Final Report

Reintroduction Evaluation and Habitat Assessments of the Virgin Islands boa, *Epicrates monensis granti*, to the U.S. Virgin Islands.

GRANT T-1

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Introduction

The Virgin Islands boa, *Epicrates monensis granti*, is an endangered, CITES I endemic of the Puerto Rico Bank (see USFWS 1980) that shows an extremely disjunct distribution indicative of a long history of population decline and extirpation (Mayer and Lazell 1988; Nellis et al. 1986; Tolson 1992a). Nonetheless, recovery activities for this snake in the U.S. Virgin Islands have been ongoing for nearly 20 years due to the efforts of the Division of Wildlife, USVI and the Toledo Zoo. Nellis and Boulon. (1985) demonstrated that it was feasible to completely eradicate the black rat, *Rattus rattus* from smaller cays in the USVI. This effort spurred searches to find suitable habitats for *E. m. granti* on the Puerto Rico Bank that were not necessarily rat free, but had the structural attributes of vegetation and food resources that the boa required. Tolson (1988) surveyed and analyzed 23 sites on the Bank as potential *E. m. granti* reintroduction sites and three sites were selected- one in Puerto Rico and two in the USVI. One site in the USVI and one site in Puerto Rico were subsequently poisoned in 1990-1991, but only the Puerto Rico site remained rat free. In 1993-94 41 boas bred at the Toledo Zoo were released to Puerto Rico. The population exploded to ca. 500 snakes and is still expanding as of August 2004. This effort demonstrated conclusively that reintroduction was a viable recovery strategy for the recovery of *E. m. granti*.

In the U.S. Virgin Islands, repeated rat surveys performed by Peter J. Tolson (most recently in 2002-03), using removal trapping and chew stick placement, indicated that *Rattus* had not re-colonized cays since the initial poisonings in the 1980's. Concurrently, conservation breedings of the *E. m. granti* deme (founders from St. Thomas) created a pool of snakes which could be drawn upon for the first reintroduction to the USVI. The potential genetic diversity of any reintroduced population was enhanced by the translocation of snakes from St. Thomas that were confiscated by Division of Wildlife staff. The survival of these snakes is currently being evaluated by the Division of Wildlife and staff from the Toledo Zoo and Departamento de Recursos Naturales y Ambientales de Puerto Rico under the direction of Peter J. Tolson.

Our primary goal for this project was to evaluate the success of the reintroductions performed during August 2003-04 in the USVI (24 boas). Our second goal was to evaluate habitat use by reintroduced and translocated boas in the USVI. Data from sequential recaptures were analyzed to assess age-specific survivorship, growth, activity patterns, movements, reproductive biology, population numbers, and habitat preferences. The latter data will be especially useful in selection of target sites for future reintroductions. The USFWS Recovery Plan mandated evaluation of sites suitable for release and reintroduction of the boa to predator-free uninhabited islands within its historical range (USFWS 1986). This was the third goal of this research.

Methods

Study site

Vegetation of the release site is primarily composed of a closed-canopy subtropical dry forest, *sensu* Ewel and Whitmore (1973) 4.28- 9.26 m in height, overwhelmingly dominated by marble tree, *Elaeodendron xylocarpum.* However, as one moves to the west, the *Elaeodendron* forest incorporates significant numbers of white cedar, *Tabebuia heterophylla*, and cotorro, *Adelia ricinella*. This mixed forest has significant numbers of large *Tillandsia utriculata* in the trees, in the understory, and on the ground. The site has a small grove of tall *Acacia macracantha* adjacent to a small opening with large numbers of *Opuntia*. The western one-third of the site is dominated by a mangrove forest of buttonbush, *Conocarpus erectus*, black mangrove, *Avicennia nitida*, and white mangrove, *Laguncularia racemosa.* Littoral vegetation varies from *Elaeodendron* with an understory of limber caper, *Capparis flexulosa*, catch-and-keep, *Caesalpinea bonduc*, and *Clerodendrum aculeatum* on the northeast to isolated stands of sea grape, *Coccoloba uvifera* mixed with *Capparis flexulosa* on the northwest. The eastern shoreline has an extensive cover of shoreline seapurselane, *Sesuvium portulacastrum*, with a small stand of *Morinda citrifolia*, and isolated living and dead *Elaeodendron xylocarpum*. The extreme south end is dominated by panic grass, *Panicum maximum*, Turk's cap cactus, *Melocactus intortus*, and shrubs, most frequently *Randia aculeata*, *Corchorus hirsutus*, and low lying *Capparis flexulosa*.

