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Population Estimates and Management of *Ameiva polops* (Cope) at Ruth Island, United States Virgin Islands

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ABSTRACT.—The endemic and endangered St. Croix Ground Lizard (*Ameiva polops*) had not been surveyed on Ruth Island (7.5 ha), a man-made islet off the south-central coast of St. Croix, US Virgin Islands. In two habitats (woodland and scrub), we conducted five surveys along 20 randomly selected fixed-width plots (25 x 4 m) from late March to late May 2003. The total weighted mean population estimate was 60 lizards. Lizards were more abundant (57% of the total weighted) in smaller areas of woodland than in larger areas of scrub, and absent from barren habitat – unvegetated raised coral rubble. Our recent population estimates determine that *Ameiva polops* has increased on Ruth Island since 10 lizards were first translocated there in 1990.

KEYWORDS.—Endangered species, lizard, population estimates, St. Croix, scrub, woodland

Man-made and undeveloped Ruth Island (17°47'N, 64°36'W), where 10 St. Croix Ground Lizards, *Ameiva polops* (Cope), were translocated from Protestant Cay in 1990 (plus one animal from Green Cay in 1995; Knowles 1990, 1997), is one of only three sites where this endemic and endangered species still exists (McNair 2003). Ruth Island was not created to protect this species, but animals were translocated there for that purpose. Anecdotal counts since translocated lizards were released

have documented as many as 27 individuals on Ruth Island, in 2002 (McNair 2003), but ground lizards had not been surveyed there. To assess its current status, we present population estimates in two habitats occupied by *A. polops*. We also discuss implementation of a habitat management plan for this lizard on Ruth Island.

Ruth Island (7.5 ha), a dredged-spoil islet ca. 250 m off the south-central coast of St. Croix, was formed in 1965 from the construction of a shipping channel for a defunct alumina plant. The substrate of the islet is sand, shell, and coral rubble. The southern third of the islet is a coral dome (ca. 10 m), scantily vegetated ($\geq 90\%$ barren) with low prostrate plants such as beach morning glory (*Ipomoea pes-caprae*). Information on vegetation and habitat for the northern two-thirds is available in Yntema and Sladen (1987), although vegetative succession has continued despite the occurrence of several tropical cyclones since Hurricane Hugo in 1989. Other than areas of barren habitat there are two main habitats, woodland and scrub, of which the former can be subdivided into littoral and smaller areas of mangrove wetlands. Semi-open littoral woodland (now 6-7 m tall; formerly ≤ 4 m, Yntema and Sladen 1987) is dominated by buttonwood (*Conocarpus erectus*), with some manchineel (*Hippomane mancinella*), seaside maho (*Thespesia populnea*), and soursop (*Annona muricata*). This habitat occurs as a rather long narrow strip along the northeastern shore and in larger patches in the middle third. Mangrove wetland (now 6 m tall; formerly 4 m, Yntema and Sladen 1987) is composed of three species: black (*Avicennia germinans*), red (*Rhizophora mangle*), and white mangroves (*Laguncularia racemosa*). One small salt pond and tiny areas of salt flat are also present in the middle third of the islet. Scrub is composed primarily of low shrubs (≤ 2 m) and prostrate plants. Scrub occurs on another, lower coral rubble dome (ca. 5 m) in the northern third and on flatter, smaller areas in the middle third. The dominant scrub species are black coco-plum (*Chrysobalanus icaco*), inkberry (*Scaevola plumieri*), bay cedar (*Suriana maritima*), sea grape (*Coccoloba uvifera*), and sage (*Lantana* spp.), with

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smaller numbers of sea lavender (*Tournefortia gnaphalodes*) and scattered acacias (*Acacia* spp.). Many areas of scrub are sparsely vegetated, especially on the lower dome, which may include low sedges (*Cyperus* spp.). Grassland (primarily hurricane grass, *Bothriochloa pertusa* [= *Andropogon pertusus*]) occurs in the northwest in both woodland and scrub habitats.

