

Caribbean Journal of Science, Vol. 39, No. 3, 392–398, 2003
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**Response of the St. Croix Ground
Lizard *Ameiva polops* to Severe
Local Disturbance of Critical
Habitat at Protestant Cay:
Before-and-After Comparison**

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The most recent survey (April-June 2002) of the endemic and endangered St. Croix Ground Lizard, *Ameiva polops* (Cope 1862), at Protestant Cay, a 1.2 ha islet in Chris-

tiansted Harbor off the northeastern coast of St. Croix, U.S. Virgin Islands, confirmed that this population (from only three) continues to decline (McNair 2003 and literature cited therein). Less suitable habitat is presently available because of landscaping practices such as raking and removal of leaf litter, removal of undergrowth and woody vegetation, and planting of exotic vegetation by hotel management on this highly developed cay. Disturbance can be negative, benign, or even positive such as enhancing habitat for *A. polops* by exposing more bare loose ground, increasing the amount of leaf fall or woody debris, or opening the undergrowth or canopy to improve the mixture of sun and shade. These positive changes within the context of *A. polops* at Protestant Cay, however, can now only occur in habitat that has already undergone major anthropogenic changes.

During late November 2002, following changes to critical habitat by Hotel on the Cay, we resurveyed areas where *A. polops* was present in an earlier survey to compare before-and-after species abundance and distribution, and seasonal effects of *A. polops* on Protestant Cay. We expected the population to decrease if deleterious landscaping practices prevailed as they have for the past 35 years. Our before-and-after survey comparison allowed us to assess whether or not this recent habitat change of general upkeep of the hotel grounds is a particularly threatening event, or only a milder event contributing to the long-term population decline of this species.

Survey methodology followed McNair (2003). Sampling units were the same habitat blocks (and one adjacent sampling unit, D) where *A. polops* was present during the spring survey. Time was fixed within each unit but varied between-units according to patch size and the difficulty of thoroughly searching the habitat. Sampling units were scored for habitat disturbance on a categorical scale from 1 (no change or negligible disturbance) to 5 (habitat completely removed; see Table 1). As before, we selected the maximum number of lizards from one of three replicated counts within each unit and summed these counts over all

units to obtain a minimum population estimate. For both survey periods we also visually estimated age-class (adults; juveniles < 50 mm snout-vent length [SVL]; Dodd 1980). This method produced higher counts than counts using the combined maximum number of lizards from both age classes, and allowed us to compare adult to juvenile age-ratios between the two survey periods (using a chi-square contingency test at $\alpha = 0.05$). We also assessed the association between the net change in adults and juveniles counted during the two survey periods within sampling units to the degree of disturbance to critical habitat (Spearman rank correlation; one-tailed tests, $\alpha = 0.05$).

The population estimate of *A. polops* during the new survey period for combined age classes was 36 animals, based on the sum of maximum counts in the 10 (43%) sampling units where lizards were present (Table 2, Fig. 1). *Ameiva polops* was concentrated in six contiguous units (A-E, S) of dry forest that contained 25 (69%) of the maximum number of lizards. Occupied habitat in unit D, a new area, was restricted to the border of adjacent occupied units. The two other occupied areas were disjunct (P-R, V), with beach habitat dominated by sea grape, *Coccoloba uvifera*. All but one *A. polops* were present in three contiguous units (P-R) where several animals were seen in tidal litter. *Ameiva polops* was not found in unit M – the most isolated area on the east side of the cay – where one individual was present during the spring survey (Table 1, Fig. 2c, d). It declined in the three (M, S, and V) most severely disturbed areas (Table 1, Fig. 2a, b). This species was absent from a large portion of unit S, but some were able to partially reoccupy habitat that was denuded of woody vegetation in late July 2002. No lizards were observed elsewhere on Protestant Cay during the new survey period (late December to mid-January).

