INFLUENCE OF THE INVASIVE GRASS *UROCHLOA DECUMBENS* ON NEST-SITE SELECTION BY THE BROWN BOOBY *SULA LEUCOGASTER* ON CASTILHO ISLAND, BRAZIL

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ABSTRACT

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The invasion of an ecosystem by exotic plants may change vegetation composition and structure, affecting the nesting habitat of birds at different spatial scales. On Castilho Island in São Paulo State, Brazil, invasion by the grass *Urochloa decumbens* has raised concern because it may affect breeding seabirds. Among those potentially affected is the Brown Booby *Sula leucogaster*, a species with populations that are currently decreasing worldwide. We located 85 Brown Booby nests during the 2015–2016 season, and we compared the proportional use of available invaded and non-invaded areas, considering the macroscale. Further, we established invaded and non-invaded plots of 300 m^2, recorded nests and random non-nest points, and modeled nest-site selection at the microscale as a function of vegetation parameters. Invaded areas were underused for nesting, while areas of native vegetation appeared to be preferred. Invaded plots had a significantly lower mean density of nests than non-invaded plots, and nest sites had lower cover by the invasive grass and higher amounts of dead vegetation than non-nest points. Our results show the importance of controlling *U. decumbens* and other similar invasive species to ensure the continued availability of preferred nesting habitats for Brown Boobies, especially in protected areas. Further, our study indicates that the expansion of invasive plants may be among the environmental changes negatively affecting seabirds.

Key words: alien plants, habitat selection, seabirds, insular species, protected areas

INFLUÊNCIA DA GRAMÍNEA INVASORA *UROCHLOA DECUMBENS* SOBRE A SELEÇÃO DO LOCAL DE NIDIFICAÇÃO PELO ATOBÁ-PARDO *SULA LEUCOGASTER* NA ILHA DO CASTILHO, BRASIL

RESUMO

ALMEIDA, G.G., SAMPAIO-E-SILVA, T.A. & SILVA-MATOS, D.M. 2020. Influência da gramínea invasora *Urochloa decumbens* sobre a seleção do local de nidificação pelo atobá-pardo *Sula leucogaster* na Ilha do Castilho, Brasil. *Marine Ornithology* 48: 111–117.

A invasão de um ecossistema por plantas exóticas pode alterar a composição e estrutura da vegetação, afetando o habitat de nidificação de aves em diferentes escalas espaciais. Na Ilha do Castilho, São Paulo, Brasil, a invasão pela gramínea *Urochloa decumbens* tem gerado preocupações, pois pode afetar a reprodução das aves marinhas. Dentre os possíveis afetados está o atobá-pardo *Sula leucogaster*, uma espécie cujas populações se encontram atualmente em declínio mundial. Localizamos 85 ninhos de atobá-pardo entre 2015 e 2016 e comparamos o uso proporcional das áreas invadidas e não invadidas disponíveis, considerando a macroescala. Além disso, estabelecemos parcelas de 300 m^2 em áreas invadidas e não invadidas, registrando pontos com ninhos e pontos aleatórios sem ninho, e modelamos a seleção do local do ninho em microescala como função dos parâmetros da vegetação. Áreas invadidas foram subutilizadas para nidificação, enquanto que as áreas de vegetação nativa foram aparentemente preferidas. Parcelas invadidas tiveram densidade média de ninhos significativamente menor do que as não invadidas, e os locais selecionados para nidificação apresentaram menor cobertura pela gramínea invasora e maiores quantidades de necromassa em relação aos pontos sem ninho. Nossos resultados orientam para a importância do controle da espécie *U. decumbens* e de outras gramíneas invasoras similares para garantir a disponibilidade contínua dos habitats de nidificação preferidos pelo atobá-pardo, especialmente nas áreas protegidas. Além disso, nosso estudo indica que a expansão de plantas invasoras pode estar entre as alterações ambientais que afetam negativamente as aves marinhas.