We assessed the distribution and abundance of *A. polops* on Ruth Island with a method similar to the one used on Green Cay (McNair and Lombard 2004). We selected woodland and scrub habitats as the two most obvious topographical or vegetative features on Ruth Island. Since during preliminary anecdotal counts we did not find lizards in the barren habitat, it was not included in our stratified random sampling scheme. We randomly chose the location of 20 fixed-width plots (25 x 4 m): 12 plots in woodland and 8 in scrub. We used a grid to ensure representative sampling yet allocated proportionally more plots to woodland where lizards were more abundant (McNair 2003). We chose the starting point and direction of each plot, plot size (100 m²) and shape, and counted lizards (adults and juveniles; McNair and Coles 2003) from 27 March to 30 May 2003, following procedures for Green Cay (McNair and Lombard 2004). The time taken to survey plots ranged from 4-16 min and was significantly longer in woodland (mean ± SD: 9.3 ± 1.8 min; $n = 60$) than in scrub (mean ± SD: 7.5 ± 2.4 min; $n = 40$; $t = 4.19$, $P < 0.001$) because woodland was more difficult to traverse. The number of animals per plot was generally low (see results); this facilitated tracking individuals within and between nearby plots. 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 from 1000 to 1500 h during good weather conditions, with no rain and wind speeds less than or equal to Beaufort scale 3 (≤ 19 km/h).

We obtained population estimates by first calculating the mean count per plot from all surveys. Our sample size was 20, and we did not use counts from repeat sur-

veys as though they represented independent information. Data did not approximate a normal distribution. We then calculated the mean of these mean counts ($\pm 95\%$ C.I.) for each habitat. Next, we multiplied each of these numbers by the dividend of the area of each habitat divided by the area of all plots for each habitat. We also calculated a mean weighted total (adjusted by different survey efforts in habitats and areas of habitats) for all 20 plots. Lacking a geo-referenced map of Ruth Island, we calculated the approximate proportion and area of each habitat (including barren habitat) by overlaying mylar squares on a 1996 aerial photograph of Ruth Island and counting the number of squares. 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 found 21 lizards (9 adults, 11 juveniles, and 1 not aged) on all plots over five surveys (Appendix). More lizards (and a higher proportion) were found in woodland ($n = 16$; 9 of 12 plots, 75%) than scrub ($n = 5$; 4 of 8, 50%), but these differences were not significant ($\chi^2 = 1.67$, $P > 0.05$). Similar proportions of both age classes were found in each habitat (woodland.—7 adults:9 juveniles; scrub.—2 adults:2 juveniles). The 0-2 lizards per plot (P) per survey were distributed as follows: 0 = 83 P, 1 = 13 P, 2 = 4 P. Slightly less than half of all animals (10 of 21, 48%) were individuals detected on the first pass of each plot; the remainder were found on the second ($n = 7$) and third passes ($n = 4$). By our fifth survey we recorded the presence of at least one lizard on 13 of 20 plots (65%; Fig. 1).

The weighted mean population estimate for both habitats was 60 lizards (Table 1), with a density of 17.8 lizards per ha (8 / ha for the entire islet, including barren habitat). Over half of the lizards encountered (57% of the weighted total) was in smaller areas of woodland and, therefore, density estimates there were higher than in scrub.

We were still recording new animals even during the third pass (19% of the total) but detected no more lizards during the last