Population estimates for each age-class were 20 adults/12 juveniles and 19 adults/21 juveniles for spring and winter surveys, respectively (Fig. 3). The difference in the proportion of the age-ratio between the two survey periods was not significant ($\chi^2 =$

TABLE 1. Description of habitat disturbance and assigned scores on a categorical scale from 1 (no change or negligible disturbance) to 5 (habitat completely removed) in sampling units occupied by St. Croix Ground Lizards, *Ameiva polops*, at Protestant Cay during winter 2002-2003 or an earlier survey in spring 2002.

Sampling unit	Habitat disturbance	Score
A	Five trees and several shrubs removed; limbs removed on some other trees and several left on ground. Four large wood chip piles dumped along area border. Light increase in planted lilies.	3
B	One tree and several shrubs removed; some shrubs lightly pruned. Moderate increase in planted lilies.	2
C	One tree removed. Shrubs moderately pruned. Wood chips lightly scattered on portion of ground; one quarter of ground dusted with lime.	3
D	No change.	1
E	Moderate amount of litter removed. One tree and several shrubs removed; many other shrubs moderately pruned. Wood chips lightly scattered along area border.	3
M	Deposition of concrete rubble pile among excavation for pipeline obliterated occupied area.	5
P	Some limbs of one Sea Grape cut.	1
Q	Small wood chip pile and trash dumped along area border.	1
R	Light vegetation at one site removed for aquatic ski-doo parking area.	2
S	All woody and non-woody vegetation of ca. one-half of area removed (only Aloe left standing) and chips left on ground; groundcover and litter smothered. Large wood chip piles deposited along area border.	4
V	Woody vegetation (including Sea Grape), groundcover, and litter partially or completely removed from several sand mounds; soil disturbed in one area. Portion of woody debris (boards piled on ground) between sand mounds removed.	4

TABLE 2. St. Croix Ground Lizards, *Ameiva polops*, counted during winter 2002-2003 within sampling units at Protestant Cay where animals were present during an earlier survey in spring 2002.

Sampling unit	Duration of survey (min) ¹	Dates	Numbers per survey	Main habitat(s)
A	35	31 Dec; 10, 12 Jan	4, 10, 4	Dry Forest
B	20	31 Dec; 11, 17 Jan	2, 3, 4	Dry Forest
C	2	31 Dec; 5, 11 Jan	1, 0, 0	Dry Forest
D ²	5	5, 11, 14 Jan	1, 1, 1	Dry Forest
E	15	31 Dec; 5, 11 Jan	1, 4, 3	Dry Forest
M	35	1, 11, 17 Jan	0, 0, 0	Dry Forest, Beach
P	30	1, 10, 12 Jan	4, 6, 5	Beach
Q	25	1, 5, 10 Jan	0, 1, 3	Beach
R	7	1, 10, 12 Jan	1, 1, 0	Beach
S	60	1, 11, 14 Jan	0, 0, 5	Dry Forest
V	25	31 Dec; 5, 10 Jan	0, 0, 1	Beach

¹Duration of survey is the time spent in each sampling unit on each survey date.

²Lizards not detected in spring 2002.

1.09). The association between the net change in lizards counted during the two survey periods within sampling units to the degree of disturbance to critical habitat was significant for adults ($R_s = -0.69$, $P < 0.05$) but not for juveniles ($R_s = -0.23$, $P = 0.49$). The number of adults between the two survey periods declined in unit S, and