Palavras-chave: plantas exóticas, seleção de habitat, aves marinhas, espécies insulares, áreas protegidas

INTRODUCTION

The invasion of ecosystems by exotic species is listed among the greatest global threats to native biota (Mack *et al.* 2000, Mooney & Cleland 2001), and it affects even protected areas (Pyšek *et al.* 2002, Spear *et al.* 2013, Ziller & Dechoum 2014). In invaded vegetal communities, species composition, richness, diversity, and evenness may be changed (Hejda *et al.* 2009, D'Antonio *et* *al.* 2017). Invasive plants can eliminate native species because they usually have features that give them competitive advantages (Williamson & Fitter 1996, Rejmánek *et al.* 2005). In addition, the invasion by exotic plants may change habitats and fundamental ecological processes, disturbing fauna in different ways (Vilà *et al.* 2011, McCary *et al.* 2016).

Vegetation diversity has a strong influence on animal distributions (Jiménez-Alfaro *et al.* 2016). Invasive plants may change both vegetation composition and structure, affecting habitat selection by birds and potentially reducing the quality of favorable habitats for nesting and other essential activities (Block & Brennan 1993, Fleishman *et al.* 2003, D'Antonio *et al.* 2017). Alien plants interfere with distribution and reproductive success of some bird species at different spatial scales (Fleishman *et al.* 2003, Lloyd & Martin 2005, Gan *et al.* 2010).

Seabirds are among the most vulnerable groups of marine vertebrates, as they are sensitive to habitat changes resulting from anthropogenic influence (Croxall *et al.* 2012, Tavares *et al.* 2016). For seabirds nesting on the ground, such as the Brown Booby *Sula leucogaster*, vegetation structure is the main feature influencing nest distribution (Kotliar & Burger 1986, Fasola & Canova 1991).

Brown Boobies reproduce on oceanic islands in all tropical oceans, and the species is classified as Least Concern according to the International Union for Conservation of Nature (IUCN). However, their populations are currently decreasing worldwide, and colonies are becoming restricted to more remote areas, which increases their risk of becoming vulnerable. Further, the restriction to more isolated areas indicates the sensitivity of the species to anthropic environmental changes (Schreiber & Norton 2002, Rosenberg *et al.* 2014, Hernández-Vázquez *et al.* 2017).

Insular populations, such as those of the Brown Booby, are particularly vulnerable to the effects of invasive species. Due to their isolation and limited geographic area, islands may support small populations with reduced genetic variation, which rarely can become adapted to new competitors and habitat changes (Cadotte *et al.* 2006, Sax & Gaines 2008). The probability of an avian population becoming extinct is forty times greater on islands than in mainland areas (Johnson & Stattersfield 1990); the introduction of exotic species is among the main causes of extinction of endemic species on oceanic islands (Sax & Gaines 2008).

Since the introduction of several species of African grasses to Brazil for commercial and livestock uses, they have become invasive and have been disturbing natural ecosystems (Freitas & Pivello 2005). Species of the genus *Urochloa* are among the most frequent invasive plants in protected areas, but studies of these grasses in insular environments are scarce (Ziller & Dechoum 2014). *U. decumbens* Stapf. is one of the invasive *Urochloa* species that was introduced for pasture formation in the 1950s.

U. decumbens densely occupies the herbaceous stratum; the species produces large amounts of biomass quickly (D'Antonio & Vitousek 1992, Freitas & Pivello 2005). Brown Boobies prefer to build their nests in areas sparsely covered with herbaceous vegetation because it facilitates access to the nest (Krul 2004). For large birds like these, which cannot move easily on the ground, the dense vegetation may hinder movement (Benoit & Askins 1999, Ma *et al.* 2011), especially during the reproductive period when both parents constantly move and alternate between periods of taking care of the nest and foraging (Martins & Dias 2003, Ceyca & Mellink 2009). We tested the hypothesis that areas invaded by *U. decumbens* would not be ideal for booby nesting—that is, that the presence of this invasive grass would have negative influence on nest-site selection. We aimed to evaluate nest-site selection by Brown Boobies: (1) at the macroscale, comparing use for nesting in invaded and non-invaded areas; and (2) at the microscale, identifying vegetation parameters associated with nests.