No feral cats, *Felis catus*, have ever been observed on the site. The site once supported a substantial population of Zenaida doves, *Zenaida aurita*, in the nesting season but this has been reduced to only a few birds (Tolson pers. obs.). Smaller passerines, such as the bananaquit, *Coereba flaveola*, yellow warbler, *Dendroica petechia*, and grey kingbird *Tyrannus dominicensis*, occasionally visit the site but are not commonly encountered. Various herons, including the snake-predating yellow crowned night heron, *Nyctanassa violacea*, nest on or commonly visit the site. Native lizards- the crested anole, *Anolis cristatellus*, the barred anole, *Anolis stratulus*, and the ground lizard, *Ameiva exsul* are common on the site. The introduced green iguana, *Iguana iguana*, has a nesting population on the site.

Snake processing

Capture- *E. m. granti* were hunted at night from sunset to 2200 using battery-powered headlamps and were captured by hand. Searches were performed during the moon periods of the last quarter through the new moon. Capture data included time of capture, locality, and perch/ forage site parameters as used by Chandler and Tolson (1990).

Identification- snakes destined for release with snout-vent lengths (SVL) > 600 mm were implanted with AVID or Trovan passive integrated transponders (PITs) on the left side 1 cm anterior to the vent. Snakes < 600mm SVL had a digital image taken of the anterior dorsal body pattern and were implanted with PITs upon recapture after reaching 600 mm SVL.

Meristics- After capture, snakes were sexed with a sexing probe, weighed with a Pesola scale to the nearest gram, and measured to the nearest mm. Cloacal body temperature was taken with a quick-recording thermometer. Reproductive condition, e.g. shedding of the hemipenial epithelium in males, presence of follicles or young in gravid females, was evaluated.

Habitat analysis- Capture sites were characterized using standard measurements for terrestrial vegetation (see Bonham 1989). Terrestrial vegetation was identified and evaluated in two nested plots with the boa capture point used as the center of the plot. A 10 m x 10 m plot was used to calculate tree (> 10 cm dbh) density and frequency data. A randomly selected 5 m x 5 m plot nested within the larger plot was used to evaluate shrub and sapling density and frequency. Canopy cover was evaluated using crown densitometry. Canopy height was measured with a clinometer. Contiguousness of the canopy was evaluated using nearest neighbor distances of other trees and shrubs. Data from sequential recaptures was analyzed to assess age-specific survivorship, growth, activity patterns, movements, reproductive biology, and habitat preferences. The latter will be especially useful in selection of target sites for future reintroductions.

Population estimates- boa populations were estimated using the Schnabel (1938) and Schumacher-Eschmeyer (1943) estimates for multiple sampling of marked individuals in closed populations, using Ecological Methodology v. 6.1 by Exeter Software.

Release site evaluation- Likely candidate cays for reintroduction were selected by Division of Wildlife staff and were visited by Peter J. Tolson to determine whether a more detailed evaluation should be performed. The detailed evaluation consisted of 10 m x 10 m plots to calculate tree (> 10 cm dbh) density and frequency data scaled to patch size, using a 5% sampling intensity. All trees within the plots were identified to the species level. A 5 m x 5 m plot nested within the larger plot was used to evaluate shrub and sapling density and frequency. Canopy cover was evaluated using a crown densitometry. Canopy height was measured with a clinometer. Contiguousness of the canopy was evaluated using nearest neighbor distances of other trees and shrubs. Prey densities were determined by distance measures of *Anolis* on transects scaled to patch size, usually one 100 m transect/ ha of habitat. *Anolis* are also quantified as number of *Anolis* seen/ man/ h during hunting episodes. Similarly, rat densities were quantified as rats/ trap hour captured on transects scaled to patch size. Normally, one 100 meter trap line, using 1 trap/ 10 m, is employed for each five ha of habitat. Rats were trapped for three hours/ night, with traps checked each hour and re-baited each hour, for three consecutive nights. Cats, when present, are quantified as number of cats observed/ man/ h.