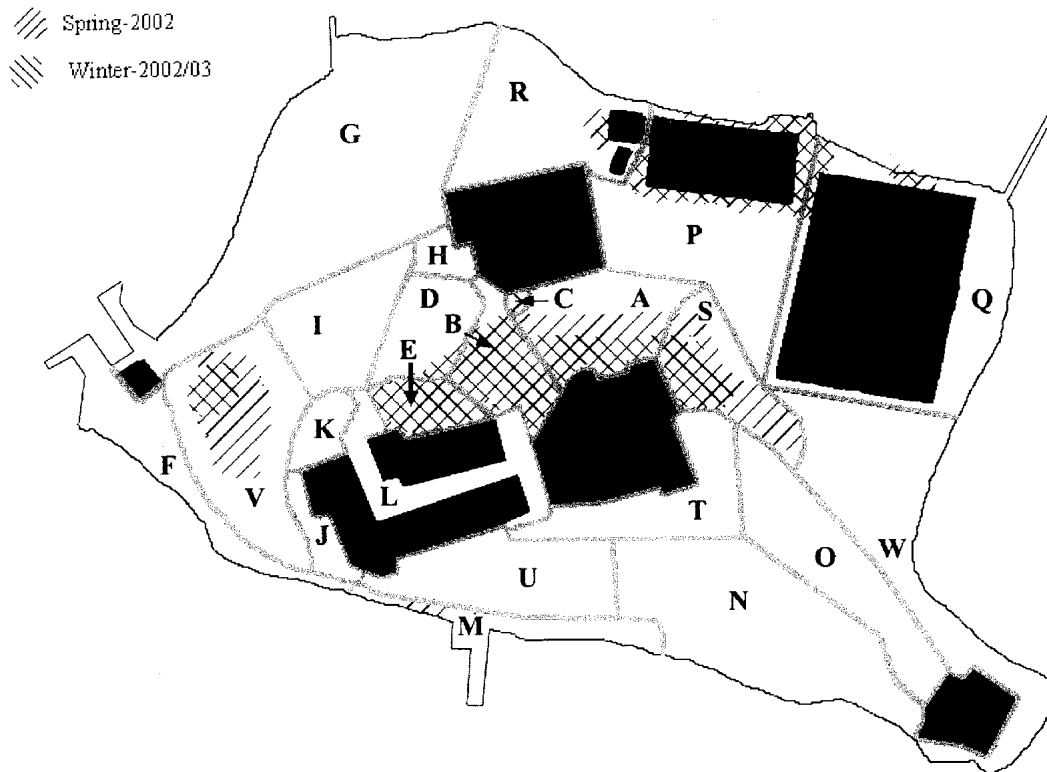


FIG. 1. Distribution of *Ameiva polops* before and after disturbance of critical habitat during spring 2002 and winter 2002-2003 in 23 sampling units (A-W) on Protestant Cay. Filled black areas are buildings or abandoned tennis courts (P, Q).

increased in the three nearest units (A, P, Q). Recruitment of juveniles was also greatest in units A and P.

Contrary to expectation, the overall population of *A. polops* did not decline but declines were observed in the three most severely disturbed sampling units. Though the long-term response to this perturbation is unknown, the number of adults was virtually identical between survey periods. Greater activity for this heliophilic animal is unlikely during winter when temperatures are 2.8-3.9° C cooler (Calvesbert 1970), but adult *A. polops* remained active during December and January, unlike most adults of three larger species of *Ameiva* in the northern Lesser Antilles and Puerto Rico (Rodriguez-Ramirez and Lewis 1991; Censky 1995). The possible reasons such as the smaller size of *A. polops* which may permit activity throughout the year, habituation to food obtained from human debris and

other human activities, or other factors need to be examined.

The only detected seasonal effect during the winter survey was greater juvenile recruitment, which was probably not confounded by differences in habitat during the two survey periods. The net change in the number of juveniles was not associated with the degree of disturbance to critical habitat (even though smaller individuals of *A. polops* were found in more exposed sites, whereas larger individuals were in canopied sites at Green Cay; Wiley 1982 unpubl. ms). Greater juvenile recruitment in winter than spring is consistent with a seasonal reproductive cycle or at least greater breeding activity in one season than another. At Green Cay, the mean size of *A. polops* in October was ca. 7 mm smaller than in April (Wiley 1982 unpubl. ms), suggesting more juveniles are present later in the year, data consistent with our results. The seasonal repro-



FIG. 2. a,b. Before (14 January 2002; top left) and after (20 February 2003; bottom left) photographs of habitat disturbance within unit V where *Ameiva polops* was formerly present. Concrete rubble now covers the site where an adult was seen near the largest shrub in foreground before disturbance. 2c,d. Before (27 February 2002; top right) and after (20 February 2003; bottom right) photographs of habitat disturbance within unit M where *Ameiva polops* was absent during the winter 2002-2003 survey. Note the virtual elimination of ground cover and litter on the sand mound, and disturbed soil in the foreground.

