Caribbean Journal of Science, Vol. 40, No. 3, 353-361, 2004

Population Estimates, Habitat Associations, and Management of *Ameiva polops* (Cope) at Green Cay, United States Virgin Islands

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ABSTRACT.—The endemic St. Croix Ground Lizard (*Ameiva polops*), listed in 1977 by the United States Fish and Wildlife Service as an endangered species, has not been surveyed since the mid-1990s on Green Cay (5.7 ha), an islet just off the northeastern coast of St. Croix, US Virgin Islands. We conducted six surveys here within three divisions (north, south, beach) along 32 randomly selected fixed-width plots (25 × 4 m) from August to October 2002. The total weighted mean population estimate, using a conservative procedure, was 183 lizards. The number of lizards was positively associated with a greater number of shrub stems. Lizards were more abundant in forested areas in the southern half of the cay (81% of the weighted total), but scarcer than expected on beaches (< 0.05% of the total), especially treeless areas. Since our recent population estimate suggests a decline in the long-term (ca. 35 yr) population of *Ameiva polops* on Green Cay, mark-resight, recapture surveys, or distance sampling (adjusted for the proportion of animals that are unobserved) are required to obtain population estimates and to assess hurricane effects (since Hugo in 1989) on habitat structure and composition.

Keywords.—Endangered species, habitat associations, lizard, management, population estimates

INTRODUCTION

The largest population of the endemic St. Croix Ground Lizard *Ameiva polops* (Cope) is on undeveloped Green Cay (17°47′N, 64°36′W), one of only three sites where this heliothermic lizard still exists (McNair 2003). This lizard was listed by the U.S. Fish and Wildlife Service as an endangered species in 1977. In the same year Green Cay was designated as a National Wildlife Refuge (Furniss 1984), primarily to protect this species. The last surveys were conducted in 1987 (Meier et al. 1993), which used a mark-resight technique, and in 1994 to 1996 (counts of unmarked lizards: unpublished; Knowles 1997). Preferred habitat characteristics of *Ameiva polops* are reviewed in Philibosian and Ruibal (1971), Meier et al. (1993), McNair (2003), and McNair and Coles (2003). We present population estimates of this lizard on Green Cay and compare these with past data to assess if the population is stable. We also investigate the relationship between habitat characteristics and the presence or absence of *Ameiva polops*, and discuss implementation of a habitat management plan for it on Green Cay.

MATERIALS AND METHODS

Study area.—Green Cay (5.7 ha) is an islet off the northeastern coast of St. Croix. It is saddle-shaped, connected by a narrow valley where the northern and southern halves meet. It's vegetation and habitat was described and classified by Woodbury and Vivaldi (1982). Some habitats, especially in the southern half of the cay, are more intermixed than suggested by Meier et al. (1993), so we avoided sampling specific habitats *per se*. The southern half of the cay, hereafter "South," is primarily open and closed dry and mesic forest with some shrub-grassland association, especially on the windward slope. The northern half of the cay, hereafter "North," is comprised primarily of a shrub-grassland association. The small isolated *Hippomane-Tabebuia-Cereus* woodland there (Woodbury and Vivaldi 1982; Zwank 1987) no longer exists. Beach vegetation, hereafter "Beach," is restricted to the beach at the southern tip of the cay and along some margins of the eastern, western, and northern coasts. The only trees on beaches are a few buttonwood (*Conocarpus erectus*) at the southern tip and manchineel (*Hippomane mancinella*), sea grape (*Coccoloba uvifera*), and seaside maho (*Thespesia populnea*) along the windward coast at mid-cay.

