GUANA
2008

JAMES LAZELL

The Conservation Agency

Exploration, Education, and Research

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10 June 2009

Dr. Henry Jarecki, Chairman
The Falconwood Foundation
10 Timber Trail,
Rye, NY 10580

Dear Henry,

It has been an exciting year with colorful results. Early in October came the discovery of the virtually complete Taino skeleton and the near-perfect Taino bowl (see Archeology). Then there was Hurricane Omar (see Ornithology). I love the stories of Barry Valentine's (in Entomology) about the serendipitous discovery of a new, tiny, parasitic bug and the dark-of-the-moon insect flights and crab migration. A lot got published, most notably the gorgeous article on Guana herpetology that finishes up this report. It is finished up itself by the writings of three of the youngest members of the October field crew. Here is summary of the contents of this report, with page numbers top right, as usual.

ENTOMOLOGY

ORNITHOLOGY

Most of this year's scientists were aware of the cutback in bednights for 2009 and were concerned for the future of their projects. So most have directly addressed the issue of ongoing research in their reports. After nearly 30 years, Guana is one of the few long-term, ongoing research sites in the biological realm. We all feel it is critically important to continue. We hope to convince you of the vitality of our work and of our enthusiasm for it. Let's confer on Island in October.

All the best,

Skip

James Lazell, Ph.D.

COVER STORY

Photo by Clint Boal

This adult male Black-throated Blue Warbler (*Dendroica caerulescens*) was in full breeding plumage, presumably right down from his breeding grounds. He was the sixth known record for the entire BVI, and only the third actually caught. (The first was seen on Anegada in 1970.)

In my book *Island...* (2005), I discussed research on stable isotopes of carbon and hydrogen assayed from Black-throated Blues' feathers that corresponded - at least roughly - to the geographic origin of each feather, which would be on the birds' breeding grounds, where they molt and regrow their plumage. The preliminary research indicated that the northernmost breeders, from Canada, wintered farthest west, in Cuba. That research was published in 2002 and no one had captured a Black-throated Blue east of Puerto Rico. So I speculated that ours in the BVI might well show the isotopic profile of the southernmost breeders, from Georgia.

Alas, Dr. Clint Boal reports that, in the intervening seven years, the isotope analyzing team seems to have given up and dispersed, so we need to find someone to take up this project anew. Clint is looking.... Meantime, where this rare bird came to Guana from remains a mystery.

ARCHAEOLOGY 2008

Guana Island
Elenan – Ostionoid Bowl - ca. AD 900 to 1200
STP 85. 15N / 25 W - 27 CMBS
October 6, 2008 Found by Josh Kehrburg
Rarely found intact in test pits

GUANA ISLAND REPORT-2008
By Elizabeth C. Righter

The project began on October 4, 2008 and ended October 17, 2008. leaving a short space of time to accomplish our goals. One of these goals was to complete a geomorphological study of the flat or prehistoric site on the flat. I, as leader, had hypothesized that there were old secondary dunes that delimited the western border of the site and were the reason that the site did not extend into the area presently occupied by tennis courts and a bathhouse. Even though there presently was a gut or small water course extending from the pond to the salt water body where the present dock is in use, I believed that, during prehistoric times, this dock and the area immediately southwest of the gut were not in use by prehistoric people.

Toward this end we invited John Foss, a well-known geomorphologist, to accompany our team for a week in the field. It is becoming more and more common for scientists from other fields to join archaeologists and to contribute to their research. John pretty much seemed to know what he was doing and went his own way. I have not yet read the full results of his study but at quick glance, I imagine that it did not address or answer issues re settlement by prehistoric people; and that we will necessarily need to use a different technique if, indeed, my hypothesis is correct

Dr. James Lazell believes that the reason for the prehistoric settlement pattern on the flat and the timing of settlement had to do with the availability of potable water. This is still a possibility, but I believe that each island in the archipelago is different from the others and even, as demonstrated by Desmond Nicholson on Antigua, two sides of an island can have different very long histories. Therefore using data from another island or area of the earth is not adequate for reaching conclusions regarding the availability of potable water to people in one area of a Caribbean island. It is also possible that Guana Island was first used for day trips (potable water was brought by canoe in jugs) and later for habitation.

Joshua Kehrburg, of our team proved to be almost magic in that during our shovel testing of an area (a hit or miss operation at best) he managed to find an almost totally intact bowl which by its decorative features could be dated to between A.D. 1100 and A.D. 1400, and the first prehistoric human skeleton found on Guana Island. Because of concern about removing a skeleton from Tortola (a British protectorate) we made our first ever tactical error and did not realize that many physical anthropologists might be anxious to come to Guana Island to study the skeleton in situ. Also, we were concerned that, given the use of the area for resort purposes, we may never find the skeleton again. We quickly removed the human bones from their resting place, wrapped them in foil and noted their location in the ground. The head had been deformed—a practice common on some islands in the Caribbean.

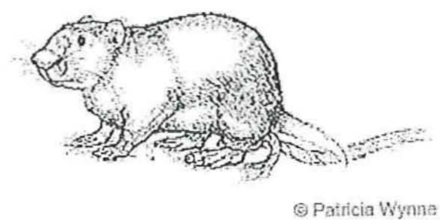
The bowl and the skeleton were found near each other, on the edge of the woods on the flat south of the southernmost road by the beach, which extends along the southwestern edge of the flat. In a paper, written by the present author in 2007, Righter also hypothesized that social change was in large part responsible for the timing of the use of the flat by prehistoric people. It is most likely that several factors came together at once to make Guana island a favorable place to live. We plan to excavate the area where the bowl (Figure 1) and the skeleton were found, in order to determine the relationship between houses and burials as well as the lay-out of the houses. Although the topmost soil layers of the flat at Guana have been disturbed, Guana Island is unique in that south of the southern road, the ground has not been disturbed and it will be possible to determine relationships between items, relationships that have been lost in more developed areas. Even though the focus of studies on Guana Island is primarily biological, humans are in fact animals and therefore part of the island's biological evolution. Also, more importantly, the undisturbed middens and remains of human activities at ca. A.D. 1100-1400 still may be found and help to verify the original flora and fauna of the island.

Dave Dennis took photographs of the bowl that Joshua Kehrburg found in test pit number 85. He neglected to include a scale bar which may be found only in one cluttered and unacceptable picture of the bowl. I had been laid up with stenosis and was getting ready for an operation so that I did not oversee the picture taking. I had an operation in late October and have been in the hospital or rehabilitation ever since. Our house is not set up to meet requirements of an invalid and so it is difficult to get anything done.

We hope to go back to Guana when I have recovered; and with a larger crew, finish up our work to document the disturbances to the land on the flat and perhaps provide insights to the way of life of prehistoric people on Guana Island.

Archaeology

Puerto Rican hutia (*Isolobodon portoricensis*)



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The Puerto Rican hutia was an important food source for the Amerindians for thousands of years, and survived until at least the arrival of early European explorers – Christopher Columbus and his crew are believed to have eaten the species on several occasions. The species declined following European colonization of the West Indies. It is unclear whether it survived for long after the early introduction of black rats by the first European settlers around AD 1500, although it may have been finally wiped out by introduced mongooses in the nineteenth or early 20th century.

From: "Samuel Turvey" <sam_turvey@hotmail.com>
To: <bobbfly@aol.com>
Sent: Thursday, September 25, 2008 5:16 AM
Subject: RE: (no subject)

Dear Holly,

Sorry for taking so long to get back to you, and also very sorry to hear that you are not well. Yes, I would certainly be willing to have a look at any new bones you've found from new excavations on Guana - please go ahead and send them to my Institute of Zoology, Zoological Society of London work address. I will be conducting fieldwork for the next two weeks in China (more extinct dolphin stuff - all very depressing), so sadly I won't be able to make it to Guana this year. Also, please let me know the best address to which I should send the Guana bones of yours that I have here.

Let's also press forward with preparing a short paper on the Isolobodon 14C dates from Guana and the weird archaeological setting up in that Bat Cave, maybe for Carib. J. Arch. Sci. or something similar?