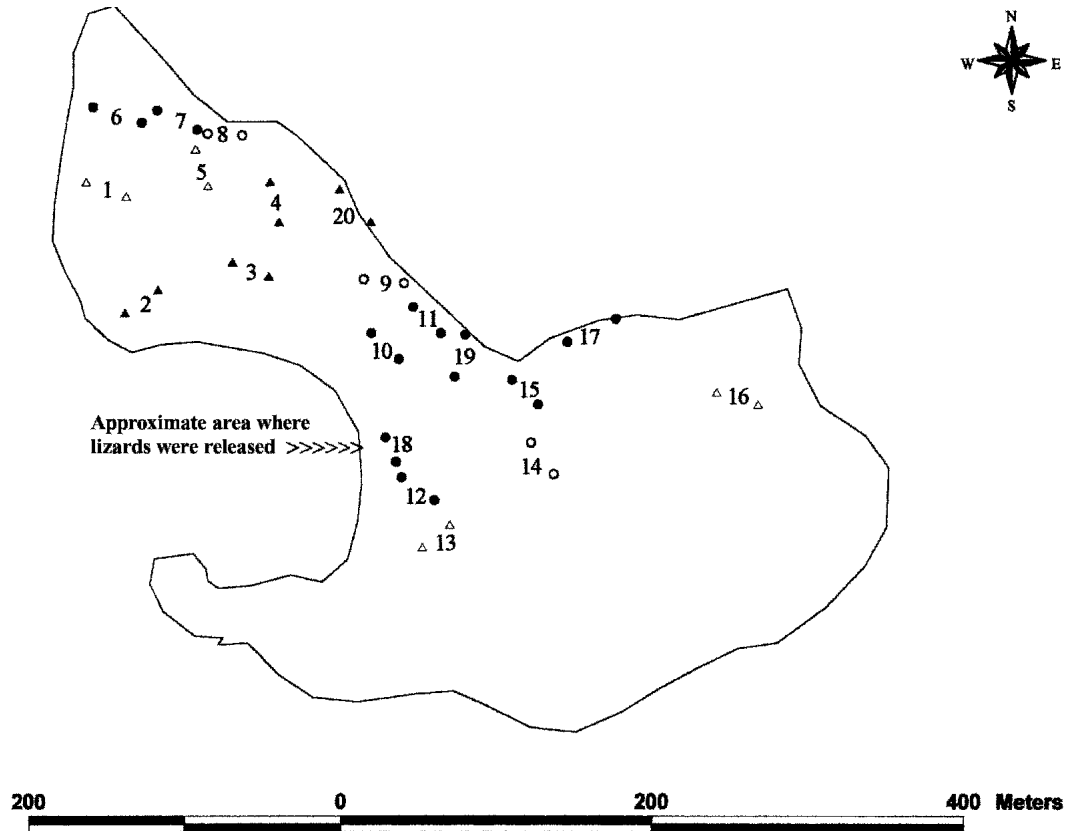


FIG. 1. The 20 plots on Ruth Island where *Ameiva polops* was surveyed in 2003. Woodland plots are represented by circles (filled: lizards present; open: lizards absent). Scrub plots are represented by triangles (filled: lizards present; open: lizards absent). Released lizards were translocated from Protestant Cay to Ruth Island in 1990 (from Knowles 1990).

survey. Population estimates had narrower confidence intervals for woodland, where more animals occurred, compared to scrub although high variances prevented precise

population estimates in both habitats. These estimates may be improved by increasing the number of plots, especially in scrub, which was underrepresented.

TABLE 1. The identity and area of each habitat, the number and area of plots, and the mean population estimates and densities of St. Croix Ground Lizards in plots within each habitat and for both habitats (weighted by different survey efforts in habitats and areas of habitats) at Ruth Island, St. Croix, United States Virgin Islands.

Habitat	Area (%)	Area (ha)	Plots		Population estimates mean ($\pm 95\%$ CI)	Densities (number/ha) mean ($\pm 95\%$ CI)
			Number (n)	Area (ha)		
Woodland	17	1.275	6-12, 14-15, 17-19 (12)	0.12	34 (11, 57)	26.7 (8.6, 44.7)
Scrub	28	2.1	1-5, 13, 16, 20 (8)	0.08	26 (0.1, 53)	12.4 (0.05, 25.2)
Both types (weighted)*	45	3.375	1-20 (20)	0.2	60 (32, 110)	17.8 (9.5, 32.6)

*Excludes the barren habitat where lizards were absent.

Our weighted mean population estimate of 60 lizards is greater than earlier anecdotal counts (McNair 2003). Lizards were more numerous in woodland (primarily littoral habitat) than scrub which was expected because lizards are closely associated with a suite of habitat variables (that we inferred but did not measure) that were predominant in littoral woodland. The rather short buttonwood-dominated littoral woodland continues to increase in height, which is generally favorable for this species. Preferred habitat characteristics of *A. polops* are reviewed in Philibosian and Ruibal (1971), Meier et al. (1993), McNair (2003), McNair and Coles (2003), and McNair and Lombard (2004). Knowles (1997) found animals along the northern and western shores of Ruth Island. We found animals in most areas with substantial vegetation, except for mangrove wetlands, the small area in the northwest dominated by grassland, and in woodland and scrub along the southern perimeter of the middle third of the island where the highest coral rubble dome begins. Thus, our results suggest that the *A. polops* population on Ruth Island has increased and expanded since 10 lizards were introduced in 1990. Lizards probably do occur in woodland and scrub plots where we did not record them, including the southern perimeter of vegetated areas where their presence was recently confirmed (June and July 2004). Favorable vegetative characteristics, including substantial litter accumulation, occurred in mangrove wetlands but *A. polops* was averse to moist soil substrates despite the favorable presence of crab burrows. Therefore, the weighted mean population estimate may be less than 60 lizards, when unfavorable woodland habitat (mangrove wetlands) is accounted for. The mark-resight technique or recapture surveys, or distance sampling (adjusted for the proportion of animals that are unobserved) if relying only on sight observations, should be used in future in conjunction with GIS gap analysis vegetative sampling to obtain more precise population estimates and habitat associations of *A. polops* on Ruth Island.