We assessed the distribution and abundance of *Ameiva polops* using stratified random sampling, selecting as divisions the three most obvious topographical and vegetative features on Green Cay (Woodbury and Vivaldi 1982). We randomly chose the location of 32 fixed-width plots (25 × 4 m) within divisions, 18 in South, 9 in North, and 5 in Beach, but allocated proportionally more plots to the two divisions (South, Beach) where lizards were more abundant (Meier et al. 1993; Wiley pers. comm.). We chose the starting point and direction of each plot from a table of random numbers (generated from a numbered mylar square grid overlaid on an aerial photo of Green Cay). We used the same size for plots (100 m^2; Meier et al. 1993) but chose a long-rectangular shape rather than a square because dense ground vegetation made it difficult to see lizards beyond 2-3 m from the center line of some plots. The long-rectangular shape also allowed us to keep track of most individual animals which were identified based on differences in size, color, and pattern.

For all plots during each survey, we counted the lizards by slowly walking each plot three times from 1000 to 1530 h from mid-August to early October (for additional details see McNair 2003). We also used two dowels to disturb litter and woody debris and kept separate totals of new animals counted during each pass. Depending primarily on the difficulty of the habitat (e.g., easier on open beach, more difficult in closed forest), the time taken to survey plots ranged from 3 to 14 minutes (mean = 8 min). The number of animals per plot was generally low (see results); this facilitated tracking individuals within and between nearby plots. Furthermore, the home ranges of *Ameiva polops* are generally small—190 m^2 on the beach—and overlap extensively (Wiley pers. comm.; Meier et al. 1993) and most plots were farther apart than this distance. Thus, we assume independent sampling of animals during each survey. Sampling was completed when the number of animals on any plot did not increase during the last survey. All surveys were conducted during good weather conditions, with no rain and wind speeds less than or equal to Beaufort scale 3 (19 kmph).

From all six surveys, we obtained population estimates by first calculating the mean count per plot. Our sample size was 32 and we did not use counts from repeat surveys as though they represented independent information. Data did not approximate a normal distribution. We calculated the mean of these mean counts (±95% CI) for each division, multiplied these numbers by the number of plots within their respective division, then multiplied these numbers by 17.8125 (the proportion of the area of all 32 plots, 3200 m^2, from 5.7 ha, the total area of Green Cay). We also calculated a mean weighted total (adjusted by different survey efforts in divisions and areas of divisions) for all 32 plots then multiplied these numbers by 17.8125. Lacking a georeferenced map of Green Cay except for GPS points we took to delineate the division between North and South, we calculated the approximate proportion and area of each division by transferring these points to an aerial photograph, overlaying mylar squares on the aerial photo and counting the number of squares within each division. From these population estimates we also determined densities (number of lizards/ha), although we recognize that accurate population density estimates require more involved methods than used herein.

We assessed the relationship between the presence or absence of lizards on plots over all counts (binary dependent variable) and seven habitat characteristics (independent variables) by using logistic regression with best-subset selection of predictors. Following a similar procedure in McNair (2003), within each plot we chose three points (centered on the midline, the mid-point and 2 m away from both ends of the plot) with non-overlapping 3-m radii to measure habitat characteristics: percentage of bare ground, litter and woody debris, canopy cover; number of shrub (woody vegetation with diameter at breast height [dbh] ≤ 7.5 cm) and tree (woody vegetation with dbh 7.5 cm) stems, and shrub and tree stem height (to the nearest 0.25 m). Percentage of bare ground, litter and woody debris and canopy cover were based on 13 ocular-tube readings of the central point and three points along each of the four cardinal directions (after James and Shugart 1970). Mean shrub height was calculated by estimating the percentage of each height class, adding them, then dividing by the total height (e.g., if 1/3 = 1 m and 2/3 = 2 m then mean shrub height = 1.67 m). We used a one-way ANOVA to examine the association between the three divisions and habitat characteristics. The three habitat variables measured as percentages and the number and heights of shrubs and tree stems were arcsine and log (x + 1) transformed, respectively, to meet the assumptions of parametric statistics (e.g., residuals were normally distributed). The data, however, are presented in their original units. All tests used $\alpha = 0.05$.