All the best,
Sam

From: Bobbfly@aol.com
Date: Fri, 5 Sep 2008 10:29:17 -0400
Subject: (no subject)
To: sam_turvey@hotmail.com

Hi Sam: How disappointing about the bones from Guana pits, but interesting news about the Isolobodon bone in the cave. I wish we knew more about the use of the island after the Quakers left and also between the Indians and the Quakers. There seems to be so much disturbance.

I wonder,.... would you be willing to look at a few more bones that we dug up last summer and that we will this October (are you coming this year?)?. We have one large bone that I think is modern (pig etc ??) and some large bird bones. Maybe they will be in better condition than the last group. I have not done much Guana work because I have been doing physical therapy most days and time just flies. If you are willing to look at a few bones (about 10 or so), please let me know where and how best to send them. Thanks a lot, Holly

PS Thanks for your info

B+B Valentine

From: B & B Valentine [bv@nwcs.com]
Sent: Monday, March 09, 2009 3:40 PM
To: Wenhua Lu
Subject: Some current projects

9 March, 2009

Skip: here are details for five of our projects (in random sequence). They all depend on our ability to distinguish small, cryptic species in the field, a skill which has taken years to develop. We are just reaching the point where we can go into the field and distinguish and identify the myriads of very small species which dominate the fauna. The next five years will enable us to work more effectively with live organisms in natural surroundings. I know you realize that a survey involving over 1500 species is never complete, especially when most are small to minute and when each does its own thing; however, we have an unparalled opportunity to work toward an understanding of tropical diversity and ecological interaction. This starts with an inventory and knowing the cast. No island in the world the size of Guana is so well documented.

Scolytidae (bark beetles). These are major infestors of healthy or diseased trees, and when abundant, kill large patches of forest. We have tracked Guana scolytid populations for ten years (1999-2008). One group excavates and feeds in complex tunnels under the bark and interrupts sap flow; a second group carries fungus spores from tree to tree, constructs complex galleries, and feeds on the resulting fungus garden. In either case, the tree usually dies. Our pinned collection of these pests has a surprising 15 identified species, plus 2 doubtfulls, and series of specimens - some of which are still on loan to specialists. The collection documents progressive increase in individuals and diversity from 1999 through 2004, followed in 2005 by loss of three species, but more specimens of the others, and then decreases in both diversity and abundance from 2006 through 2008. No species has been found every year, and the rarest species were almost entirely confined to 2004 and 2005; thus these two years were 2 to 4 times as productive as any others, depending on the species involved. Reasons for these fluctuations are not clear-cut, but weather and competion are intellectual candidates. We have not yet studied intra- or inter-species competition, but suspect it occurs. Weather remains to be investigated. Our inventory (several hundred specimens) is almost certainly incomplete.

Fulgoroidea (plant hoppers). Bartlett's 2000 paper on the Guana fauna lists 27 species of these plant juice suckers and he writes he has a 28th. Availability of a reference by an authority has provided the stimulus to investigate what was for us an unfamiliar group. We have now found an astonishing 40 species, and each year we find more. The past efforts have been strictly inventory oriented because many of the species (all small to very small) were, for me, mostly indistinguishable in the field. I can now name most of the species on sight, so Bartlett and I are working on a restudy of the fauna, and I am spending alot of time and effort in preparation. He and I know of no island like Guana with so diverse an assembledge.

Blatteria (roaches). Four species of Guana roaches are world-wide associates of humans. The remaining 20 species are, for most people, rarely seen woodland inhabitants that usually avoid human activity. Wenhua and I are working with Perez-Gelabert of the Smithsonian on a summary of our species. This project is in manuscript and seriously close to completion.

Carabidae (ground beetles). This is one of the more diverse families of beetles on Guana (and in the World), with an unlikely mixture of fast-running predators and seed eaters. The world authority for this family, Dr. G. E. Ball, is interested in our work, and is supplying identificatioins and other data for our species. We are in the advanced inventory stage, and finally able to investigate biology and behavior.

Cerambycidae (long-horned beetles). This large family is almost entirely confined to species which bore and feed in tree trunks and branches. The attacks weaken the host, and can be lethal. Guana has 22 species, and six others occur on nearby islands (five on Tortola) and are expected. About half of the species come to ultra-violet light, but the others are seldom seen and difficult to collect. These are prime candidates for multiple-visit studies because you never find all of the species in one year, numbers fluctuate wildly from year to year, and unfamiliar species continue to turn up. An understanding of population dynamics is developing, but requires alot more work and time.

WebMail - 2008 report

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Date Sent: Sunday, February 08, 2009 4:59 PM
From: "B & B Valentine" <bv@nwcs.com> Add to Address Book
To: Wenhua Lu <wenhua@etal.uri.edu>
Subject: 2008 report
Status: Urgent New

5 Feb., 2009
Skip and Wenhua:
Greetings! Here is an overview of this past October, 2008.

BLATTERIA and ISOPTERA (roaches and termites). I'm combining these because of neat findings by Barbara Thorne. In 1993 she found an unusual roach in the galleries of the rare (on Guana - only two nests, but common on other islands) Nasutitermes costalis (Holmgren). We still have not been able to identify this unique roach. This year she checked for more but none were found. There is a second, common species of Nasutitermes on Guana: acajutlae (Holmgren), so she checked it and found a small, diverse fauna of guests: 7 juveniles of a different roach: Euthlastoblatta facies (Walker), adults of which appear regularly in our Malaise traps, also one silverfish (Thysanura), one immature bug, 1 dealate queen ant, 1 larval dermestid beetle, 1 small adult zopherid beetle, and 2 small spiders. At present, we do not know the significance of this diverse assembledge, and hope Barbara can continue to investigate. The diversity of our roaches is a continual surprise. Four roach species, all world-wide, are associated with human activity on Guana, and our total fauna is now up to at least twenty. In 1994 Roth reported only 8 species from Guana, so long-term studies make a difference. I assume Wenhua and Barbara have more complete and current information.

ORTHOPTERA (grasshoppers, crickets, and relatives). These provide a mixture of enthusiasm and frustration, sparked respectively by Dave Dennis and Dan Otte. Dave, who I have known since 1960, is an outstanding herpetologist-naturalist-photographer-artist with a

special gift for field work. He and Wenhua started collecting at night with headlamps, and the results were the
best collections yet of crickets, katydids, and grasshoppers, the first two active at night, the
latter sleeping on vegetation. We now have: Gryllidae (true crickets) - 12 BVI species, 10 on Guana;
Tettigoniidae (katydids and long-
horned grasshoppers) - 8 BVI species, 7 on Guana; Gryllacrididae (odd
cricket relatives) - 2 on Guana, and unknown on rest of BVI; Acrididae (locusts and short-horned
grasshoppers) 11 BVI species, 10 on Guana. In 2005 I stimated we totaled 14 genera and 19 species, now we have
approximately 29 genera and 33 species. Of the 33 species, Guana has 29; the maximum for any other
BVI is 4 on Tortola.
The family Gryllidae remains the principle problem. In 2005 we loaned
our entire collection of 230 BVI crickets to Dr. Dan Otte of the Academy of Natural Sciences of Philadelphia,
who was writing a synopsis of the Caribbean cricket fauna. Because he is the world authority, I
suggested he could retain most of the specimens IF he returned an identified set for our reference. We now have
none of these specimens, no evidence of progress, and no answer to recent e-mails. Subsequently, we
have collected 200+ additional crickets, but of course have no firm identifications. Otte will not see
these until he returns a set from the first lot.

PHASMIDA (walking sticks). Our five species are being studied by Wenhua.

MANTODEA (praying mantids). Our BVI mantids have four distinct color
patterns, two of them on Guana. I suspect two sexually dimorphic species are involved, one on Guana,
Tortola, and Little St. James, and the other on Tortola, Moskito, and Anegada. With no useful literature on
hand, this is at best a guess. I have not found an expert to identify this fascinating group.

DERMAPTERA (earwigs). We have found three species in the BVI, one on Guana and two on Tortola.
This is the only insect order where at present, another island has more
species than Guana! Our specimens have not been identified.

