1 individuals.km^2) (Table 3), the population was estimated at 13,921 *H. pectoralis* in Rio Grande do Norte and estimate for the area of study was 16,173 individuals. Estimated area of occupancy for *H. sellowi* in Atlantic Forest was 119.25 km^2, resulting in a population of 7202 individuals (mean density 60.4 individuals.km^2) (Table 3) and estimate for the area of study was 6830 individuals.

Table 2. Abundance and density of *Herpsilochmus pectoralis* and *Herpsilochmus sellowi* at Mata de Jundiai, Industrial Park, Estivas and Dunas State Park of Natal, Rio Grande do Norte, northeast of Brazil. Abundance and mean number of individuals obtained by census and population density based on calculations (individuals.km^2). CV = Coefficient of Variation and CI = Confidence Interval).

Location	*Herpsilochmus pectoralis*		*Herpsilochmus sellowi*	
	Abundance Mean ± SD (Min – Max)	**Density (% CV; CI 95%)**	**Abundance Mean ± SD (Min – Max)**	**Density (% CV; CI 95%)**
Mata Jundiai	2.6 ± 1.3 (1 – 4)	67.84 (25.57; 39.50 – 116.52)	9.6 ± 1.5 (8 – 11)	57.83 (20.51; 37.69 – 88.74)
Industrial Park	35.4 ± 12.7 (20 – 46)	142.12 (18.32; 98.03 – 206.05)	3.4 ± 1.9 (1 – 6)	76.57 (30.18; 39.77 – 147.42)
Estivas	14.5 ± 5.0 (8 – 24)	53.03 (22.81; 32.98 – 85.28)	12.6 ± 3.4 (8 – 16)	66.73 (34.51; 32.16 – 138.46)
Dunas Park	20.3 ± 5.9 (10 – 28)	93.39 (19.25; 62.98 – 138.48)	9.1 ± 2.8 (5 – 14)	40.49 (24.84; 24.11 – 68.01)
Mean Density ± SD		89.1 ± 39.1		60.4 ± 15.3
Whole study area		103.51 (21.11; 61.96 – 172.95)		57.28 (11.58; 45.33 – 72.39)

Table 3. Population estimate of *Herpsilochmus pectoralis* and *Herpsilochmus sellowi* in Rio Grande do Norte state, northeast of Brazil.

	Herpsilochmus pectoralis	*Herpsilochmus sellowi*
Physiognomy	**Suitable habitat (km^2)**	**Viable habitat (km^2)**
Semideciduous forest	216.5	95.6
Deciduous forest	98.1	98.1
Restinga	114.3	37.7
Open savanna	75.8	80.6
Total area	504.7	312
Occupation area (km^2)	156.25	119.25
Mean density (individuals.km^2)	89.1	60.4
Population estimate (individuals)	13,921	7202

DISCUSSION

Herpsilochmus pectoralis and *H. sellowi* are widely distributed on the eastern coast of the state of Rio Grande do Norte, occurring in *restingas*, open savannas, deciduous and semideciduous forests. Data obtained contribute to knowledge of the geographic distribution of these species. The scant information available for *H. pectoralis* in RN was restricted to three regions in the south of the state, and to *restingas* of Baia Formosa and Tibau do Sul (Teixeira *et al.* 1993, Whitney *et al.* 2000, Olmos 2003). *Herpsilochmus sellowi* was known only in

the Ecological Sanctuary of Pipa in the municipality of Tibau do Sul (Whitney *et al.* 2000).

In RN *H. pectoralis* was found in plant formations similar to those mentioned for other Brazilian states (Wege & Long 1995, Parrini *et al.* 1999, Kirwan *et al.* 2001). However, it was cited in areas with good conservation status (Whitney *et al.* 2000). Our observations show that *H. pectoralis* is common even in fragmented and anthropized areas. *Herpsilochmus sellowi* is much more widely distributed on the east coast of the state, but not found inland in the moist forest enclave of Martins, in contrast to those in Pernambuco, where it occurs (Roda 2002, Roda & Carlos 2004). This species, which is closely associated to the Caatinga (Whitney *et al.* 2000), has been considered endemic to this biome (Parker-III *et al.* 1996). However, all our records of this species are in the Atlantic Forest domain. In studies conducted in other areas of Caatinga this species is registered (Santos 2004, Olmos *et al.* 2005), but in the RN state, recorded only had been made in *restingas*, open savannas, deciduous and semideciduous forests.