RESULTS

We found 63 lizards on all plots over six surveys (Appendix). The 0-4 lizards per plot (P) per survey were distributed as follows: 0 = 146 P, 1 = 33 P, 2 = 10 P, 3 = 2 P, 4 = 1 P. Slightly more than half of all animals (31 of 59, 52.5%; four not recorded) were individuals detected on the first pass of each plot, the remainder on the second (n = 13) and third passes (n = 15). By our last, sixth survey we recorded the presence of at least one lizard on 20 of 32 plots (63%).

The total weighted mean population estimate was 183 lizards (Table 1). Most animals encountered (81% of the weighted total) were in the South division, and therefore, density estimates there were high (Table 1). Lizards were least numerous on the beach.

The number of lizards were significantly associated with one habitat characteristic, a greater number of shrub stems (logistic regression: maximum likelihood score = 18.62, $\chi^2 = 5.11$, df = 1, P = 0.02). Nineteen of 20 (95%) plots where *Ameiva polops* was present were correctly classified *post-hoc*, whereas only four of 12 (33.3%) plots where lizards were absent were correctly classified. Six of seven mean habitat characteristics were significantly associated with divisions (Table 2). South had a higher percentage of litter and woody debris, canopy cover, and greater shrub and tree stem heights; South and North had a greater number of shrub stems; and Beach had a higher percentage of bare ground. Within South, the mean height of manjack (*Cordia* spp.) was significantly higher than white cedar *Tabebuia heterophylla* (6.75 versus 3.2 m; $t = 3.62$, df = 26, P = 0.001).

DISCUSSION

Despite our disturbance, results indicate that after the first plots pass, *Ameiva polops* either emerge from refugia within plots or move into plots from outside. We were still

TABLE 1. The identity and area of divisions, the number and area of plots, and the mean population estimates and densities of St. Croix Ground Lizards in plots within each division and for the entire cay (total weighted by different survey efforts in divisions and areas of divisions) at Green Cay, St. Croix, United States Virgin Islands.

	Divisions		Plots		Population estimates	Densities (number/ha)
Identity	Area (%)	Area (m^2)	Number (n)	Area (m^2)	Mean (±95% CI)	Mean (±95% CI)
South	53	30,210	1-6, 21-31 (18)	1800	157 (118-196)	52 (39-65)
North	43	24,510	11-19 (9)	900	32 (0-75)	13 (0-31)
Beach	4	2,280	7-10, 20 (5)	500	2 (0-6)	9 (0-26)
Total (weighted)	100	57,000	1-32 (32)	3200	183 (108-258)	32 (19-45)

TABLE 2. One-way ANOVA of the association between divisions (South, North, Beach) and seven mean habitat characteristics within 3-m radii circles in plots[a] at Green Cay.

Habitat variable	South (S) Mean (±95% CI)	North (N) Mean (±95% CI)	Beach (B) Mean (±95% CI)	df	F	P	Tukey's HSD for unequal N
% bare ground	0.42 (0.38-0.46)	0.41 (0.35-0.47)	0.85 (0.77-0.93)	2	16.42	0.000001	B > N, S
% litter and woody debris	0.54 (0.48-0.59)	0.39 (0.32-0.47)	0.27 (0.17-0.37)	2	11.03	0.00005	S > N, B
% canopy cover	0.16 (0.11-0.21)	0.00 (0-0.07)	0.02 (0-0.11)	2	7.04	0.001	S > N, B
Number of shrub stems	291 (246-336)	376 (313-439)	0.4 (0-85)	2	614.06	0.0000001	S, N > B
Number of tree stems[b]	0.70 (0.45-0.96)	0.33 (0-0.69)	0.13 (0-0.61)	2	2.74	0.07	ns
Shrub stem height (m)	1.32 (1.19-1.45)	0.77 (0.58-0.96)	0.15[c] (0-0.40)	2	56.33	0.0000001	S > N, B
Tree stem height[d] (m)	1.68[e] (1.12-2.24)	0.45[e] (0-1.25)	0.23[e] (0-1.3)	2	4.19	0.02	S > N, B