HOMOPTERA (leafhoppers, aphids, scales, etc.). The planthoppers are
turning into a fun group despite
the fact I knew nothing about them previously. Dr. Charles Bartlett, an
authority, was a great help; however, we now disagree on several matters, and the resulting questions remain
unresolved. He worked with fresh specimens, mine were in alcohol, and especially

those in the family
Flatidae, were discolored. He assumed (correctly) that some of my flatids were faded by differing immersion times
and lumped them. Despite the fadeing, I thought some were different, and in subsequent years concentrated
on getting fresh specimens
which, as it turned out, supported my view. So, Bartlett collected 28
species on Guana, some unknown to me, and I assume we have 34 to 38 species, some unknown to him. This is
not very satisfactory, but identifications require males, and sometimes side-by-side comparison with
the original old type specimens scattered in various European museums. We hope to get together and resolve
our differences, but even then there will be unanswered questions.
We continue to survey other homopterans, but they have not yet been
identified. We expect the huge family Cicadellidae will be next, and are trying to eliminate the delays.

HEMIPTERA (true bugs). Like the Homoptera, for me this has been a
peripheral group. Now, Tom Henry (a world authority) and Al Wheeler (a close second) are providing unlimited
resources and new prospectives.
It is a pleasure to have them on board. I'll leave the species lists for
them; however two items require separate mention. On 20 October, Susan was collecting on Great Camanoe and
picked up a common mantispid (Neuroptera: Mantispidae). We kept it for the island record, and
for comparison with Guana specimens (they are the same). After mounting it, I brushed it off but a
tiny fleck of "dirt" remained stuck to the abdomen. Not to be outdone by frass less than 1mm in diameter, I
brushed it again. Still stuck. Try again. Still stuck. Check with microscope. It has legs! But the
legs do not touch the mantispid. Try the other end. The mouth-parts (a minute beak) are embedded in the
mantispid abdomen. The speck is a weird predatory blood-sucking bug. With perfect timing, Tom and Al
walk in, take turns at the microscope, and decide it is a species of the rare family Schizopteridae.
It is a neat coincidence that Tom had published on this seldom seen group, so I gave the specimen to him. I
trust he can provide additional details.
The second item involves some of Lianna's pets, the aquatic bug family
Corixidae (water boatmen), which live in the Salt Pond. We have from time to time found occasional
specimens of Trichocorixa at our blacklight which runs every night on our porch on Upper Camanoe. On the night of 28
October, we returned from Barbara and Ed's beach ceremony and found under the porch light a seething

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pyramid of live Trichocorixa which covered several square feet. We sampled representative sections and
the minimum estimate was
50,000 individuals! Later we learned that on the same night, in Crab Cove,
the land crabs migrated by the hundreds back to the water to lay their eggs. Why 28 October? Checking
reveals that 27/28 October was the dark of the moon, and we had witnessed a rare "flight night" of corixids,
and a better-known "oviposition migration" of land crabs. Depending on weather, moon phases can be
critically important for night-time zoological work. Dark of the moon is best, but full moon works for some
groups. Insect flight nights are very rare, and usually only a fraction of the resident species are involved.
However, in Fortin de las Flores, Mexico, in 1959, Buena and I experianced an extraordinary flight night of hundreds
of insect species of all kinds and sizes, and uncountable thousands of individuals, attracted to our motel
porch light, forming a huge pulsing mound, and covering the walls. We get the impression that when conditions
are perfect, everybody does it, otherwise none, one, or a few species get involved. On Guana we have kept
track every year, but wind, rain, and/or lowering temperature have cancelled most flight nights. For
example, last year, dark of the moon (11 October) was windy, we collected three beetles at light. In 1999, dark of
the moon (9 October) had heavy rain and no insects. In 2000, dark of the moon (27 October) had wind followed
by heavy rain. In 2004, dark of the moon (13 October) was hot and still with many individuals, but poor
diversity. In the other years, conditions appeared suitable, but nothing happened. In our ten Octobers on Guana, we
have not yet had a major multi-
species flight night. Perhaps other months?

NEUROPTERA (ant lions and lace wings). This was a normal year for neurops, with no new faces. We are now checking the entire ten-year collection (about 500 specimens) for the
schizopterid bug mentioned above. Nothing yet.

COLEOPTERA (beetles and true weevils). This is the best-known order on Guana, with well over four hundred species, but new faces turn up and abundance patterns change every
year. Unfortunately, we can not distinguish new arrivals from those previously overlooked. 2007 and
2008 were carabid years, with almost 250 specimens at our black light. The largest single days were 27/28
October, 2008. The family Añobiidae is a very large group of very small beetles, most in the 1.5 to 2.0mm range;

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a big one is 2.5mm. This year we found a "huge" species, 5mm long, which may be undescribed. We can not settle the question because the only other very large species (found in the Bahamas) is too poorly described and specimens are not presently available. Scarab beetles are also producing novelties. In Skip's book we listed 5 Guana species in the subfamily Aphodiinae, only 2 in my collection. I now have 10 species, 8 from Guana, 1 from Tortola and 1 from Anegada. In the subfamily Melolonthinae (June-bugs) we had 3 species, and now have what appears to be 6, all from Guana. Other beetle families are also adding species, but the accumulation rate is now very slow.

DIPTERA (true or two-winged flies). Although one of the larger orders on Guana, flies are among the least known. We are accumulating specimens, but there is a shortage of people to work on them. Horse flies (family Tabanidae) were abundant this year so we kept a series. Since only females bite, I checked the sex ratio and found 5 males to 103 famales, and as usual, all the same species. However, a few days after the hurricane, one female of a second species turned up. If she laid eggs before our encounter, we now have another pest. When Evenhuis and Miller (1994) published on the bee flies (Bombyliidae), they recorded 5 species on Guana, and a sixth on Tortola. We have 9 species from Guana and a tenth from Tortola. I asked Miller for identifications; he recommended we contact Evenhuis who is the main authority on the group; and Evenhuis declined because he already had too many projects. This is a frequent problem, so names will have to wait. Other flies are acumulating and slowly being sorted to family.

HYMENOPTERA (parasitic wasps, and aculeates: ants, bees, and true wasps). Worldwide this order has about 48 families of parasitic wasps and about 37 families of aculeates. Although many do not occur in the Antilles, or even in the New World, we suspect perhaps half of these families may occur on Guana. The unexpected death of Roy Snelling has left a major void. His inventory of the Guana aculeate fauna is more diverse than ours. For example, he had 5 families, 12 genera , and 17 species of Guana bees, we have 5, 8, and 12 respectively. He lists 24 species of ants, we have the same number, but the species representation is different. Present totals indicate 19 families of parasitoids (genera and species unknown), and 14 aculeate families (with 88 species). Completing this inventory is our largest future project.

There are a few small orders which we have not mentioned because there is nothing new to report. Please feel free to request additional details. Barry

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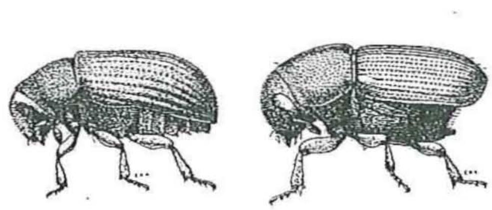
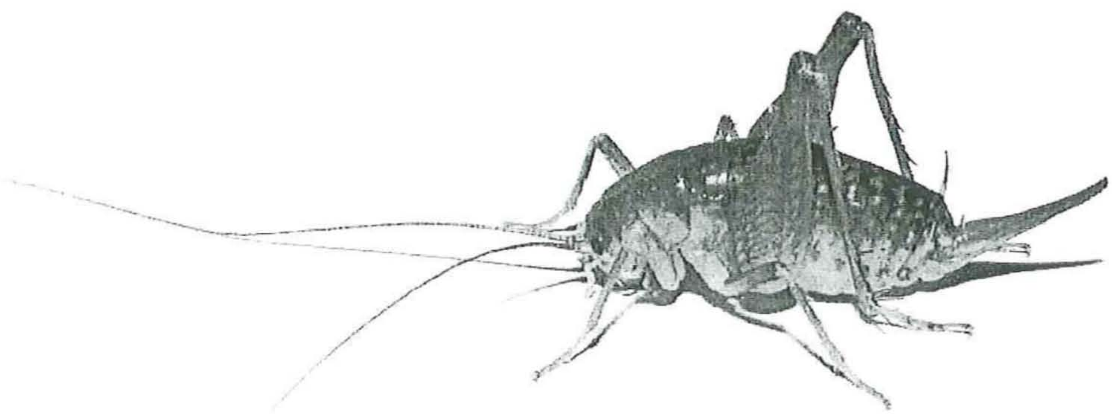


bark beetles (Scolýtidae).