Results:

Reintroduction/ translocation

Reintroduction- the first group of 11 reintroduced boas from the Toledo Zoo was released on site 6 August 02. The snakes ranged from 20.2 g in mass and 455 mm SVL to 301g in mass and 1042 mm SVL.

Translocation- 31 boas were translocated to the site from 5 February 96 through 15 September 03. Body masses were not recorded but the snakes ranged from 320 mm to 780 mm SVL. Nine snakes were implanted with AVID or Trovan passive integrated transponders.

Captures/ recaptures- During the first evaluation trip to the USVI 28 February- 6 March 03 we made a total of 18 captures of *E. m. granti*. Four of these were recaptures; three were from the group released from the Toledo Zoo and one was a Division of Wildlife snake released on 23 February 96. Of the unidentified snakes, seven were implanted with PITs. The remaining snakes were too small for implantation and had their dorsal body patterns photographed as a means of future identification.

During the second evaluation trip to the USVI 19-29 August 03 we made a total of 53 captures of *E. m. granti*. This makes a total of 52 individual snakes captured in 2003. There were eight snakes captured twice during August and three snakes captured three times. Twenty four additional unidentified snakes were implanted with PITs.

During the third evaluation trip to the USVI 10-23 February 04 we made a total of 103 captures of *E. m. granti*. We captured 81 individual snakes on this trip. There were 16 snakes captured twice, five snakes captured three times, and one snake captured four times in February. Forty-two additional unidentified snakes were implanted with AVID transponders or photographed.

During the fourth evaluation trip to the USVI 10-20 August 04 we made a total of 51 captures of *E. m. granti*. We captured a total of 45 individual snakes on this trip. Six snakes were captured twice. Twenty-two additional unidentified snakes were implanted with AVID transponders or photographed.

Sex ratios- seven males and three females were captured in February-March 03, a sex ratio of 2.3:1. Three snakes were too young to sex. There were 13 males and 24 females captured in August 03, a sex ratio of 1:1.85. Three snakes were too young to sex.

Sex ratios were skewed toward females in 2004. There were 23 males and 47 females captured in February 04, a sex ratio of more than two females for each male. Eleven juvenile snakes were too young to sex. There were 15 males and 27 females captured in August 04, a sex ratio of nearly two females for each male. Four juvenile snakes were too young to sex and one snake escaped before being sexed.

Age distribution- Tables I-III show the age distributions of snakes captured from August 2003 through August 2004.

Table I. Age distribution of snakes captured on site August 2003.

Age Class	Number of snakes
Newborn < 400 mm SVL	3
Young of year 400-550 mm SVL	2
2 years, 550-650 mm SVL	15
3 years, 650-750 mm SVL	9
4+ years, > 750 mm SVL	14

Table II. Age distribution of snakes captured on site, February 2004.

Age Class	Number of snakes
Neonate (born August 03) < 400 mm SVL	7
Young of year 400-550 mm SVL	11
2 years, 550-650 mm SVL	20
3 years, 650-750 mm SVL	19
4+ years, > 750 mm SVL	24

.Table III. Age distribution of snakes captured on site, August 2004.

Age Class	Number of snakes
Neonate (born August 04) < 400 mm SVL	0
Young of year 400-550 mm SVL	5
2 years, 550-650 mm SVL	13
3 years, 650-750 mm SVL	12
4+ years, > 750 mm SVL	16

The largest male captured had a SVL of 1112 mm and a tail length of 237 mm. This snake was a wild male with no transponder that was born or translocated to the site, date unknown. The largest female captured had an SVL of 1066 mm and a tail length of 137 mm (stub). This snake was a wild female that was born or translocated to the site, date unknown.