[a]The 32 plots have 96 circles (54 in S, 27 in N, and 15 in B).
[b]The total number of trees in 49.
[c]Includes 12 circles without shrubs (all in beach habitat), which were each scored zero. The mean shrub stem height (and ±95% CI) in the three circles with shrubs was 0.73 (0.14-1.32) m.
[d]Excludes the dildo cactus *Cephalocereus royenii* (which does not shed leaves).
[e]Includes 65 circles without trees (all three habitats), which were each scored zero. The mean tree stem height (and ±95% CI) in the 31 circles with trees were 4.32 (3.31-5.34; n = 21), 1.53 (0-3.18; n = 8), and 1.75 (0-5.04; n = 2) m for S, N, and B respectively.

recording new animals even during the third pass (ca. 25% of the total), suggesting that new animals would have been recorded during a fourth pass. According to our assumption of independent sampling in plots, this result suggests that we underestimated the number of animals although we conducted surveys until we detected no more lizards during the last survey. This was unlike earlier studies that used unmarked animals. Had we increased the number of passes until we recorded no more animals we could resolve this discrepancy and also could have completely distinguished between plots where lizards are truly absent.

Population estimates were most precise for the South division, where more animals occurred, compared to the other two divisions where high variances prevented precise population estimates. To eliminate a weakness of the original experimental design, the estimates for these two divisions can be improved by increasing the number of plots, especially in the North division (where a substantial number of animals occur) so it will not be underrepresented. Nonetheless, one advantage our study has over earlier studies is that plots were permanently marked with iron stakes and georeferenced, which permits future repeat surveys that may allow more precise estimates of relative population trends compared to our baseline measure. Another alternative would be to conduct surveys along new randomly selected plots, which would avoid biases associated with sampling the same plots.

The total weighted mean population estimate may have underestimated the true population of the St. Croix Ground Lizard on Green Cay because this procedure underestimated lizard abundance on Protestant Cay (D. B. McNair, unpubl. data) where a maximum count procedure was used (McNair 2003; McNair and Coles 2003). Regardless of any emergence of lizards within plots or movement into plots from outside, our conservative mean population estimate probably represents the minimum population size on Green Cay, a figure appropriate for consideration of future planned translocation of lizards from

Green Cay to Buck Island (also off the northeastern coast of St. Croix).

Our total weighted mean population estimate of 183 lizards is less than earlier efforts using unmarked (or marked) animals which involved a plethora of census techniques and observers (McNair 2003). This includes mean population estimates of 420-462 animals that were derived using the mark-resight technique (Meier et al. 1993). Maximum estimates of 2500 and 4300 animals from one earlier, unpublished study (that used a mark and release technique; Yntema and Hewitt 1981 [not examined]; Furniss 1984) do not agree with other studies nor our upper 95% confidence interval of 258 lizards. We believe these high estimates should be ignored, unless confirmed by future studies. Regardless, our results suggest that the population on Green Cay has declined. In all studies, actual numbers were probably less because none accounted for the area effects of steep slopes and precipitous cliff faces which we believe have low densities of lizards. The mark-resight technique or recapture surveys, or distance sampling (adjusted for the proportion of animals that are hiding) if relying only on sight observations, should be used in future to obtain more precise population estimates.

