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Morphological and Genetic Variation Among Three Populations of the Endangered San Salvador Rock Iguana, Cyclura rileyi rileyi

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ABSTRACT

The San Salvador Island rock iguana, *Cyclura r. rileyi*, is a subspecies of one of three endangered Bahamian iguana species. Approximately 500 individuals dwell on at least seven tiny offshore/inshore cays of San Salvador. Recently we captured, measured, permanently marked, and collected blood samples from 28 iguanas on three of these isolated cays. Iguanas on the smallest cay, Guana (Hermitage Lake; <1 ha), were significantly larger and were missing more nuchal crests than those on Green Cay (offshore; 4.8 ha) or Manhead Cay (offshore; 3.0 ha). Frequency of regenerate tails, femoral pores and injured digits did not vary significantly among the populations studied. DNA isolated from blood samples is presently under RAPD analysis to compare genetic relationships among the isolated populations. Further studies will address behavioral and ecological causes and consequences of these population differences.

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INTRODUCTION

Among the largest lizards in the Western Hemisphere, the rock iguanas of the genus *Cyclura* are scattered throughout the Caribbean (Schwartz and Carey 1977). Their range has historically included several island chains of the Caribbean, including the Bahamas, the Greater Antilles, and the Virgin Islands (Blair 1991). Archeological and paleontological evidence confirm that, before the first native Americans sailed the Caribbean Sea, at least six additional species of iguanas were formerly widespread but now are extinct (Iverson 1978). At present, all eight remaining species are officially designated as "endangered" due to habitat destruction and hunting by man and feral predators such as dogs, cats, and mongooses. These animals have greatly decimated many extant populations--some to the brink of extinction. Their vulnerability is aptly illustrated by the formerly healthy population of 15,000 lizards on Pine Cay in the Caicos Islands. This population became extinct within five years due to hunting by dogs and cats introduced by hotel construction workers (Iverson 1978).

Three species of *Cyclura* currently occupy the most remote islands of the Bahamas. Of these, the subspecies endemic to San Salvador Island, *Cyclura rileyi rileyi*, is regarded as the most seriously threatened (Auffenburg 1976). Thought to be extirpated from the mainland, Auffenburg reported that approximately 200

individuals remained on about six offshore and inshore cays (small islands). Although morphological, ecological, physiological, and behavioral studies have been made on various *Cyclura* species, no genetic analysis has been published to date (Schwartz and Henderson 1991).

The specific purposes of this study were to determine if gene flow has been limited between the various populations and to support future population studies through our marking technique.

MATERIALS AND METHODS

STUDY SITE

The Bahamas are located east and south of Florida's Atlantic coast. The average annual rainfall in the Bahamas is about forty-four inches. The daily average temperature ranges from about 70°F during the winter to about 81°F in the summer. Temperature extremes rarely drop below 60°F or rise above 90°F (*Encyclopedia Britannica* 1993).

San Salvador Island is one of the southeastern-most islands in the Bahamas. The vegetation on the island is composed of scrub trees, cactus, and various smaller plants described by Gicca (1980). The vegetation ranges from sparse to extremely dense. *Coccolobia uvifera*, *Stumphia maritima*, and *Casasia clusiaefolia* are most abundant on the offshore cays. San Salvador is comprised of limestone rock and contains several

inland hyper-saline lakes surrounding smaller islets.

Our research was conducted on Manhead and Green Cays, two satellite islets off the north end of San Salvador, and on Guana Cay, in Hermitage Lake in the northeastern portion of San Salvador. The area of Manhead Cay is 3.0 ha, Green Cay covers 4.8 ha (Gicca 1980), and Guana Cay is <1 ha (Ostrander 1982). The vegetation on Green Cay and Manhead Cay is relatively sparse. Guana Cay is much more densely vegetated.