Population estimates of *A. polops* on Ruth

Island are difficult to compare to populations on Green and Protestant cays because of the various factors that differ between islets (McNair and Lombard 2004). Nonetheless, the density for Ruth Island is lower than on either of the two natural cays despite a pronounced decline on developed Protestant Cay (McNair 2003; McNair and Coles 2003). Woodland is the most favorable habitat on Ruth Island, but lizard density was still lower than in comparable areas on Green and Protestant cays. Natural cays, whether developed or undeveloped, generally contain superior habitat than man-made cays.

The pronounced decline of the lizard population on Protestant Cay and the possible decline on Green Cay reinforce the need for a management plan for Ruth Island. The population here has increased to become the second largest for this species. Ruth Island, as permitted under the Endangered Species Act (1973), should be designated critical habitat for this lizard (cf., Furniss 1984). Although natural succession continues, habitat could be improved to help this species. Hurricane grass (and guinea grass, *Panicum maximum*) in the northwest should be eradicated by mechanical removal. This area should then be immediately replanted with native buttonwood and other suitable littoral trees and shrubs which will prevent this shade-intolerant grass from re-establishing itself. Other exotic species do not present any immediate problems although acacias should be removed. Planting of native trees and taller shrubs in some other areas should also improve habitat for *A. polops*.

The exotic black rat (*Rattus rattus*) should also be eradicated, although it appears to be scarce on Ruth Island (Yntema and Sladen 1987; D. B. McNair pers. obs.) despite the presence of substantial amounts of human refuse (from fishermen who visit illegally). Human debris can be beneficial to *Ameiva* (Henderson and Powell 1999, 2001): on Ruth Cay, the highest counts in woodland plots (nos. 7, 18) occurred next to two temporary fish camps. Boards, food cans, and other debris on the ground may enhance habitat for these ground-dwelling lizards by mimicking natural litter and

woody debris and providing additional hiding places or food or attracting other animals that *Ameiva* consume. Consequently, illegal human activity on man-made Ruth Island where habitat is otherwise undisturbed may have boosted numbers of *A. polops*. This confounded issue needs to be resolved.

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APPENDIX Counts of the St. Croix Ground Lizard on 20 plots over five surveys from late March to late May 2003 at Ruth Island, 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.

Plot	Habitat	Survey					GPS	
		First	Second	Third	Fourth	Fifth	Latitude (N)	Longitude (W)
1	Scrub ¹	0	0	0	0	0	17.68538 17.68546	-64.76368 -64.76391
2	Scrub	0	0	2	0	0	17.68484 17.68471	-64.76350 -64.76369
3	Scrub	1	0	0	0	0	17.68492 17.68500	-64.76286 -64.76307
4	Scrub	0	0	0	1	0	17.68523 17.68546	-64.76280 -64.76285
5	Scrub	0	0	0	0	0	17.68565 17.68544	-64.76328 -64.76321
6	Woodland	1	0	0	0	0	17.68589 17.68580	-64.76387 -64.76359
7	Woodland	0	0	2	0	0	17.68587 17.68576	-64.76350 -64.76327

APPENDIX. Continued.

Plot	Habitat	Survey					GPS	
		First	Second	Third	Fourth	Fifth	Latitude (N)	Longitude (W)
8	Woodland	0	0	0	0	0	17.68574 17.68573	-64.76321 -64.76301
9	Woodland	0	0	0	0	0	17.68490 17.68488	-64.76231 -64.76208
10	Woodland	0	0	1	0	0	17.68459 17.68444	-64.76227 -64.76211
11	Woodland	0	0	1	0	0	17.68459 17.68474	-64.76187 -64.76203
12	Woodland	1	0	0	0	0	17.68376 17.68363	-64.76210 -64.76191
13	Scrub	0	0	0	0	0	17.68349 17.68336	-64.76182 -64.76198
14	Woodland ²	0	0	0	0	0	17.68378 17.68396	-64.76122 -64.76135
15	Woodland ²	1	1	1	0	0	17.68432 17.68418	-64.76146 -64.76131
16	Scrub	0	0	0	0	0	17.68425 17.68418	-64.76028 -64.76004
17	Woodland	1	0	0	0	0	17.68454 17.68467	-64.76114 -64.76086
18	Woodland	2	2	0	1	0	17.68399 17.68385	-64.76219 -64.76213
19	Woodland ^{2,3}	0	1	0	0	0	17.68458 17.68434	-64.76173 -64.76179
20	Scrub ⁴	0	1	0	0	0	17.68542 17.68523	-64.76245 -64.76227

¹Included grassland dominated by hurricane grass.

²Woodland plots that also include white mangroves.

³Woodland plot that also includes red mangrove.

⁴The only scrub plot not underlain by some exposed coral rubble (sandy beach).