METHODS

Study site and species

We conducted the study on Castilho Island (25.2733°S, 047.9547°W; Fig. 1), an oceanic island with an area of 7.4 ha (0.74 km^2) that is located 7.5 km off the Brazilian south coast, in São Paulo State. The study site was chosen due to presence of *U. decumbens*, which was introduced in the mid-1970s and is currently occupying a large proportion of the island's area (ICMBio 2008). In addition, the island is one of the more important nesting sites for Brown Booby and other seabirds in the state. It is in the Tupiniquins Ecological Station, which is an IUCN protected area, Category Ia - Strict Nature Reserve. Our research was conducted under access permits from the Brazilian Ministry of the Environment (MMA) - Chico Mendes Institute for Biodiversity Conservation (Protocol #48258).

The regional climate is subtropical, with an annual mean relative humidity of ~87%. Rainfall accumulations are greater than 200 mm per month from December to April and ~80 mm per month from May to November. The island is rocky, composed predominantly of syenite and quartz syenite (ICMBio 2008). The native vegetation includes shrubs (mainly *Ficus luschnathiana*), herbs (represented

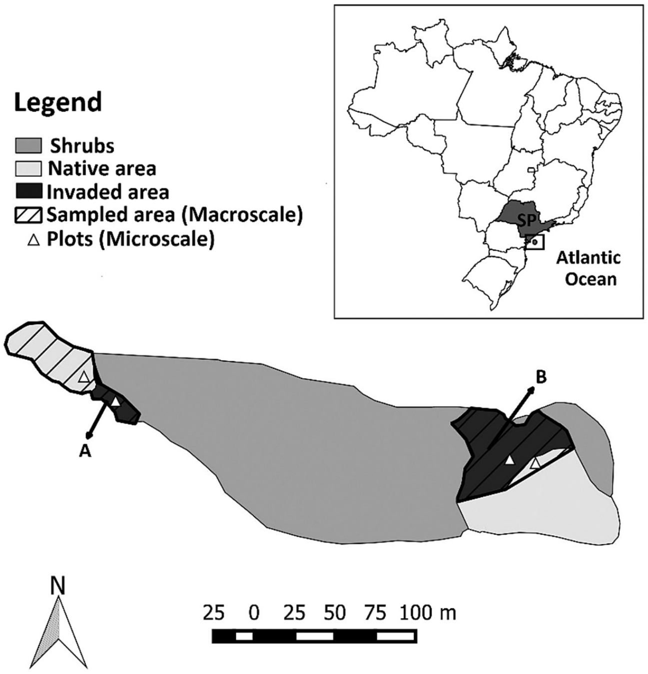

Fig. 1. Castilho Island, SP, Brazil, where nest-site selection data for Brown Boobies were collected, 2015–2016. Shown is the partition of the island by vegetation type, the invaded areas (A and B), and macroscale- and microscale-sampled areas.

by *Philodendron bipinnatifidum* and *Cyperus* spp.), grasses (e.g., *Paspalum vaginatum*), and typical rocky shore plants of the Cactaceae and Bromeliaceae families (e.g., *Cereus peruvianus* and *Bromelia antiacantha*) (ICMBio 2008, TAS pers. obs.).

The Brown Booby is the most common species of the family Sulidae occurring along the Brazilian coast (Sick 1997). Individuals can be found breeding in all months, but reproductive peaks are usually recorded in the dry season (April to August in Brazil; Krul 2004, Ceyca & Mellink 2009). The nests are built on the ground, typically in areas of herbaceous vegetation, on bare ground, or on rocks (Schreiber & Norton 2002, Ospina-Alvarez 2008), and preferentially in sparsely covered areas, which facilitates access to the nest (Krul 2004, Grose *et al.* 2011).