Body mass index- one simple way to assess the success of a reintroduced snake is to examine a crude body mass index that relates the ratio of body mass to snout vent length. Healthier snakes, with greater muscle mass and higher stores of lipids, will exhibit more body mass per unit of SVL than snakes that have not been as successful in hunting, and thus have lower muscle mass and lower lipid reserves. As a basis of comparison, adult female snakes captured in August, 2004 on site were compared with a population of female snakes captured in Puerto Rico in August, 1991. An equivalent population of snakes from St. Thomas was not used as the basis for comparison as no body masses were recorded for any of the DFW confiscated boas. Eighteen adult female snakes from the site > 700 mm SVL had a mean body mass of 128 g and a mean SVL of 862 mm. The mean mass/ SVL ratio was 0.145422. In the equivalent population on Puerto Rico in 1991, 17 adult female snakes > 700 mm SVL had a mean body mass of 69.2 g and a mean SVL of 785 mm. The mean mass/ SVL ratio was 0.086952. The huge difference in body mass index was highly significant ($p < 0.001$; $U = 10$, $U' = 296$) using the Mann-Whitney U test, indicating that the reintroduced/ translocated boas had much higher body mass/ unit SVL than an unmanaged wild population of the same taxon. It should be noted, however, than these two populations are different genetically, and the Virgin Islands population of *E. m. granti* may simply be more robust snakes than their Puerto Rican counterparts.

Growth- sequential recaptures allowed growth data to be collected on 39 individual boas. Only one neonate was recaptured; it had a growth rate of 11.13 mm/ month over a growth period of 11.77 months. No snakes were recaptured in the 450-550 mm size class. Ten snakes were recaptured in the 550-650 mm size class; the mean growth rate was 5.50 mm/ month. Nine snakes were captured in the 650-750 mm size class; the mean growth rate was 3.68 mm/ month. Nineteen snakes were captured in the > 750 mm size class; mean growth rate was 3.48 mm/ month. These data are tabulated in Appendix 1. Although there appears to be a trend of fast growth for young snakes and slower growth for adult snakes and the means between these size classes appear to be substantially different in some cases, the variances of each class, along with the very small sample sizes (n=1, n=0) for the newborn and young of the year snakes, resulted in no statistical significance of growth rates between the age classes at the $p > 0.01$ level using a one-way ANOVA (STATISTICA v 5.5, StatSoft software).

Habitat preferences- *E .m. granti* was found most frequently in the dominant tree on site, the marble tree, *Elaeodendron xylocarpum.* Other tree species commonly utilized in 2003- 2004 were limber caper, *Capparis flexulosa,* sea grape, *Coccoloba uvifera,* buttonbush mangrove, *Conocarpus erectus,* and white cedar, *Tabebuia heterophylla*. In 2003, snakes were also captured in gumbo limbo, *Bursera simaruba,* and ironwood, *Krugiodendron ferreum*. In 2004 snakes were also captured in Acacia, *Acacia macracantha*, white mangrove, *Languncularia racemosa*, black mangrove, *Avicenna nitida*, yellow torch, *Erithalis fructicosa*, and tree cacti, *Opuntia rubescens*, for the first time. Table IV shows tree capture sites for the snakes captured from February 03 to August 04. Snakes were also captured in terrestrial bromeliads *Tillandsia utriculata*, vines, primarily *Stigmaphyllon emarginatum*, and on coral rubble. All snakes captured were active at night; none were found in refugia during the day.

Vegetation analysis- The subtropical dry forest of the site is overwhelmingly dominated by the marble tree, *Elaeodendron xylocarpum*. *E. xylocarpum* comprised 59.4% of the canopy species > 10 cm DBH within the 10 m x 10 m forest plots, almost forming a monoculture in several areas of the site. *Coccoloba uvifera*, *Tabebuia heterophylla*, and *Bursera simaruba* were the other dominant species of the canopy comprising 9.9%, 8.9%, and 7.9% respectively of the canopy species > 10 cm DBH within the 10 m x 10 m forest plots. Total tree density on site equaled 0.018 trees/ m^2, or 180 trees/ ha. Densities of specific trees ***in the capture plots***, expressed as number of trees/ ha, are as follows: *Avicennia nitida*, 1.82/ ha; *Bursera simaruba*, 15.45/ ha; *Capparis cynophallophora*, 3.64/ ha; *Conocarpus erectus* 1.82/ ha; *Cocos nucifera* 5.46/ ha; *Coccoloba uvifera*

18.18/ ha; *Elaeodendron xylocarpum* 109.09/ ha; *Laguncularia racemosa* 3.64/ ha; *Krugiodendron ferreum* 3.64/ ha; *Pisonia albida* 5.46/ ha; *Tabebuia heterophylla* 16.36/ ha. Many species, by virtue of their nonrandom distribution on the cays, were very dense in some areas, but absent from others, e.g. *Acacia*, *Avicennia*, *Languncularia*, and others.