MORPHOLOGICAL MEASUREMENTS

The iguanas were captured using a monofilament noose attached to a 2.7 meter fishing rod. Following capture, we determined the gender by probing to detect the presence of hemepenes in males. Head length, snout-vent length, and tail length were measured. Measurements of mass were taken of some iguanas. (Due to a malfunctioning scale, mass was not always measured.) Femoral pores and dorsal crests were counted. Unusual features that may relate to social interactions, such as regenerate tails, injured digits, and missing dorsal crests, were noted. The animals were marked with a pair of color-coded plastic beads, sutured to the dorsal crest (Rotta et al. 1988). This will enable future population studies to be based on percentages of animals marked (Lincoln-Peterson method).

After all procedures were completed, the iguanas were released in the approximate area of capture.

GENETIC MEASUREMENTS

Blood samples were obtained by clipping up to three toe nails. The ensuing blood was collected in heparinized capillary tubes which were immediately placed on ice.

The blood samples were collected to compare the genetic material of the three populations.

RESULTS

Figure 1 shows head length, snout-vent length, and tail length. It indicates that for all measurements the iguanas on Manhead Cay tended to be the shortest and the iguanas on Guana Cay tended to be the longest. Table 1 shows that each of these measurements is significant.

Additional morphological data are given in Table 1. As with the measurements of length, the average mass of Green Cay iguanas was greater than the average mass of Manhead Cay iguanas. The variance of injured digits was insignificant between these populations when considered together, but it may be significant between individual populations. The variation of missing dorsal crests was significant. However, the numbers of dorsal crests, femoral pores, and regenerate tails were insignificant.

Blood samples are currently at Loma Linda University in Loma Linda, California awaiting tests involving polymerase chain

reactions (PCR) and RAPD analysis. No specific data have been obtained to date.

DISCUSSION

The significant measurements of snout-vent length, tail length, head length, and total length indicate morphological polymorphism between the three populations. This data may support our hypothesis that gene flow between populations has been limited. More specific answers will be obtained upon completion of the genetic analysis.

The insignificant variance of the number of femoral pores and dorsal crests suggests that polymorphism between populations is not present for these characteristics. Of the characteristics possibly resulting from social interactions, the variation of regenerate tails and injured digits is insignificant. The variation of missing crests is significant and directly correlates with animal size. These data could be a result of the disproportionate male/female ratio captured on Green Cay (although the ratio captured seemed reflective of the population).

The objectives of this research have not yet been fulfilled. Genetic analysis has not begun. Therefore no limitations in gene flow have been detected. The marking has not yet aided other researchers in population studies.

Future studies should primarily involve an expansion of our original work. The islands studied should be revisited. There, percentages of marked specimens among the total observed can indicate population numbers. More specimens should be processed, especially on Guana Cay, to get larger sample sizes. In addition, iguanas on other cays should be captured and analyzed to compare with results from the first three cays. Due to the intervening time since other studies have been conducted, population estimates should be made and compared with past studies to determine population trends.

We believe that our research may indicate restricted gene flow between the San Salvador iguana populations. Limited gene flow could increase the likelihood that disease could destroy a population. Hurricanes, introduced vegetation, and the introduction of feral creatures to the populated islands could quickly eliminate the iguana populations as well.

Although *Cyclura r. rileyi* is not yet known to greatly benefit man, these iguanas should be protected to preserve their genetic information and their niche in the environment. The extirpation of a species before its importance is understood is a risk too great to leave to chance.

Table 1.

Morphological data collected on *Cyclura r. rileyi* on/near San Salvador.

Measures	Manhead	Green	Guana	P-Value
<n>	11	12	5	
Sex (M/F)	(6/5)	(11/1)	(2/3)	
Mass (g)	10.0±2.4	23.8±1.6	NA[1]	
SVL (cm)	20.0±0.9	25.5±0.7	30.3±2.0	0.0001[2]
TL (cm)	25.6±1.6	25.6±1.6	43.4±1.7	0.0001
HL (cm)	3.64±0.1	4.78±0.1	5.70±0.5	0.0001
Total Length (cm)	45.6	51.1	73.7	
Femoral Pores	43.9±0.7	43.4±0.8	45.0±0.4	0.4592
Dorsal Crests	16.8±0.8	15.9±0.4	16.0±0.6	0.610
Injured Digits[3]	(3/11)	(7/12)	(0/5)	0.055
Missing Crests	(1/11)	(3/12)	(4/5)	0.014
Regenerate Tail	(4/11)	(3/12)	(1/5)	0.747

[1]Not available.