Orthoptera: Gryllacrididae

Preliminary List of the Heteroptera Collected on Guana Island Oct. 2007-2008, based on Henry, Wheeler, and Valentine collections

ENICOCEPHALIDAE:

1. Species 1, prob. new

ALYDIDAE:

1. *Burtinus luteomarginatus* Maldonado
2. *Esperanza texana* Barber
3. *Megalotomus pallescens* (Stål)

ANTHOCORIDAE:

1. Species 1
2. Species 2
3. Species 3
4. Species 4

BLISSIDAE:

1. *Blissus* sp., prob. *antillus* Leonard

COREIDAE:

1. *Catorhintha* sp.
2. *Chariesterus* sp.
3. *Cebrinis* sp., nr. *cauta* Brailovsky
4. *Leptoglossus zonatus* (Dallas)
5. *Leptoglossus* sp.

CORIXIDAE:

1. *Trichocorixa reticulata* (Guerin-Meneville) (Jarecki, *In* Lazell 2005)

CYDNIDAE:

1. *Amnestus pusio* (Stål)
2. *Corimelaena cognata* (Van Duzee)
3. *Rhytidoporus identatus* Uhler
4. *Tominotus communis* (Uhler)

GEOCORIDAE:

Geocoris sp., prob. uliginosus

HEBRIDAE:

1. Species 1

LYGAEIDAE:

1. *Kleidocerys virescens* (Champion)
2. *Nysius scutellatus* Dallas
3. *Ochrimnus henryi* Brailovsky
4. *Oncopeltis aulicus* (Fabricius) (Lazell 2005).
5. *Xyonysius californicus* (Stål)

MIRIDAE:

1. *Dagbertus olivaceus* (Reuter)
2. *Dagbertus semipictus* (Blatchley)
3. *Diphleps* sp., prob. *maldonadoi* Henry
4. *Eustictus brunnipunctatus* Maldonado.
5. ***Cyrtocapsus* n. sp.**
6. *Engytatus modestus* (Distant)
7. *Macrolophus* sp. 1
8. *Macrolophus* sp. 2
9. *Nesidiocoris tenuis* (Reuter)
10. *Paracarniella puertoricensis* Henry and Ferreira
11. *Phytocoris brunneus* Maldonado
12. *Proboscidotylus nigrosquamus* Maldonaldo
13. *Pseudatomoscelis seriatus* (Reuter)
14. *Pycnoderes heidemanni* Reuter
15. *Reuteroscopus hamatus* Kelton
16. *Rhinacloa basalis* (Reuter)
17. *Rhinacloa forticornis* Reuter
18. *Rhinacloa pallipes* Maldonado
19. *Rhinacloa* sp.
20. *Trigonotylus tenuis* Kirkaldy

NABIDAE:

1. *Nabis capsiformis* (Germar)
2. *Arachnocoris berytoides* (Uhler) (Lazell 2005)

NINIDAE:

1. *Cymoninus notabilis* (Distant)

OXYCARENIDAE:

1. *Oxycarenus hyalinipennis* (Costa)

PENTATOMIDAE:

1. *Banasa herbacea* (Stål)
2. *Bericynthes hastator* (Fabricius)
3. *Brepholoxa barberi* Rider
4. *Caribo fasciatus* Rolston
5. *Chinavia wygodzinskyi* Rolston
6. *Cyptocephala antiguensis* (Westwood)
7. *Edessa* sp.
8. *Euschistus* sp. (shiny brown)
9. *Euschistus* sp. (dull brown)
10. *Euschistus crenator* (Fabricius)
11. *Loxa viridis* (Palisot de Beauvois)
12. *Mecidea longula*
13. *Mormidea* sp.
14. *Oebalus pugnax* (Fabricius)
15. *Proxys victor* (Fabricius)
16. "*Tepa*" sp.
17. *Thyanta testacea* (Dallas)
18. *Vrelsirea violacea* (Fabricius)

PYRRHOCORIDAE:

1. *Dysdercus andreae* (Linnaeus)
2. *Dysdercus* sp. 2

REDUVIIDAE:

1. Emesinae sp. 1 (small)
2. Emesinae sp. 2 (large)
3. phymatid nymph (Macrocephalinae)
4. *Zelus longipes* (Linnaeus)

RHOPALIDAE:

1. *Jadera antica* (Walker)
2. *Liorhyssus hyalinus* (Fabricius)
3. *Niesthrea sidae* (Fabricius)
4. ***Niesthrea* n. sp.**

RHYPAROCHROMIDAE:

1. *Bubaces uhleri* (Distant)
2. *Neopamera albocincta* (Barber)
3. *Neopamera neotropicalis* (Kirkaldy)
4. *Neopamera* sp.
5. *Ozophora divaricata* Barber (Lazell 2005)
6. *Ozophora quinquemaculata* Barber (Lazell 2005)
7. *Ozophora* sp. (small species)
8. *Paromius dohrni* (Guerin)
9. *Prytanes* sp.
10. *Pseudopachybrachius vinctus* (Say)
11. lethaeine at light

SALDIDAE:

1. Species 1

SCHIZOPTERIDAE:

1. Species 1

SCUTELLERIDAE:

1. *Diolcus* sp. 1
2. *Tetyra antillarum* Kirkaldy

TINGIDAE:

1. *Corythaica carinata* Uhler (Lazell 2005) (slender sp. on *Desmodium* vine)
2. *Corythucha gossypii* (Fabricius)
3. *Leptopharsa* sp. (slender sp. on tree)
4. *Pseudocysta perseae* (Heidemann)
5. *Teleonemia* sp. 1
6. *Teleonemia* sp. 2
7. *Vatiga manihotae* (Drake) (cassava)
8. Tingid sp. 1

Preliminary totals for 2007

Henry and Wheeler collections: 61 spp.
Valentine collections: 28 spp.
Lazell (2005) listed one species not so far collected (Arachnocoris).

Total listed in 2007: 89 species in 22 families

Added 11 new records in Oct. 2008

Total for 2008: 101 species in 22 families.

Additions in 2008:

1. *Dagbertus semipictus* 5-10 ok Adults (flowering tree–see sample)
2. *Geocoris* sp., prob. *uliginosa* (under mats of Bermuda grass)
3. *Prytanes* sp. (at light)
4. Black lygaeine (at light and on host, with immatures– *Ochrimnus henryi* Brailovsky
5. *Lethaeine (at light)*
6. *Proboscidotylus nigrosquamus* (at light)
7. Additional tingid on *Piscidia*??
8. *Sthenaridea basalis* (on grass heads)
9. *Leptoglossus* "*phyllopus*" (on guava fruits).
10. Additional *Rhinacloa* sp. (at light)
11. Additional species of *Ozophora*.

Butterflies: Richard Lutman

Guana Island Butterflies (10/21-10/26, 2009)

Butterflies in Becker and Miller's Original Publication

PIERIDAE
Appias drusilla
Ascia monuste virginia
Eurema elathea
Appias drusilla boydi
Eurema lisa eutrepe
Phoebis sennae sennae

NYMPHALIDAE
Biblis hyperia hyperia
Heliconius charitonius charitonius
Agraulis vanillae insularis
Junonia evarete
Danaus plexippus megalippe

LYCAENIDAE
Hemiargus hanno watsoni

HESPERIIDAE
Pyrgus oileus oileus
Cymaenes tripunctus
Hylephila phyleus
Polygonus leo savigny
Ephyriades arcas philemon

Butterflies Not collected

PAPILIONIDAE
Battus polydamus thyamus

PIERIDAE
Eurema elathea

NYMPHALIDAE
Junonia genoveva
Vanessa cardui

HESPERIIDAE
Chlorostrymon maesites maesites
Electrostrymon angelia boyeri
Strymon acis mars
Strymon bubastus ponce
Strymon columella colemella
Hemiargus thomasi woodruffi
Leptotes cassius catilina

HESPERIIDAE
Choranthus vitellius
Panoquina sylvicola
Wallengrenia otho druryi
Urbanus dorantes cramptoni
Urbanus proteus domingo

Butterflies not in Becker and Miller

NYMPHALIDAE
Anaea trolodyta
Anartia jatrophae saturata

PIERIDAE
Eurema Amelia
Aphrissa neleis

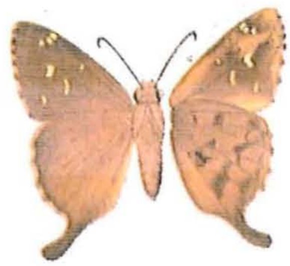
LYCAENIDAE
Brephidium exilis thompsoni

HESPERIIDAE
Urbanus obscurus

Anaea troglodyta

Eurema amelia

Brephidium exilis thomponsi



Urbanus obscurus

Anartia jatrophae saturata

Aphrissa neleis

Butterflies not in Becker and Miller

Seventeen butterflies were caught that were in Becker and Miller's original publication. Sixteen butterflies were not caught. There were six new butterflies that were not in Becker and Miller.