The few data available on *H. pectoralis* were only qualitative, classifying the species as locally common or rare (Teixeira *et al.* 1993, Ridgely & Tudor 1994, Silveira 2008), but Teixeira *et al.* (2016) estimated the density of this species in 85 individuals.km^2 in a forest fragment in Rio Grande do Norte. Densities found for *H. pectoralis* and *H. sellowi*, despite using different methods, are similar to those obtained for other common (*e.g.* Variable Antshrike *Thamnophilus caerulescens*, Plain Antvireo *Dysithamnus mentalis* and White-backed Fire-eye *Pyriglena leucoptera*) and threatened thamnophilids (*e.g.* Rio Branco Antbird *Cercomacra carbonaria* and Restinga Antwren *Formicivora littoralis*) (Duca *et al.* 2006, Vale *et al.* 2007, Mattos *et al.* 2009). The estimated population of *H. pectoralis* in RN state reached 13,920 individuals or a more optimistic estimate of about 16,170 individuals. This number exceeds the estimates of 3500 to 15,000 individuals in an 860,000 km^2 of distribution size (BirdLife International 2017), but this estimates take into account a density of 2.6–9.6 individuals.km^2. The density found for species in forest fragments are much larger and similar to that found for other species of the thamnophilidae family. Based on this new species density information, BirdLife International (2017) information seems to be underestimated. We found the species occurring in small fragments of forest and well altered, showing that the species tolerates altered areas. But this species had lost suitable areas with the expansion of sugar cane cultivation and the growth of cities, and today it continues to have its habitat destroyed for infrastructure activities along the coast of Rio Grande do Norte and popular houses.

The large number of unprotected private areas where *H. pectoralis* occurs reinforces the need for stablishing new protected areas, as suggested by Zimmer & Isler (2003). It is also important to correctly manage these units through better control of anthropic influences such as the introduction of new species, invasion, access of domestic animals and people. There is a clear need to establish corridors between the best forest fragments due to the existence of isolated populations such as those found in Dunas State Park of Natal. Due to their extent, number of records and estimated size of population, the following areas are important for the conservation of *H. pectoralis*: RPPN Mata Estrela, as reported by Bencke & Maurício (2006), Muriu Military Area in Ceará Mirim, APA Jenipabu in Extremoz, Dunas State Park of Natal in Natal, Morro do Careca in Natal/Barreira do Inferno in Parnamirim, Mata do Jiqui in Parnamirim, Industrial Park in Parnamirim, Campo de Santana in Nisia Floresta and Limoal in Goianinha. We recommend that government authorities pay more attention to the conservation of these areas. We also underscore the importance of military areas for protecting habitats and threatened species.

Despite the representative populations of *H. pectoralis* and *H. sellowi* in the state, they face short-term threats due to fragmentation and loss of habitat. In some areas we observed deforestation for real estate development, formation of pastures, and monocultures. Real estate speculation in the coastal areas of the state is worrisome, since several large scale projects are being implemented along nearly the entire coast. Some of these were approved without considering the presence of remnant populations of these species. Unplanned development, mainly in the city of Natal, also threatens important areas for populations of *H. pectoralis*. Finally, sugar cane burning has serious impacts on nearby forest fragments. We suggest that these threats could reduce the sutable habitats of *H. pectoralis* by at least 50% in the next decade if current trends are not reversed. For theses reason we emphasize the need to define conservation plans for these species, as both occur in highly fragmented areas that are subject to anthropic pressures. In addition, it is also recommended to conduct long-term studies on these populations to address questions about ecological and behavioral aspects such as reproduction, home range, territory, and environmental requirements.

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