Table IV. Tree capture sites for the snakes captured in February 2003 through August 2004.

Tree species	**Number of snakes**
Acacia macracantha	3
Avicenna nitida	1
Bursera simaruba	2
Capparis flexulosa	36
Clerodendrum aculeatum	1
Corchorus hirsutus	2
Coccoloba uvifera	30
Conocarpus erectus	15
Elaeodendron xylocarpum	93
Erithalis fructicosa	1
Krugiodendron ferreum	3
Languncularia racemosa	5
Opuntia rubescens	2
Randia aculeata	6
Tabebuia heterophylla	7

The shrubby understory of the site was primarily composed of small trees of the species tabulated in Table IV. Additional species in the plots included *Adelia ricinella*, *Capparis flexulosa*, *Clerodendrum aculeatum*, *Corchorus hirsutus*, and *Thespesia populnea*. Two species, however, dominated the understory: small *Elaeodendron xylocarpum* comprised 46.6% of the stems counted in the 5 m X 5 m understory plots and *Capparis flexulosa* comprised 24.6% of the stems. Some of the vegetative cover, particularly in coastal situations free of canopy, was dominated by dense mats of low growing vegetation primarily composed of viney tangles of *Capparis flexulosa* overgrown with *Stigmaphyllon emarginatum* or *Canavalia rosea*. We could not quantify stems in these associations without destroying the vegetation within the plot. In most areas both the understory and canopy were contiguous. Nearest neighbor distances, i.e. the distance of the nearest tree or shrub from the capture site, had a value of zero (0) in every case but one, meaning that every three or shrub in which a boa was captured had another tree or shrub touching it at some point. The lone exception was a snake capture in a small tree *Opuntia*; this cactus was 31 cm from its nearest neighbor.

Foraging heights- There was wide overlap in the foraging heights and perch diameters of boas of different size classes. Table V presents the data for range and mean capture height for the different size classes of boas.

Table V. Foraging height and perch diameters of boas captured on site

Size class	Mean height	Range in m	BRDA in mm	Range BRDA
< 450 mm	1.87 m	0.89-2.93 m	8 mm	2-44 mm
450-550 mm	2.14 m	0.89-3.74 m	8 mm	5-13 mm
550-650 mm	1.78 m	0.72-3.80 m	13 mm	3-84 mm
650-750 mm	1.36 m	0.41-2.58 m	11 mm	3-39 mm
> 750 mm	1.54 m	0.33-3.58 m	15 mm	2-58 mm

Although there was a slight trend of larger boas foraging at lower heights and larger branch diameters, these differences were not significant using a two-way ANOVA.

Prey base- the prey base continues to be sufficient, with large numbers of *Anolis cristatellus*. While we have known for years that the common green iguana, *Iguana iguana*, inhabits the site, this is the first year that we have seen hatchling iguanas. They were very numerous in August 04. Seven adult snakes were observed feeding on hatchling iguanas or regurgitated a hatchling iguana shortly after capture.

Reproduction- Thirteen of the female snakes captured in August 04, which is within the season of parturition, were of reproductive size; two of these (15.4%) had recently given birth. However, we found no newborn snakes with umbilical scars in August 04.

Population estimate- a Schnabel (1938) population estimate performed on the February-August 04 data gives an estimate of **168 snakes on the site, an increase of 126 snakes over the 42 snakes originally released.** The population has increased fourfold, with a density of 202 boas/ ha. The new Schnabel population estimate eclipses the old 2003 estimate of 98 snakes for the site.

Reintroduction site selection

Initial evaluations were performed on five cays in the U.S. Virgin Islands in 2003-04: Dutch Cap Cay, Henley Cay, Salt Cay, West Cay and Whistling Cay. Neither Dutch Cap Cay, Henley Cay, nor Whistling Cay seemed to be optimal for *E. m. granti* because of the lack of adequate forest cover for a large boa population, but Salt Cay and West Cay both seemed suitable. An intensive four-day evaluation was performed on West Cay In August 04. Attempts were made by DFW to gain access to Great St. James Cay and Little St. James Cay without success. Both are privately owned.