Common names not mentioned by Becker and Miller follow Riley.

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ORNITHOLOGICAL MONITORING AND RESEARCH ON GUANA ISLAND, BRITISH VIRGIN ISLANDS

PROJECT REPORT 2008

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Texas Tech University, Lubbock, TX 79409

29 April 2009

Black-throated Blue Warbler

ORNITHOLOGICAL RESEARCH AND MONITORING ON GUANA ISLAND, BRITISH VIRGIN ISLANDS: PROJECT REPORT 2008

Dr. Clint W. Boal, *USGS Texas Cooperative Fish and Wildlife Research Unit, Texas Tech University, Lubbock, TX 79409-2120*

INTRODUCTION

The Caribbean is an important region for neotropical migrant landbirds during their annual migration from North America to South America. While considerable research has been conducted on migrant ecology in the western Caribbean, comparatively little has been conducted in the Virgin Islands or east Caribbean (Wiley 2000). Thus, ornithological work on Guana Island makes substantive contributions toward a better understanding of the Virgin Islands as stop-over habitat for migrant birds (McNair et al. 2002, Boal et al. 2006, Boal and Estabrook 2007) and the basic ecology of Caribbean birds (Chipley 1991, Boal et al. 2006).

Components of avian research on Guana Island are 1) mist-netting and banding neotropical songbirds that migrate through the Caribbean region during the autumn migration, and 2) specific studies focusing on species resident to the island. Current projects on resident species are 1) a population demography study of bananaquits, 2) a study of distribution and habitat associations of mangrove cuckoos, and 3) monitoring distribution and relative abundance of resident species across the island. Despite curtailment of research activities for several days due to Hurricane Omar, progress on all components of the ornithological work were satisfactorily met during the 2008 Science Month. Here I provide data and discussion of the results of the 2008 field season, a review of research productivity stemming from avian research on Guana Island, and plans for the 2009 Science Month.

RESULTS AND DISCUSSION

Mist-Netting and Migrant Ecology

I conducted mist-netting from 8 to 29 October 2008. During a total of 460 net-hours I captured 274 total birds of 21 species (Table 1). This exceeds trap effort from all previous years, but overall capture rate (0.59 birds/net hr) was the lowest since 2003 when I took over netting operations (Table 2). However, diversity of neotropical migrants birds (10 species) was a marked increase over 2007 (3 species). The primary neotropical migrant was, as usual, the blackpoll warbler, of which we captured 57 individuals. This is fewer than last year, but still a respectable number, especially considering the disruptive influences on migration by weather associated with Hurricane Omar (Fig. 1).

There is little information available regarding age and condition of blackpoll warblers migrating through the Caribbean in general (e.g., Latta and Brown 1999) and the east Caribbean in particular. I examined data for blackpoll warblers banded on Guana Island from 2003 to 2008 to identify any possible patterns. I found that mass was significantly variable among years, ranging from averages of just over 9.5 grams up to almost 11.5 grams (Fig. 2). However, the range is from < 9 grams to > 14 grams, indicating the wide variation among years that is likely associated with weather conditions favoring or inhibiting migration. Concurrent with this is the significant variation in fat scores among years (Table 3). Fat is burned as energetic fuel, and the amount of fat birds have when arriving on Guana Island is indicative of the comparative ease or difficulty in the migration. Based on fat scores, it appears migration was more energetically taxing in 2003, 2004, and 2006 compared to 2005, 2007, and 2008 (Table 3).

Latta and Brown (1999) found no difference in age classes among migrant blackpoll warblers in the Dominican Republic. My data is consistent with theirs in that, although the trend appears to be for more young-of-the-year birds, there no significant difference in age classes among years except for 2007 (Table 4).

In Boal and Estabrook (2007) we provide evidence that Guana Island is important stop-over habitat for migrant landbirds based on mass gains observed among Swainson's thrushes during the unique fallout of the species in 2005. The substantial mass and fat gains demonstrated by two blackpoll warblers (Table 5) lends further credence to this assessment. This suggests that, physiologically, blackpoll warblers can make dramatic mass and fat gains in a relatively short time. However, is also indicates the value of Guana Island in providing high-quality stop-over habitat that allows the warblers to rest and recover during migration.

I am currently attempting to analytically assess annual species diversity and richness of neotropical migrant landbirds scaled to mist-netting efforts. I have to examine net locations and mist-netting efforts prior to my involvement in Science Month to insure consistency of net locations used in the data. I will then examine the data for correlations between species diversity and richness to weather patterns in the Caribbean and Atlantic seaboard. This may help explain patterns observed in the autumnal migration.

Surveys

I conducted an island-wide bird survey that has been repeated annually since 2006. The methodological approach is similar to that used by Arendt (1995) and Wunderle (2001) during previous surveys on Guana Island. By conducting this survey each Science Month, changes in species abundance and distribution across the island and over time may be detected. I have developed 60permanent survey points distributed along the Pyramid, Snake Transect, Lao Wei Ping, Long Man Point, Monkey Point, Sugar Loaf, and Palm Ghut trails, Quail Dove Ghut, and in the vicinity of the Hotel and the Flat. Due to weather conditions limiting research activities during one week, I was only able to conduct surveys at 53 of the points.

Compared to 2007, I detected fewer bananaquits this year (65 compared to 89) and fewer pearly-eyed thrashers (68 compared to 86). These two species remain the most abundant birds on Guana Island. Estimating population sizes is problematic due to differences in detectability of different species. For example, bananaquits were detected within the 25-m-radius perimeter of >60% of survey plots, whereas thrashers were detected within the 25-m radius at <40% of the plots (Table 6). Detectability of bananaquits beyond 25 m decreased dramatically (<10% of plots), whereas detectability of thrashers was > 50% (Table 6). However, this may be misleading in that thrashers are often secretive and may remain quiet when close to the surveyor and, hence, may have reduced detections. The only migrant detected on surveys was a few blackpoll warblers. I suspect this is because surveys were conducted prior to the arrival of Hurricane Omar and the subsequent arrival of migrants later in the month.

With the consistent survey methodology, population trends detected should be reflecting real changes in the populations of individual species. I am attempting to use program DISTANCE to calculate more rigorous and reliable density estimates of common avian species on Guana Island. This will likely be limited to bananaquits and thrashers due to sample size requirements of the program.

Bananaquit Demography

Since 1994, 784 bananaquits have been banded on Guana Island. To date, 160 of these birds have been recaptured at least once, and some have been recaptured several times. In total, there have been 429 recaptures of these 160 individuals. This is an incredibly robust data set which I will use to model sex- and age-specific survival rates for the species. I will also attempt to incorporate covariates of weather and climate factors to attempt to understand how global climate change may affect this species. If bananaquits are a suitable surrogate for other Caribbean birds, this may also allow broader predictions of the impact of climate change on Caribbean birds in general.

As part of this study, I am also investigating behavioral ecology and dispersal of bananaquits. To do this, I am banding bananaquits with unique color-band combinations. To date, I have color-banded 176 adult birds. This allows the identification of individuals without having to recapture them, and allows identification of mated pairs of birds and breeding territories, pair and site fidelity over time, and dispersal across the island. For example, I have also acquired visual recaptures of some individuals that are never physically captured again due to their dispersal to other areas of the island. Because I have found that bananaquits can live at least 8 years (Boal et al. 2006, unpubl. data), a demography study is necessarily an ongoing and long-term component of the ornithological research on Guana Island.