On Castilho Island, Brown Boobies nest in areas dominated by herbs and grasses. Besides the boobies, Magnificent Frigatebirds *Fregata magnificens* and Kelp Gulls *Larus dominicanus* also breed on the island (ICMBio 2008, GGA & TAS pers. obs.). Magnificent Frigatebirds nest on the top of shrubs, occupying the areas of *Ficus luschnathiana*; Kelp Gulls, like Brown Boobies, nest on the ground (ICMBio 2008), but the two species do not nest in overlapping areas. The Kelp Gull is a potential predator of booby eggs and chicks, and they may significantly reduce the reproductive success of Brown Boobies when both are nesting in the same area (Yorio *et al.* 1998, Branco 2003). The Black Vulture *Coragyps atratus*, another potential booby nest predator (Sick 1997, Coelho *et al.* 2004), was observed visiting the study site. There is no record of other predator groups (such as mammals and reptiles) on the island (ICMBio 2008, GGA & TAS pers. obs.).

Nest-site use and selection at the macroscale

We classified the entire study site according to vegetation type by analyzing Google Earth images (dated 2013) at 1:2500 scale and by conducting checks in the field (adapted from Canavelli *et al.* (2003)). Two main types of vegetation were identified: (1) shrubs, represented mainly by *Ficus luschnathiana*; and (2) grass and/or herbs. We subdivided the grass/herbs into two other categories: (2.1) Native and (2.2) Invaded. Native vegetation was composed of only native species, mainly the grass *Paspalum vaginatum* and sedge species *Cyperus* spp., along with a lower proportion of *Philodendron bipinnatifidum*. Native vegetation was confined to about 3100 m^2 of the island. Invaded vegetation consisted of patches composed only or predominantly (> 80%) of *U. decumbens*. There were two invaded areas in the study site: (A) an area of 300 m^2 to the west and (B) an area of 2300 m^2 to the east (Fig. 1).

We searched for Brown Booby nests in areas classified according to each vegetation category during two field trips, one in April 2016 and the other in July 2016. Considering the habits of the species and our aim to focus on comparison between invaded and native areas, only areas classified as "grass and/or herbaceous vegetation" were included in the study. We recorded all the nests, active and inactive, in both invaded areas (A and B). However, for native areas, it was not possible to access all the areas due to difficult terrain. Thus, we recorded the number of nests in an area of 1020 m^2 (Fig. 1).

Nest-site selection at the microscale

We established two plots of 300 m^2, the first corresponding to the smaller invaded area (A) and the other chosen randomly in the larger invaded area (B), as shown in Fig. 1. For each of the two invaded plots, we established a corresponding native plot of 300 m^2, giving two pairs of plots. The native plots were placed as close as possible to the corresponding invaded plot, so that both plots had similar environmental conditions. Thus, the influence of factors such as relief, soil, and winds were reduced (Hejda *et al.* 2009).

From December 2015 to October 2016, we sampled four times (December, April, July, and October), and we found all Brown Booby nests and recorded the density of nests in each plot. Each pair of plots was sampled twice: the invaded plot and the corresponding native plot in the western area were sampled in December 2015 and July 2016, and the plots in the eastern area were sampled in April 2016 and October 2016. All nests were marked with colored tags, so that nests previously counted were not included in the second sampling. For each nest, we identified one random point in each pair of plots during the same sampling where nests did not occur. For each marked nest and random point, we established a circular plot of one-meter radius (according to the minimum distance between nests, to avoid overlap) and assessed the percentage of cover according to six different vegetation parameters (cover by native grass, cover by invasive grass, cover by other herbaceous plants, bare ground, exposed rock, dead vegetation (necromass)) and the predominant height of live vegetation (measured in cm; adapted from Davis (2005) and Gibson *et al.* (2016)).