The habitat variable that predicted the presence or absence of lizards on plots and significant habitat characteristics between divisions that we measured generally corresponded to expectations favorable to greater numbers of *Ameiva polops* in the southern half of Green Cay (Philibosian and Ruibal 1971; Meier et al. 1993; McNair 2003; Wiley pers. comm.). We did not record the presence of crab burrows and porous substrates; these were strongly correlated with the presence of *Ameiva polops* in an earlier study (Wiley pers. comm.). *Ameiva polops* were more numerous on plots in the shorter, closed, and drier *Tabebuia* (formerly *Hippomane-Tabebuia*) woodland which had greater canopy cover and abundant litter (Woodbury and Vivaldi 1982; Meier et al. 1993; Wiley pers. comm., pers. obs.) than in plots in taller, mesic manjack *Cordia rickseckeri* forest, although substantial litter accumulation also occurred in semi-open *Cordia* forest. Lizards were formerly abundant in a semiopen Manchineel-dominated littoral woodland on the windward side of Green Cay until Hugo and later storms dramatically changed habitat structure and composition (Wiley pers. comm.). Zwank (1987) stated that in the northern half of Green Cay, where this lizard is less numerous, they were most abundant in a small forested area along the beach (actually, in the uplands above the beach) on the western side south of Breccia Point, but a forest no longer occurs here, probably because of hurricane damage. Thus, lizards on Green Cay may have declined in response to reduction of forest cover (and hence, reduction in canopy cover) by hurricane effects on vegetation (Wiley, pers. comm.). Nonetheless, lizards were present in the grassland association at the northeastern tip (which also included low barren scrub) where Zwank (1987) and Meier et al. (1993) found them to be scarce or absent.

We recorded fewer animals than expected in beach vegetation, including the beach at the southeast tip (area currently 585 m^2), where, although we had up to two individuals on three supplemental counts, Wiley (pers. comm.) and Meier et al. (1993) stated *Ameiva polops* was numerous in 1980 and 1987 when Zwank (1987) counted 16 animals in one day. *Ameiva polops* forages in beach debris or litter, especially *Thalassia* wrack where amphipods are abundant (Philibosian and Ruibal 1971; Dodd 1978, 1980; Wiley pers. comm.; Zwank 1987; Meier et al. 1993), so the scarcity of lizards in treeless areas in or near tidal wrack was particularly striking. Nonetheless, Wiley (pers. comm.) and Meier et al. (1993) probably overstated the importance of beach vegetation for *Ameiva polops* (because of the small area involved; Wiley mistakenly claimed that 1 ha of Green Cay is beach vegetation). Beach habitat, including the former sea grape dominated habitat along the windward shoreline at mid-cay (Wiley, pers. comm.), may have eroded away since the late 1980s because of the onset of greater tropical cyclone activity, but this is uncertain because of inadequate comparative material from dated aerial photographs or from other sources.

The different procedures of population estimates, higher proportion of beach habitat on Protestant Cay, and other factors make it difficult to compare the population estimates and habitat associations of *Ameiva polops* on undeveloped Green Cay and developed Protestant Cay. Despite our conservative procedure on Green Cay, our island-wide density of *Ameiva polops* on Green Cay is greater than on Protestant Cay (McNair 2003; McNair and Coles 2003), even though densities in occupied habitats on Protestant Cay exceeded the highest estimated density of lizards in dry forest in the southern half of Green Cay. The latter density is similar to the density of lizards on Protestant Cay in 1967, before the hotel was built (Philibosian and Ruibal 1971). This strongly suggests that natural, undeveloped cays generally contain superior habitat than developed cays.