Mangrove Cuckoo Ecology

The lead field investigator for this project is Tracy S. Estabrook (M.S.). The mangrove cuckoo is one of the least-studied North American birds and baseline population estimates and habitat requirements have been identified as among the most important research needs for the species. In 2005 we initiated a standardized call-playback survey along trails on Guana to try to establish baseline information on minimum number of individual cuckoos, pairs, and/or family groups present. A call-playback survey consists of broadcasting the call of the species over a loudspeaker. If an individual of the species is present, it may interpret the broadcast as the vocalization of a territorial intruder, and respond by approaching the surveyor while calling in response.

We surveyed 87 points for mangrove cuckoos between 11 October and 29 October 2008. Points surveyed included 86 points from 2007 plus 1 new point. Survey points represent complete coverage of the marked trail system on Guana Island. We obtained responses from cuckoos at 35 (40%) of survey points during 2008, which was lower than the response rate during 2007 (51%). In addition, at several survey points where cuckoo presence had been confirmed outside the survey period (by audio or visual identification), birds failed to respond during the survey proper. We detected ≥2 cuckoos in close proximity to each other at 7 (20%) of the 35 active survey points, indicating the potential presence of pairs or related individuals.

Although response rate of cuckoos at territories known to be active has been fairly consistent during previous years, little is known about specific factors affecting response rates; therefore, we hesitate to speculate as to the reason for reduced response rates in 2008 as compared to previous years. Cuckoo responsiveness might increase due to territoriality associated with breeding behavior (as is true in many bird species) or, alternatively, might be higher in non-paired birds searching for mates.

This highlights the difficulty of estimating densities of cuckoos and/or active territories in a given year, as opposed to identifying overall trends in population distribution and vegetation-community selection of cuckoos over multiple years. We had planned to capture and radio-tag 2 cuckoos in 2008, in order to establish detailed data on home range size and use. However, we were unable to capture target birds due to their apathetic response to call-playback (as experienced during surveys), despite having had birds approach within 10 feet of us on numerous occasions during previous years.

The relevancy of this study, in addition to acquiring basic biological information for the species, is its utility as a tool for conservation of mangrove cuckoos. The species is suspected of being substantially impacted by habitat loss and degradation due to conversion of low-lying vegetation areas on islands and in coastal regions throughout its range to urbanization, resorts, and agricultural production. Refinement of our survey protocol may enable detection, monitoring, and enhanced conservation of mangrove cuckoos not just in the Caribbean, but in coastal areas of North America.

Other Observations of Note

General numbers of birds were down this year, possibly due to the Hurricane systems that moved along the east coast of North America and, especially, Hurricane Omar which passed through the British Virgin Islands. Bridled quail doves continue to appear to be doing well; they were seen island-wide, although (as noted last year),were not as vocal as during previous years. They were regularly seen in the common areas, such as the work shop and orchard, but also along the shoreline of Monkey Point trail, along the trail to Sugar Loaf peak, in Palm Ghut, and on Long Man's Point (including Crab Cove trail). Several were seen this year near the hotel and behind Anegada House. 2008 was also an unusual year in terms of the number and approachability of scaley-naped pigeons, a species that is usually quick to flush when disturbed by human activity.

PROJECT PRODUCTIVITY

Avian research is of little value if not made available to both the scientific community and the general public. Since engaging in avian research on Guana Island in 2003, I have published 4 papers in peer-reviewed journals. I am currently writing one paper addressing timing and condition of blackpoll warblers arriving on Guana Island. I am also modeling the age- and sex-specific survival of island resident species based on mark-recapture methods. My colleagues and I have also made 5 Guana Island-related presentations at professional meetings, the most recent of which was at the annual meeting of Cooper Ornithological Society in Tucson, Arizona in April 2009.

<u>Publications</u>

Boal, C. W. 2008. Observations of an Antillean crested hummingbird (*Orthoryhncus cristatus*) attacking saddled anoles (*Anolis stratulus*). *Caribbean Journal of Ornithology* 21:48-49.

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Boal, C. W. 2003. Birds of prey in the British Virgin Islands. H. Levity Stoutt Community College, Roadtown, Tortola, British Virgin Islands.

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Boal, C. W. 2009. Timing and condition of autumn migrant Blackpoll Warblers in the British Virgin Islands. Annual Meeting of the Cooper Ornithological Society, Tucson, AZ, USA.

Estabrook, T. S. 2005. Mangrove cuckoos: where the heck are they and what the heck are they doing? H. Levity Stoutt Community College, Roadtown, Tortola, British Virgin Islands.

FUTURE WORK

Avian studies during Science Month in 2009 will essentially be a continuation of the current projects. These are:

- Operation of the banding station to study species diversity, abundance, and ecological aspects of neotropical migrant land birds using Guana Island during autumn migration.
- Continuation of island-wide point-count surveys at established locations to track species distribution and abundances across Guana Island, and how these parameters change in relation to climate patterns.
- Continuation of the population demography and survival study of bananaquits.
- Continuation and expansion of the mangrove cuckoo study; we plan to initiate a radio-telemetry study of their home range and habitat use in 2009.

ACKNOWLEDGEMENTS

First and foremost, I thank Dr. James Lazell and Dr. Gad Perry for continuing to facilitate avian research activities on Guana Island. I thank Gloria and Henry Jarecki for providing the opportunity for me and other researchers to conduct our studies on Guana Island. I thank the several people who assisted with ornithological studies on Guana Island during the 2008 season. Specifically, these were Tracy Estabrook and Susan Valentine. Funding for this research was provided by The Conservation Agency through a grant from the Falconwood Foundation and by the U.S. Geological Survey, Texas Cooperative Fish and Wildlife Research Unit.

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Table 1. Species captured, new captures and recaptures of birds on Guana Island, British Virgin Islands, 8 – 28 October 2008.

Species	Status	Abundance in VI[1]	New captures	Recaptures	Released without Band[2]	Total Birds
Scaley-naped Pigeon	Resident	Common			9	9
White-winged Dove	Resident	Rare			1	1
Zenaida Dove	Resident	Common	11	6	6	23
Common Ground-dove	Resident	Common	3	1		4
Bridled Quail Dove	Resident	Uncommon	1		4	5
Green-throated Carib	Resident	Common			9	9
Antillean Crested Hummingbird	Resident	Common			1	1
Caribbean Elaenia	Resident	Common	2	3		5
Gray-cheeked Thrush	Migrant	?	1			1
Pearly-eyed Thrasher	Resident	Common	12	8	3	23
Red-eyed Vireo	Migrant	Very Rare	3			3
Northern Parula	Migrant	Common	1			1
Cape May Warbler	Migrant	Uncommon	1			1
Black-throated Blue Warbler	Migrant	Rare	1	1		2
Blackpoll Warbler	Migrant	Uncommon	57	3	1	61
Black-and-white Warbler	Migrant	Common	1			1
American Redstart	Migrant	Common	2			2
Canada Warbler	Migrant	Very Rare	1			1
Bananaquit	Resident	Common	46	31	2	79
Indigo Bunting	Migrant	Common	1			1
Black-faced Grassquit	Resident	Common	18	20		38
Total Birds			**162**	**73**	**36**	**271**

[1] Common = one or more seen daily
Uncommon = not seen daily, but at least twice a year
Rare = sighted less than twice a year but at least one record every five years
Very Rare = occus less than once every 5 years
? = Status uncertain
Definitions and abundances taken from Raffaele et al. 1998.

[2] Some birds were released without bands due to not having the proper band size (e.g., hummingbirds, pigeons), when higher priority birds were in the net (e.g., warbler fallouts), or when escaping while being removed from the net.

Table 2. Comparison of mist-netting effort and capture rates at the Guana Island field site, British Virgin Islands, 2003–2008. Captures listed include both new birds captured and recaptures of previously banded birds.