Statistical analysis

At the macroscale, we analyzed habitat use and selection by comparing the expected use (according to the available area) and the observed use. The expected use corresponded to the proportional area of each vegetation category in the total sampled area, and the observed use corresponded to the proportion of nests found in each vegetation category relative to the total number of nests found. From the observed proportions, we calculated simultaneous confidence intervals, which provided an estimate of the true proportion of use (*pi*). Thus, the selection or rejection of each vegetation category for nesting was determined by comparing the calculated interval and the expected use (Garshelis 2000). We used Bailey's interval (Bailey 1980) because it is appropriate for small samples, having a smaller margin of error than other intervals that usually are employed in studies of habitat use and availability (Cherry 1996, Pons *et al.* 2003).

At the microscale, we tested the differences between the density of nests and parameters of vegetation in invaded and native plots using a Wilcoxon-Mann-Whitney test ($P < 0.05$). General linear mixed-models were built to test the correlation between the parameters of vegetation and nest-site choice, using the package "lme4" in R (version 3.3.2, R Development Core Team 2016). The binomial data representing nests or non-nest points were included as dependent variables, and the seven parameters of vegetation described above were set as fixed independent variables, including all the possible combinations. Variables that substantially correlated (Pearson's $R > 0.50$) were not included in the same model, because multicollinearity among variables in a model may artificially inflate the standard error of parameter estimates. The sampling month was included as a random variable in all models. The models were ranked based on lowest Akaike's Information Criterion, corrected for sample size (AICc; Hurvich & Tsai 1989), which was calculated using the package "bbmle". AICc weights (*wi*) were used to compare top models and determine their relative likelihood. We included in inferences and discussion the models within two AICc units of the top-ranked model, and we considered the variables within the models to be informative in nest-site selection if the 95% confidence intervals of the parameter estimate did not overlap zero (Burnham & Anderson 2002).

RESULTS

Nest-site use and selection at the macroscale

The proportions of sampled nests ($n = 85$) in native and invaded areas were 54.1% and 45.9%, respectively. Expected proportions according to proportional areas in the total sampled area were 28.2% for native areas and 71.8% for invaded areas. According to Bailey's interval, the real proportion of use (*pi*) in areas of native vegetation was greater than expected, indicating a preference for nesting in this vegetation category; invaded areas were underused (Table 1).

Nest-site selection at the microscale

We found significantly fewer nests in invaded plots than native plots in all the samples (Mann-Whitney test: $U = 1\,678.5$, $P < 0.01$), with a mean density of 0.05 ± 0.01 nests/m^2 on native plots and 0.02 ± 0.00 nests/m^2 on invaded plots. For vegetation parameters, the mean cover proportion by native grass (Mann-Whitney test: $U = 547.5$, $P < 0.01$) and other native herbaceous plants (Mann-Whitney test: $U = 1\,890.5$, $P < 0.01$) were significantly lower in invaded plots, while the mean cover proportion by *U. decumbens* (Mann-Whitney test: $U = 5\,312.5$, $P < 0.01$) was higher in invaded plots. In addition, the mean vegetation height was higher in invaded plots (Mann-Whitney test: $U = 4\,602.5$, $P < 0.01$). Other parameters were not different between plots in the two vegetation categories (Table 2).

The best-adjusted model (AICc = 176.7, $wi = 0.21$) to explain nest-site selection by Brown Boobies included the coverage proportion by the invasive grass and by necromass as explanatory variables. Both are included in the four following models (ΔAICc ≤ 2) in different combinations with other variables, and both were significant ($P < 0.05$) according to 95% confidence intervals in the five top models (Tables 3 and 4). None of the other variables in the first five models were significant ($P > 0.05$) (Table 4).

DISCUSSION

At the macroscale, we found that Brown Boobies nest preferentially in areas of native vegetation, while available invaded areas were underused. At the microscale, boobies selected nest-sites with low or no cover by the invasive grass and with higher proportions of necromass. Because the sites selected at the microscale occur in the same type of macrohabitat, the choice at macro- and microscale are usually related (Garshelis 2000). Thus, the apparent preference for nesting in native areas may be explained by the differences in vegetation composition and structure between both vegetation categories.