Management Recommendations

The recent population decline of this lizard on Green Cay reinforces the need for a management plan for the cay. White-crowned Pigeons (*Columba leucocephala*) nested abundantly before the 1930s (Beatty 1930), suggesting the cay once had intact forest cover. Habitat now could be restored to a less disturbed ecosystem (Woodbury and Vivaldi 1982; *contra* Dodd 1978 who stated Green Cay was unmodified biologically). Following land-use patterns of many other small islands in the eastern Caribbean (Lazell 1983), including nearby Buck Island (Woodbury and Little 1976), hardwoods may have been removed: for charcoal, destroyed by fire, or by introduced goats. Introduced rats (*Rattus rattus*), recently exterminated on Green Cay (C. D. Lombard, unpubl. data), were also destructive to native vegetation. *Ameiva polops* is essentially absent from areas dominated by the most deleterious exotic and difficult to eradicate Hurricane Grass, *Bothriochloa pertusa* (= *Andropogon pertusus*) (Wiley pers. comm.; Zwank 1987; pers. obs.), which has formed dense mats and shaded out shrubs in many open, more xeric areas, especially on the windward slope (Woodbury and Vivaldi 1982). This includes the southern half of Green Cay where *Ameiva polops* is most numerous. *Bothriochloa pertusa* (as well as guinea grass *Panicum maximum* which is also spreading) should be mechanically removed and the area immediately replanted with native seedlings of *Tabebuia heterophylla*, *Cordia rickseckeri*, *Conocarpus erectus*, and other suitable trees (Gumbo Limbo, *Bursera simaruba*) and taller shrubs, which will prevent this shade-intolerant grass from re-establishing itself. *Tecoma stans* (gingerthomas), the second most deleterious exotic, may form monospecific tree stands on the windward slope and top of the southern half of the cay where it is spreading (Woodbury and Vivaldi 1982; C. D. Lombard, pers. obs.) and forms an unsuitable habitat for *Ameiva polops* (D. B. McNair and C. D. Lombard, pers. obs.). Leaf litter can be sparse underneath gingerthomas, presumably because the thin leaves usually decay quickly or blow away after falling. Before- and after-treatment censuses should document the effects of removal of exotic vegetation on the abundance of *Ameiva polops*. Lastly, planting of native trees and taller shrubs in some other areas should also improve habitat for *Ameiva polops*.

Translocation

The reduced though still fairly numerous population of *Ameiva polops* on Green Cay probably justifies translocation of animals to Buck Island. These should be preferably captured from canopied areas where larger individuals are most abundant. The earlier translocation of 10 animals from Protestant Cay to Ruth Island in 1990 (plus one animal from Green Cay in 1995; Knowles 1990, 1997), where they have increased (D. B. McNair and A. Mackay, unpubl. data), suggests that low numbers of translocated lizards could survive, reproduce, and establish themselves on Buck Island. Extermination of the small Indian mongoose *Herpestes javanicus* from Buck Island by the National Park Service (which has occurred; Z. Hillis-Starr, pers. comm.) is essential. In 1968, before the mongoose was eradicated there was an initial attempt to reintroduce this lizard (16 animals) to Buck Island. This was not successful because trapping and poisoning of mongooses ceased (Philibosian and Ruibal 1971; Philibosian and Yntema 1976). To lessen the impact on the lizard population on Green Cay, as few as 20 individuals—rather than the 50 recommended for the initial release (Furniss 1984; Meier et al. 1990)—could be removed and relocated to Buck Island. Some of these animals can be swapped with animals captured from Ruth Island to increase genetic mixing of translocated populations. The population on Protestant Cay is too small (McNair 2003; McNair and Coles 2003) to be considered as introduction stock. However, translocation of lizards to Buck Island will be delayed until 15 pre-Hurricane Hugo plots (Wiley pers. comm.) are resurveyed to compare pre- and post-Hugo population estimates (J. W. Wiley, A. Mackay, and D. B. McNair in prep.) with the population estimates documented in this study.

Acknowledgments.—We thank G. S. Johnston for providing kayaks which allowed us to reach Green Cay, our appreciation to W. Coles, F. E. Hayes, and J. W. Wiley for reviewing a penultimate draft of this manuscript and an anonymous individual and especially W. E. Magnusson for reviewing the submitted manuscript, D. J. Brownlie for providing information on Hurricane Grass, and the United States Fish and Wildlife Service for financial support (Federal Aid Program, Wildlife Conservation and Restoration Project R-1, Study 2). Copies of unpublished studies cited below and a map of transect points on Green Cay are available from either author.

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APPENDIX. Counts of the St. Croix Ground Lizard on 32 plots over six surveys from mid-August to early October 2002 at Green Cay, St. Croix, United States Virgin Islands. General habitat designation for each plot and Geographical Positioning System (GPS) latitudinal and longitudinal decimal co-ordinates for the two end points of each plot are also given.