Year	Net hrs.	Total Birds Captured	Birds /net hr.	Species Captured
2003	184	185	1.00	25
2004	218	168	0.80	20
2005	403	428	1.10	21
2006	400	284	0.71	24
2007	450	347	0.77	13
2008	460	271	0.59	20

Table 3. Distribution of fat score indices for migrant blackpoll warblers at first capture on Guana Island, British Virgin Islands during Octobers, 2003 – 2008.

Year	0	1	2	3	4	Mean	SD
2003	19	0	0	0	0	0	
2004	4	1	1	1	0	0.86	1.21
2005	44	42	46	40	0	1.48	1.11
2006	39	14	9	0	0	0.52	0.74
2007	48	10	24	19	9	1.37	1.40
2008	26	16	5	8	0	0.91	1.08
Total	180	83	85	68	9	1.21	1.93

Table 4. Distribution of adults (AHY) and young of the year (HY) age classes among migrant blackpoll warblers captured on Guana Island, British Virgin Islands, Octobers of 2003 – 2008.

Year	AHY	HY	χ^2	*P*
2003	9	5	0.58	0.445
2004	2	5	-	-
2005	78	97	1.03	0.309
2006	38	25	1.35	0.246
2007	33	78	9.47	0.002
2008	19	37	2.97	0.085

Table 5. Mass gain, adjusted mass gain (mass/wing chord), fat score, and breast muscle condition of two blackpoll warblers on initial and subsequent recaptures on Guana Island, British Virgin Islands, October 2008.

Band	Day	Mass	Adj. Mass	Fat Score	Cond.
38741	20	9.1	0.130	0	1
	22	11.2	0.160	2	2
	27	12.4	0.180	4	2
38760	22	10.7	0.151	1	2
	24	11.8	0.169	3	2

Table 6. Relative indices of abundance[1] of Guana Island birds derived from point-count surveys conducted in October 2007 and October 2008.

	2007					2008				
Species	Count	<25M	f(<25)	f(u)	Det/ratio	Count	<25M	f(<25)	f(u)	Det/ratio
Pearly-eyed Thrasher	86	0.827	0.46	0.50	0.34	68	0.585	0.38	0.53	0.78
Bananaquit	89	1.344	0.74	0.17	0.08	65	1.151	0.64	0.08	0.11
Zenaida Dove	12	0.155	0.12	0.03	0.22	11	0.189	0.09	0.02	0.17
Black-faced Grassquit	20	0.258	0.17	0.05	0.09	16	0.283	0.19	0.02	0.09
Antillean Crested Hummingbird	7	0.121	0.10	0.00	0.00	5	0.094	0.09	0.00	0.00
Green-throated Carib	3	0.034	0.03	0.02	0.33	5	0.075	0.06	0.02	0.25
Gray Kingbird	12	0.034	0.03	0.14	0.80	19	0.075	0.08	0.21	0.79
Scaley-naped Pigeon	5	0.086	0.09	0.00	0.00	8	0.094	0.08	0.06	0.50
American Kestrel	3	0.034	0.03	0.02	0.33	1	0.000	0.00	0.02	1.00
Blackpoll Warbler	3	0.051	0.02	0.00	0.00	6	0.113	0.08	0.00	0.00
Caribbean Elaenia	27	0.258	0.22	0.19	0.41	9	0.151	0.15	0.02	0.12
Smooth-billed Ani	4	0.000	0.00	0.05	1.00	8	0.000	0.00	0.09	1.00
Prairie Warbler	1	0.017	0.02	0.00	0.00	0				
Red-tailed Hawk	0					1	0.000	0.00	0.02	0.00
Bridled Quail-dove	5	0.051	0.05	0.02	0.25	4	0.075	0.04	0.00	0.00
Mangrove Cuckoo	2	0.034	0.17	0.17	0.50	4	0.000	0.00	0.08	1.00
Common Ground-dove	0					6	0.038	0.02	0.08	0.80

[1] Indices key: <25m = mean number observed per 25m radius plot; f(<25) = proportion of 25m radius plots within which birds were detected; f(u) = proportion of plots in which birds were detected beyond the 25m radius; Det/ratio = number of plots in which birds were recorded beyond the 25-m radius divided by the total number of plots at which they were recorded both within and beyond the 25m radius.

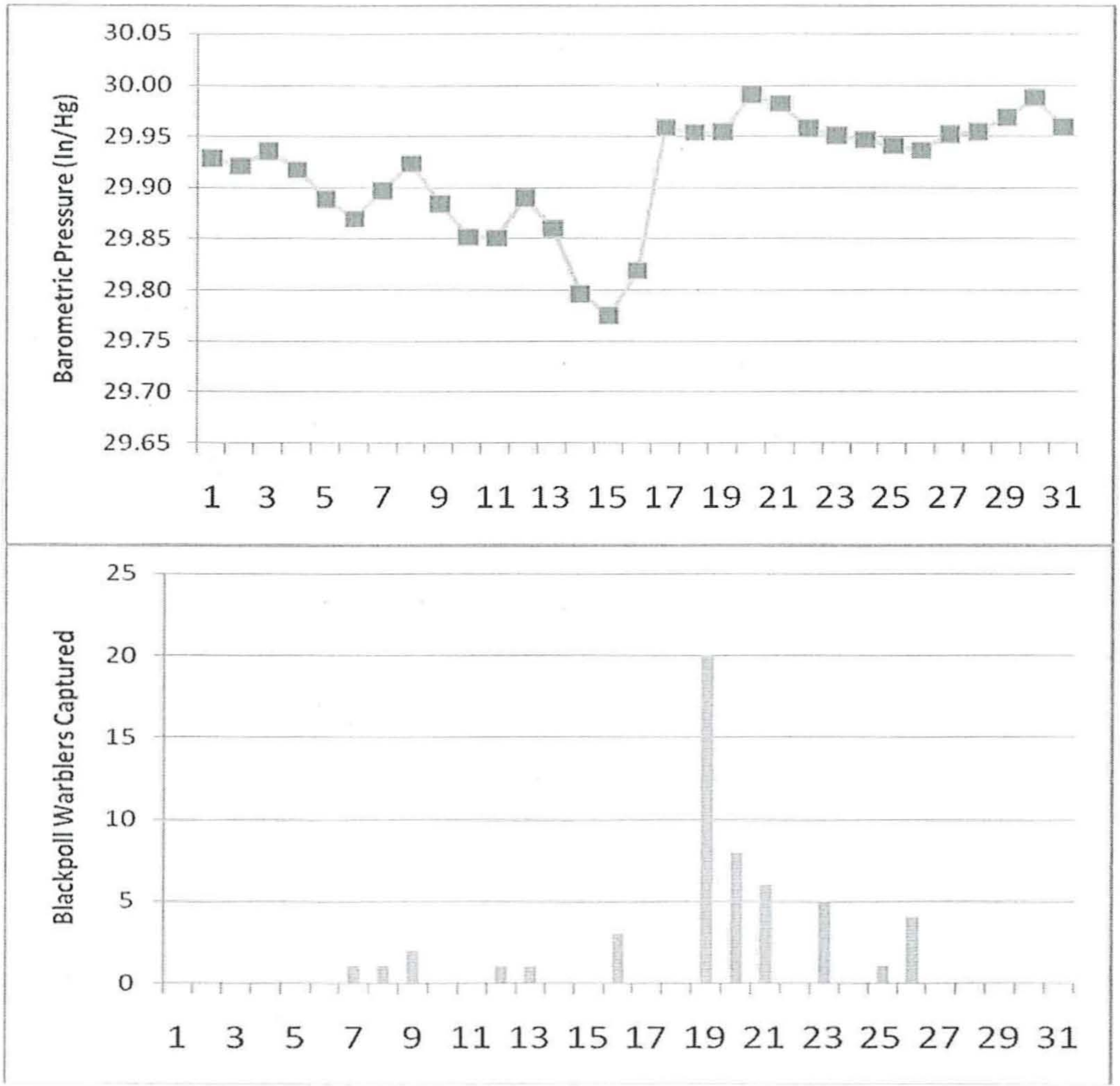

Figure 1. Illustration of migrant arrival related to passage of low barometric pressure system (Hurricane Omar; top) and subsequent arrival of blackpoll warblers (bottom) on Guana Island, October 2008.