TABLE 1

Bailey's confidence interval and analysis at the macroscale of nest-site use and selection by Brown Boobies, comparing areas of native vegetation and those invaded by *U. decumbens* on Castilho Island, Brazil (2016)

Vegetation	Available area (m^2)	Expected proportion of use	Observed proportion of use	Bailey's interval[a]	Use trend[b]
Native	1020	0.282	0.541	$0.383 \leq pi \leq 0.679$	+
Invaded	2600	0.718	0.459	$0.306 \leq pi \leq 0.602$	-

[a] *pi*: real proportion of use in each vegetation category.

[b] (+): selection, used more than expected; (-): rejection, used less than expected

TABLE 2

Wilcoxon-Mann-Whitney test (*U*) results comparing the density of nests (*n* = 74) and vegetation parameters between plots (300 m^2) in areas of native vegetation and those invaded by *U. decumbens* on Castilho Island, Brazil (December 2015–October 2016)

Parameters	Mean (± SD)		*U*-value	*P* value[a]
	Native	Invaded		
Density of nests (per m^2)[b]	0.05 ± 0.01	0.02 ± 0.00	1678.5	< 0.001
Native grass (%)[b]	54.82 ± 31.38	3.49 ± 14.39	547.5	< 0.001
Invasive grass (%)[b]	0.00 ± 0.00	73.97 ± 18.97	5312.5	< 0.001
Herbs (%)[b]	24.59 ± 27.58	7.14 ± 10.99	1890.5	0.001
Exposed rock (%)	19.41 ± 17.68	15.08 ± 13.30	2295.0	0.119
Bare ground (%)	1.18 ± 8.92	0.32 ± 2.52	2656.5	0.745
Necromass (%)	49.53 ± 22.93	44.68 ± 25.38	2258.0	0.100
Vegetation height (cm)[b]	45.71 ± 7.16	54.84 ± 6.41	4602.5	< 0.001

[a] The differences were considered significant if $P < 0.05$

[b] $P < 0.05$

TABLE 3
Model selection results explaining nest-site selection at the microscale by Brown Boobies on Castilho Island, Brazil (December 2015–October 2016) according to corrected Akaike Information Criterion (AICc) and weight (*wi*)

Fixed independent variables[a]				AICc	ΔAICc	*wi*
- Inv_gr[b]	**+ Necr**[b]			176.5	0.0	0.21
- Inv_gr[b]	+ Herb	**+ Necr**[b]		177.0	0.5	0.17
- Inv_gr[b]	+ Rock	**+ Necr**[b]		177.6	1.1	0.12
- Inv_gr[b]	+ Bare_gr	**+ Necr**[b]		178.5	1.9	0.08
- Inv_gr[b]	+ Herb	+ Rock	**+ Necr**[b]	178.5	2.0	0.08
Null				209.3	32.8	0.00

[a] Inv_gr: coverage proportion by *U. decumbens*; Necr: coverage proportion by necromass; Herb: coverage proportion by native herbs; Rock: proportion of exposed rock; Bare_gr: proportion of bare ground; (-) negative relation; (+) positive relation

[b] Variables in bold have 95% confidence intervals of parameter estimates that do not overlap zero and $P < 0.05$.

TABLE 4
Parameter estimates of the five top models (ΔAICc ≤ 2) to explain nest-site selection at the microscale by Brown Boobies on Castilho Island, Brazil (December 2015–October 2016)