Errata: The correct legend appears at the bottom of this page.
--Editor, CJS

ductive cycles of *A. plei* in the northern Lesser Antilles and *A. exsul* and *A. wetmorei* in Puerto Rico, at similar latitudes and location to St. Croix, were more closely associated with daylength than with rainfall or temperature (reviewed in Censky 1995; also Rodriguez-Ramirez and Lewis 1991). Rainfall on St. Croix was ca. half of normal in 2002, so reproduction of *A. polops* on Protestant Cay was apparently not curtailed by the drought.

The distribution of adults changed in response to severe local disturbance to habitat even though the proportion of lizards in the two habitat types (dry forest, beach) was similar during the two survey periods (McNair 2003; this study). *Ameiva polops* re-occupied unit A where some disturbance was probably beneficial (i.e., cut limbs left

on the ground). Cattle Egrets (*Bubulcus ibis*) nested here during the winter survey but in much fewer numbers (3-8 pairs) than during spring when their predation temporarily eliminated *A. polops* from unit A (McNair 2003). Adult and juvenile lizards also increased in units P and Q which, in addition to unit A, were possibly individuals displaced from unit S. The decrease in the number of *A. polops* from unit S is probably even greater, as during a fourth replication conducted just after the spring survey ended (6 June) recorded eight adults here. The greater density of *A. polops* in the slightly larger occupied areas of units P and Q during the winter survey probably represents compensatory habitat use by animals moving in from unit S,

Fig. 2. a,b. Before (27 February 2002; top left) and after (20 February 2003; bottom left) photographs of habitat disturbance within unit V where *Ameiva polops* was absent during the winter 2002-2003 survey. Note the virtual elimination of ground cover and litter on the sand mound, and disturbed soil in the foreground. 2c,d. Before (14 January 2002; top right) and after (20 February 2003; bottom right) photographs of habitat disturbance within unit M where *Ameiva polops* was formerly present. Concrete rubble now covers the site where an adult was seen near the largest shrub in foreground before disturbance.