Feral mammal densities- No cats were seen on any of the cays, but evidence of the black rat, *Rattus rattus* was present on every offshore cay visited in 2003-04. Intensive three-night trapping was carried out on West Cay from 11-13 August 04 to obtain an index of rat populations. The index for West Cay was 0.155 rats/ trap/ hour. Data for 110 trap/ hours were recorded. These data indicate a very heavy rat density for West Cay, in fact the highest rat density we have recorded in the U.S. Virgin Islands. In the U.S. Virgin Islands we have previously recorded densities of 0 (Saba Cay- coastal forest; Steven Cay-dry forest) to 0.09 (Buck Is.-grassland) rats/ trap/ hour. Recent goat or deer droppings were also present on West Cay but no goats or deer were observed.

Prey densities- *Anolis* densities on West Cay were the lowest observed on any cay in the U.S. Virgin islands. Only three *Anolis* were seen in nine hours of observations; two individuals of *A. stratulus* and one individual of *A. cristatellus*. This dismal observation of an anole density of 38 *Anolis* /ha contrasts sharply with the normal observations of ca. 5000 *Anolis*/ ha.

The subtropical dry forest of West Cay is far more diverse than that of the site. Dominant tree species > 10cm DBH of 20 randomly selected 10 m x 10 m forest plots included marble tree, *Elaeodendron xylocarpum*, gumbo limbo, *Bursera simaruba*, sea grape *Coccoloba uvifera*, and white cedar, *Tabebuia heterophylla*, as on the site, but several other tree species were very common, including bastard mahogany, *Andira inermis*, gree-gree, *Bucida buceras*, silver palm, *Coccothrinax alta*, black manjack, *Cordia rickseckeri, Eugenia axillaris*, black mampoo, *Guapira fragrans*, manchineel, *Hippomane mancinella*, and frangipani, *Plumeria alba. E. xylocarpum* was the dominant dicot tree and comprised 20.4% of the canopy species > 10 cm DBH within the 10 m x 10 m forest plots, but the silver palm, *Cocothrinax alba*, was the tree most frequently found in the plots, comprising 27.8% of the trees with the forest plots. *Coccoloba uvifera*, *Guapira fragrans*, *Capparis cynophallophora*, and *Bursera simaruba* were the other dominant species of the canopy comprising 16.7%, 9.3%, 7.4%, and 7.4% respectively of the canopy species > 10 cm DBH within the 10 m x 10 m forest plots. Tree density on West Cay equaled 0.017 trees/ m^2 or 170 trees/ ha. Densities of specific trees ***in the evaluation plots***, expressed as number of trees/ ha, are as follows: *Andira inermis*, 10/ ha; *Bucida buceras* 5/ ha; *Bursera simaruba*, 20/ ha; *Capparis cynophallophora*, 20/ ha; *Coccothrinax alba* 75/ ha; *Cocos nucifera* 10/ ha; *Cordia rickseckeri* 5/ha; *Coccoloba uvifera* 25/ ha; *Eugenia axillaris* 5/ ha; *Elaeodendron xylocarpum* 55/ ha; *Guapira fragrans* 25/ ha; *Hippomane mancinella* 5/ ha.

The shrubby understory of West Cay was primarily composed of small trees of the species listed above for the site. Additional species in the plots included *Andira inermis*, *Capparis flexulosa*, *Corchorus hirsutus*, *Eugenia sp.*, and *Hippomane mancinella*. Two species, however, dominated the understory: *Elaeodendron xylocarpum* comprised 25.5% of the stems counted in the 5 m X 5 m understory plots and *Coccoloba uvifera* comprised 26.8% of the stems. Some of the vegetative cover, particularly in exposed rocky coastal situations free of canopy, was dominated by low growing vegetation primarily composed of *Corchorus hirsutus* with dispersed *Melocactus intortus*. These areas appeared to be heavily grazed by goats. There were also areas of viney tangles of *Pithocellobium dulce*, *Caesalpinea bonduc*, and *Clerodendrum aculeatum*.