	Variables[a]	Estimate	SE	*P*	CI
Model 1	**Inv_gr**[b]	**–2.62**	**0.52**	**< 0.001**	**–3.68, –1.65**
	Necr[b]	**1.70**	**0.82**	**0.038**	**0.12, 3.41**
Model 2	**Inv_gr**[b]	**–2.88**	**0.56**	**< 0.001**	**–4.03, –1.83**
	Herb	–1.06	0.82	0.190	–2.69, 0.55
	Necr[b]	**1.82**	**0.84**	**0.030**	**0.21, 3.52**
Model 3	**Inv_gr**[b]	**–2.54**	**0.52**	**< 0.001**	**–3.61, –1.55**
	Rock	1.22	1.22	0.320	–1.11, 3.73
	Necr[b]	**1.86**	**0.85**	**0.030**	**0.24, 3.62**
Model 4	**Inv_gr**[b]	**–2.62**	**0.52**	**< 0.001**	**–3.67, –1.64**
	Bare_gr	1.86	4.63	0.690	–4.12, 16.86
	Necr[b]	**1.64**	**0.83**	**0.047**	**0.05, 3.37**
Model 5	**Inv_gr**[b]	**–2.78**	**0.57**	**< 0.001**	**–3.95, –1.70**
	Herb	–0.94	0.83	0.260	–2.59, 0.70
	Rock	0.97	1.25	0.440	–1.43, 3.51
	Necr[b]	**1.92**	**0.86**	**0.030**	**0.29, 3.66**

[a] Inv_gr: coverage proportion by *U. decumbens*; Necr: coverage proportion by necromass; Herb: coverage proportion by native herbs; Rock: proportion of exposed rock; Bare_gr: proportion of bare ground.

[b] Variables in bold have 95% confidence intervals (CI) of parameter estimates that do not overlap zero and $P < 0.05$.

Invasion by exotic plants may change the species composition of vegetation and structural parameters such as cover proportion by herbs and vegetation height, which are all important features for nest-site selection by some birds nesting on the ground (Fleishman *et al.* 2003, Lloyd & Martin 2005, Spyreas *et al.* 2010). Native areas are vegetated by different herbaceous species, which have distinct sizes and distribution. According to the parameters of vegetation measured in invaded and native plots, native areas had higher proportions of native grasses and herbs, lower vegetation height, and no invasive grass. On the other hand, invaded areas were apparently more homogeneous, both in structure and composition, were vegetated predominantly by *U. decumbens*, and had higher vegetation height. In addition, the invasive grass formed a dense biomass layer (D'Antonio & Vitousek 1992, Freitas & Pivello 2005). Thus, invaded areas tended to be less favorable habitats for nesting, other than Brown Boobies choosing to nest preferentially in areas with scarce coverage by herbaceous vegetation (Schreiber & Norton 2002, Krul 2004). Their movement is easier in those areas, including access to the nest (Ma *et al.* 2011, Winiarski *et al.* 2017). Therefore, high coverage by *U. decumbens*, which is taller and denser than native species, negatively affects booby nest-site selection at the microscale, leading to a preference for native areas at the macroscale.

Further, structural features of vegetation that influence nest-microhabitat selection may have a complex relationship with protection against nest predation, including strategies that prioritize nest concealment or visibility (Götmark *et al.* 1995, Gómez-Serrano & López-López 2014). Brown Boobies alternate parental care, with the nest rarely being without one of the parents, and they deal with invaders aggressively (Sick 1997, Martins & Dias 2003, Ceyca & Mellink 2009). Thus, visibility around the nest appears to be prioritized, as the early detection of predators in invaded areas may be more difficult.

Along with the coverage proportion by *U. decumbens*, the coverage proportion by necromass positively affected the microscale selection of nest-sites. Brown Booby nests are typically formed by dead vegetation (Schreiber & Norton 2002, Grose *et al.* 2011). Thus, the high proportions of necromass on nest-sites were clearly associated with nest building. This was because the circular plots we used at the microscale were centered on the nests.

We found strong evidence that higher cover proportions by *U. decumbens* negatively affect nest-site selection by Brown Boobies at both macro- and microscale. Thus, our results indicate that the expansion of invasive plants, which occurs more on the islands closer to the mainland, may be among the factors contributing to the greater booby restriction to more remote areas. The rapid expansion of *U. decumbens*, and its ability to produce large amounts of biomass quickly, may significantly reduce the availability of ideal nest-sites for Brown Boobies. Considering their currently decreasing populations and the need for action to ensure their long-term conservation, our results may guide the eradication and controlling of invasive grasses in the breeding habitats of this species, primarily in protected areas.

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