[2]All P-values reflect probability of the three values occurring concurrently with each other by chance.

[3]Values given reflect (Number Affected/Total Captured on Island) for Injured Digits, Missing Crests, and Regenerate Tails.

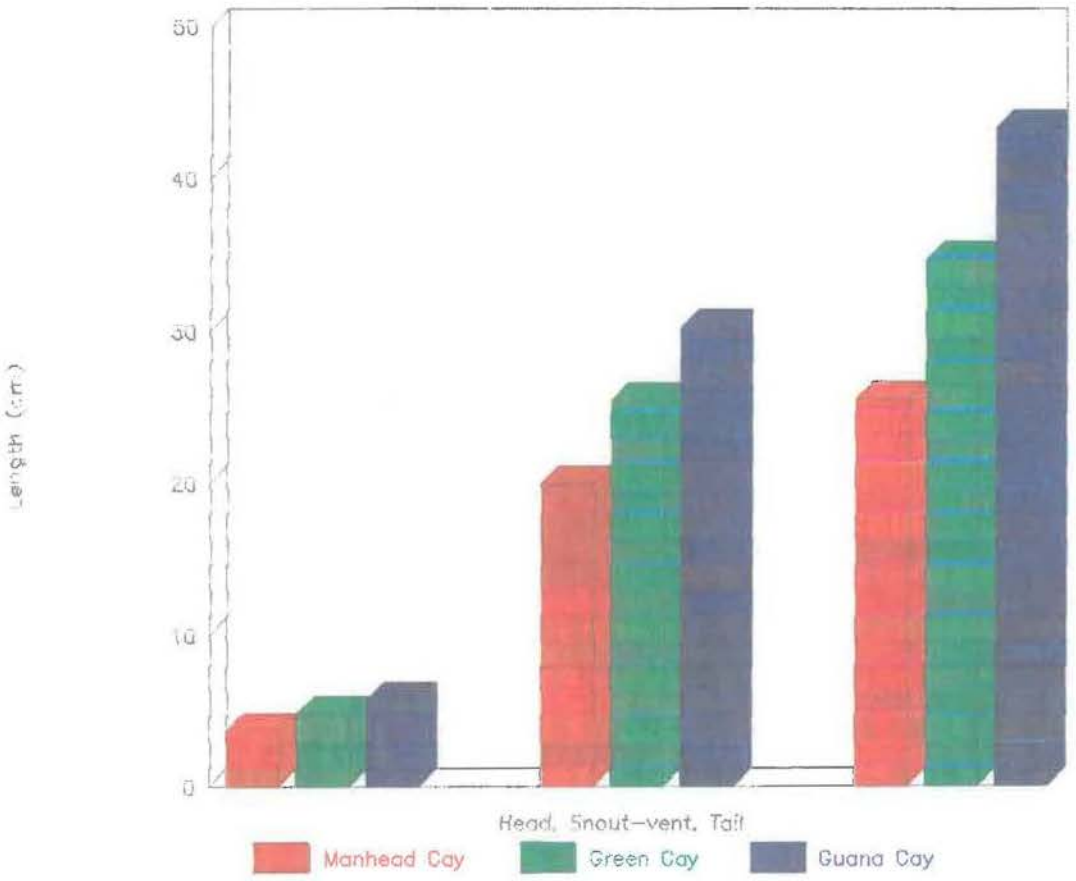

Figure 1.

The above graph shows the head, snout-vent, and tail lengths of *Cyclura r. stileyi* on the various Cays studied.

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SOUTHERN SCHOLARS SENIOR PROJECT

Name Brent Goodge

Major Biology

Please describe in as much detail as you can the project you will undertake:

Bahamian iguana studies

Morphological

Genetic

Populations

Expected date of completion DONE (May '94)

Signature of faculty advisor William K. Hayes

To be signed upon completion and approval of faculty advisor

Advisor William K. Hayes

Chair, Honors Committee Dr. Mildred McClary