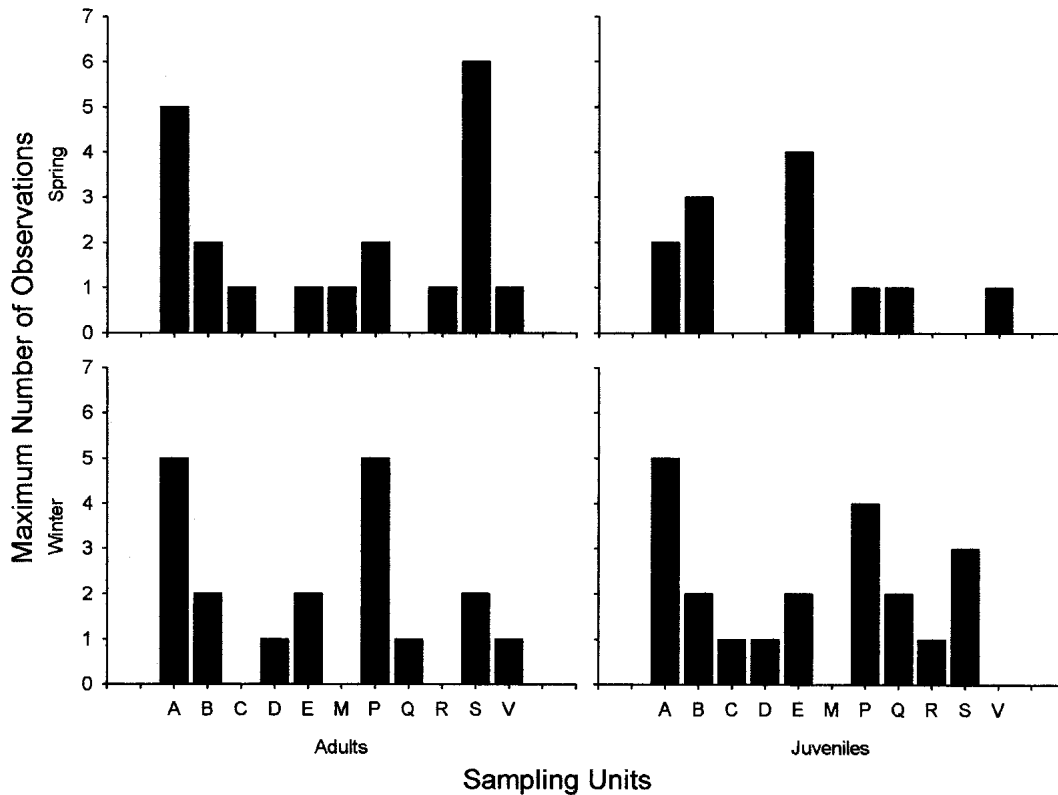


FIG. 3. Maximum number of adult and juvenile St. Croix Ground Lizards, *Ameiva polops*, counted during two survey periods (spring 2002, winter 2002-2003) within sampling units at Protestant Cay.

but some also may have been previously overlooked by chance (as in unit D). Severe disturbance to habitat also occurred in two disjunct sampling units (M, V) where the number of *A. polops* was also reduced or eliminated, but displacement of this species could not be detected in the nearest occupied sampling units. Even moderately disturbed sampling units (score of 3) retained *A. polops* (at least in the short-term), though adults are more sensitive to disturbance, as long as essential habitat components remained (e.g., a moderate amount of litter and some woody vegetation). These results augment the earlier conclusion (McNair 2003) that *A. polops* is resilient and pre-adapted toward disturbance because it occupies littoral habitat periodically disturbed by hurricanes.

Although severe local disturbance of critical habitat at Protestant Cay by owners

of Hotel on the Cay was inadvertent, it effectively removed some *A. polops* from these areas and thus constitutes a violation of the Endangered Species Act (1973). Subsequent to this inadvertent action and following recommendations in McNair (2003), for the first time owners of Hotel on the Cay have entered into a non-punitive agreement with the United States Fish and Wildlife Service (Partners with Wildlife program) in association with the Division of Fish and Wildlife of the territorial government to protect *A. polops*, which has included capture of a second small Indian mongoose on the cay in early January 2003 (cf., McNair 2003). This plan proposes to eliminate deleterious landscaping practices and minimize human disturbance of habitat and will include public use regulations. Improvement of the quality and amount of habitat for the benefit of *A. polops* should proceed, and possibly lead to

a reversal of the long-term population decline on Protestant Cay which will continue if earlier practices are not modified. Future surveys will determine the short- and long-term effects of disturbance at all sites. This study is one of few on the herpetofauna of the West Indies that focuses on a species in conspicuously disturbed habitats (Henderson and Powell 2001) as well as assesses the effects of degree of disturbance in these altered habitats (Germano et al. 2003).

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Acknowledgments.—We thank F. E. Hayes, T. Herman, C. D. Lombard, and R. Philibosian for reviewing a penultimate draft of this manuscript and K. L. Krysko, W. E. Meshaka, Jr., and an anonymous individual for reviewing the submitted manuscript. We also thank the United States Fish and Wildlife Service for financial support (Federal Aid Program, Wildlife Conservation and Restoration Project R-1, Study 2) and Christine Willis for her support.

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