		Survey						GPS	
Plot	Habitat	First	Second	Third	Fourth	Fifth	Sixth	Latitude (N)	Longitude (W)
1	Open forest (*Cordia*)	0	0	0	0	0	0	17.76559	64.66663
								17.76551	64.66686
2	Open forest (*Cordia*)	2	0	1	0	0	0	17.76571	64.66683
								17.76548	64.66694
3	Open forest (*Cordia*)	2	0	1	1	1	1	17.76541	64.66695
								17.76521	64.66687
4	High scrub	2	0	1	0	0	0	17.76528	64.66676
								17.76508	64.66689
5	High scrub	0	1	1	0	0	0	17.76511	64.66681
								17.76517	64.66659
6	Open forest (*Cordia*)	0	0	0	0	0	0	17.76524	64.66656
								17.76505	64.66644
7	Beach wrack	0	0	0	0	0	0	17.76534	64.66596
								17.76550	64.66588
8	Beach wrack	0	0	0	0	0	0	17.76572	64.66578
								17.76587	64.66572
9	Beach wrack	0	0	0	0	0	0	17.76614	64.66558
								17.76640	64.66557
10	Beach wrack	0	0	0	0	0	0	17.76699	64.66533
								17.76718	64.66528
11	Low scrub	0	0	1	0	0	0	17.76754	64.66535
								17.76764	64.66515
12	Low scrub	0	0	0	0	0	0	17.76766	64.66531
								17.76789	64.66530
13	Low scrub	0	0	0	0	0	0	17.76775	64.66544
								17.76788	64.66563
14	Low scrub	0	0	0	1	0	0	17.76807	64.66584
								17.76805	64.66561
15	Low grassland	0	0	0	0	0	0	17.76825	64.66524
								17.76804	64.66518
16	Low scrub	0	0	1	0	0	0	17.76801	64.66498
								17.76781	64.66511
17	Low scrub	0	0	2	0	1	0	17.76733	64.66557
								17.76751	64.66546
18	Low scrub	0	0	0	0	1	0	17.76717	64.66546
								17.76697	64.66552
19	Low scrub	0	0	0	0	0	0	17.76711	64.66570
								17.76733	64.66565
20	Beach	0	1	0	1	0	1	17.76497	64.66633
								17.76510	64.66614
21	High scrub	2	0	0	0	1	0	17.76687	64.66556
								17.76664	64.66565
22	Open forest (*Tabebuia*)	1	0	0	0	0	0	17.76689	64.66572
								17.76675	64.66590
23	Open forest (*Tabebuia*)	1	0	0	2	1	0	17.76662	64.66572
								17.76659	64.66595
24	Open forest (*Tabebuia*)	0	0	0	3	2	1	17.76654	64.66578
								17.76655	64.66600
25	Open forest (*Tabebuia*)	0	0	2	0	0	0	17.76651	64.66610
								17.76629	64.66601

APPENDIX. Continued.

		Survey						GPS	
Plot	Habitat	First	Second	Third	Fourth	Fifth	Sixth	Latitude (N)	Longitude (W)
26	High grassland	0	0	0	0	1	0	17.76617	64.66594
								17.76594	64.66600
27	Open forest (*Tabebuia*)	1	1	2	0	4	0	17.76613	64.66599
								17.76618	64.66617
28	Open forest (*Tabebuia*)	1	2	3	0	1	0	17.76608	64.66627
								17.76602	64.66652
29	High grassland	0	0	0	0	0	0	17.76587	64.66621
								17.76578	64.66643
30	High scrub	0	0	0	0	0	0	17.76563	64.66642
								17.76543	64.66637
31	High scrub	1	1	1	0	0	0	17.76548	64.66661
								17.76529	64.66648
32	Open forest (mixed)	0	0	1	1	1	1	17.76575	64.66586
								17.76595	64.66581