Discussion

The population structure on the site continues to be stable, with a continued skew towards adult snakes. This could have easily been caused by the large number of adults that were translocated to the site, as Virgin Islands boas may easily live more than 25 years, but may also be due in part by the importance of hatchling iguanas in the diet of *E. m. granti*. Using only the available capture numbers (102 individuals) the snakes existed in a minimum density of 123 snakes/ ha in August 04. Using the Schnabel (1938) population estimation for closed populations I calculated a population of 167.5 snakes (95% confidence interval from 144.9 to 237.2); using the Schumacher and Eschmeyer (1943) population estimation calculated a population of 165.9 snakes (95% confidence interval from 129.4 to 237.2) for August 04. The density of boas on the site, 202 boas/ ha exceeds the densities of 125 snakes/ ha calculated for Puerto Rico and selected habitat patches on Isla Mona.

The age structure of the snakes is indicative of a healthy population, with a preponderance of snakes ≤ three years of age. This is coupled with a healthy population of older animals of indeterminate age. In fact, the snakes ≥ four years of age were the most numerous age class of the population. I believe that this indicates substantial food resources for adult snakes (predominantly hatchling/ juvenile *Iguana*) and low predation pressure. The only predator currently on the island is the yellow crowned night heron, *Nyctanassa violacea*. Only the slight skew of the population indicates that the island is near carrying capacity for boas. As the adult snakes are able to utilize large prey, such as birds and hatchling green iguanas, they need not eat as often as the smaller boas.

Nothing about the population of boas on site suggests that it is different in any respect from any healthy population of boas. Capture data suggest that boas on site have activity patterns, reproductive timing, and prey selection similar to, if not exactly like, other populations of Virgin Islands boas. The boas on site seem more flexible in their selection of foraging heights. On Puerto Rico, Chandler and Tolson (1990) found that boas SVL was correlated with foraging height. This association did not hold for the site, possibly due to structural differences of the vegetation between the two sites. There were statistically significant differences in the perch height selection of *Anolis cristatellus* on Puerto Rico. Large males tended to perch high, while females and juveniles tended to perch lower. Large snakes, which preyed on the male *Anolis*, were most frequently found higher in the trees, while smaller snakes, which fed on smaller *Anolis*, were most often found in the understory. Differential perch height selection by different sexes and age classes of *Anolis cristatellus* was not observed on the site. This factor may explain why there were no significant foraging height differences between different size classes of boas.

Habitat is excellent for the boas. The site has a very dense closed canopy forest, which is apparently very important for this species (Tolson 1988). The density of the forest seems more important than the relatively low diversity of tree species, as boas were often captured in areas that were essentially a monoculture of *Elaeodendron*, *Conocarpus*, and *Laguncularia*. West Cay seems to be an excellent site for an additional population of reintroduced boas. The low *Anolis* densities there are doubtless due to the high densities of *Rattus*. The situation could be reversed with rodent eradication on the cay.

Management Recommendations

The most important activity that the DFW can continue for the site is the continued enforcement of the non-visitation policy of the site. Despite this policy, however, occasional visitors continue to flagrantly disregard the posting of the site. We observed five different instances when visitors ignored the restrictions during the course of our study. In two instances, non English-speaking visitors were collecting hermit crabs for use as fish bait. In one instance, a visitor allowed his dog to run free on the site. Fire from illegal visitation or poaching of boas are serious concerns.

For the time being, boas confiscated by DFW biologists from St. Thomas can be released, but it is essential that at least two additional sites on offshore cays be located for additional reintroductions. At least three cays appear to be suitable: Congo Cay, Salt Cay, and West Cay. However, all three are densely populated with *Rattus rattus*; these must be eradicated before boas are released on these islands. Although boas on Puerto Rico weathered Hurricane Hugo quite well (pers. obs.), the low elevation of the site makes the boa population there potentially vulnerable to a high storm surge. Although there are some concerns about maintaining small isolated populations of boas that are reproductively isolated, such a strategy spreads the risk of having a single stochastic event, such as disease or a predator introduction, doom all of the reintroduced boas. It is likely that the boas on St. Thomas are genetically similar, and yet there are no signs of inbreeding depression. This indicates that it is unlikely that boas would have to be genetically augmented. However, such an augmentation could be implemented easily by translocating as few as one or two boas to each site from St. Thomas every ten years. This is a far greater interval of translocation than what already occurs from DFW confiscations.

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