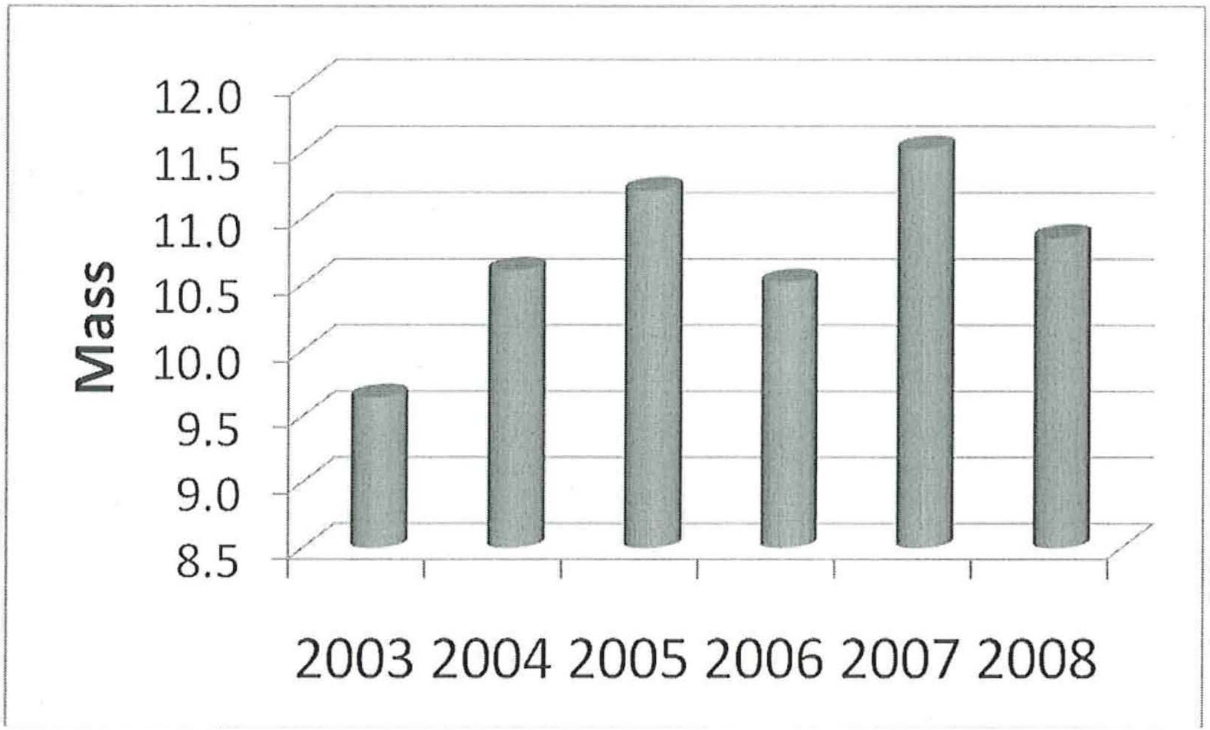

Figure 2. Average mass (in grams) of migrant blackpoll warblers captured on Guana Island, British Virgin Islands, during Octobers 2003 – 2008 varied significantly among years ($F_{5,402}$ = 9.53, P = 0.0001).

Images from Science Month 2008, Guana Island, BVI

This Canada Warbler is a very rare capture for Guana Island.

It is not uncommon to encounter Northern Parulas on Guana during autumn migration, but they are present only in very low numbers.

This Gray-cheeked Thrush is an uncommon encounter for Guana Island; less than 6 have been captured and banded.

White-winged Doves are a recent colonizer on Guana Island, and the numbers have increased dramatically around the club and flat.

Scaley-naped Pigeons are usually quick to flush and fly away when humans approach, but they were quite approachable around the club in 2008. They have a unique habit of hanging upside down, much like parrots, when feeding.

American Redstarts are uncommon on Guana and few have been captured and banded.

Sula leucogaster

Brown Booby

FRENCH: *Fou brun*
SPANISH: *Boba prieta, Bubi chaleco*
HAWAIIAN: *'A*

Female (foreground) and male Brown Boobies © E. A. Schreiber

This handsome brown-and-white booby is common in tropical waters throughout the world, occurring in the Atlantic, Pacific, and Indian Oceans and the Caribbean Sea. Its breeding range overlaps considerably with that of the Masked (*Sula dactylatra*) and Red-footed boobies (*S. sula*); all 3 may be found nesting and feeding together along with frigatebirds (*Fregata* spp.) and other tropical seabirds.

The Brown Booby feeds mainly on flying fish that it catches in often spectacular plunge dives from varying heights in the air; it may not feed as far from land as other boobies, but there are few data. Individuals are often seen soaring, banking, and turning without flapping, as they follow air currents. When flapping, wing-beats are steady and may alternate with gliding or soaring. Individuals seem to prefer roosting and nesting in windy areas, suggesting that takeoff without wind is difficult. The species generally nests in small colonies, tens to hundreds of pairs, with nests on flat ground, hillsides, or cliff ledges; nests vary from not much more than a scrape in the sand to a fairly substantial, well-formed pile of twigs and grasses. Pairs lay 2 eggs but generally raise only 1 chick, as the first to hatch usually outcompetes its sibling during feedings and frequently pushes it out of the nest.

Conservation status. Not listed as Federally Endangered or Threatened in U.S. Few data from most of Caribbean–Gulf of Mexico Is. on current population status. Best data from U.S. and British Virgin Is., Puerto Rico, Cayman Is., where human disturbance and development have greatly reduced population size over past 100 yr, and remaining birds nest in small colonies on fairly remote, difficult to access islands (Schreiber 2000c). Currently listed as protected in all, but colonies not patrolled at all, or rarely so. Goats destroy some nests on major colony in British Virgin Is.

Degradation of habitat. In the 1800s, phosphate mined on several nesting islands in Pacific and Caribbean, destroying habitat as tons of soil hauled away. Over last 300 yr, development of islands in Caribbean, primarily (U.S. Virgin Is., British Virgin Is., St. Bartes, Saba, Dominica, Grenadines, Grenada) has destroyed nesting sites. Today, increasing numbers of boaters landing in colonies, causing disturbance; introduced mammalian predators eat eggs and birds. Loss of habitat is a major problem in Caribbean as mangrove (*Rhizophora, Avicennia* spp.) and other wetlands areas are developed and human populations on islands increase (Schreiber 2000c).

The Birds of North America, No. 601, 2002 ANTONY W. DIAMOND AND ELIZABETH A. SCHREIBER

Magnificent Frigatebird

Fregata magnificens

FRENCH: *Frégate superbe*
SPANISH: *Tijerata de Mar, Fragata magnífica*
PORTUGESE: *Grapira, Tesoura, João-grande, Rabo-Porcado*

With their long, pointed wings and deeply forked tail, frigatebirds present a distinctive flight silhouette. They seem to soar effortlessly throughout the day and are rarely seen to flap their wings; yet their great aerial agility enables them to chase and harass other birds until the chased bird regurgitates a recently caught meal, whereupon the frigatebird darts down, catching the food before it hits the ocean. While frigatebirds have a reputation of being pirates—reflected in their colloquial name 'Man-o'-War Bird'—they catch most of their food on their own, by snatching fish or squid from near the ocean surface, never wetting a feather. This species lacks waterproof plumage and is rarely, if ever, seen to sit on the water. While adept in the air, frigatebirds have short legs and small feet, and never walk or swim.

The frigatebird family is perhaps the most distinctive among the order Pelecaniformes. Anatomically, they are the only bird family with a fused pectoral girdle, and the vestigially-webbed feet set on very short legs attracted Darwin's (1859) attention as an example of a phyletic vestige with no current adaptive value.

Conservation status. West Indian population considered "near threatened" (Schreiber 2000a); approximately 50% of Caribbean colonies extirpated (Appendix). Fact that historic colonies, such as Barbuda, have not changed locations by more than a few meters in years (Schreiber 1997) suggests that species probably does not readily move nesting locations when subjected to disturbance.

In Caribbean, only one colony (Barbuda) known to be regularly patrolled for protection (Schreiber 1996, 1997). Colony on Great Tobago, British Virgin Is., protected only by difficult access; goats are destroying vegetation allowing no regeneration of trees; eventually frigatebirds will have to nest on ground where vulnerable to trampling and goats.

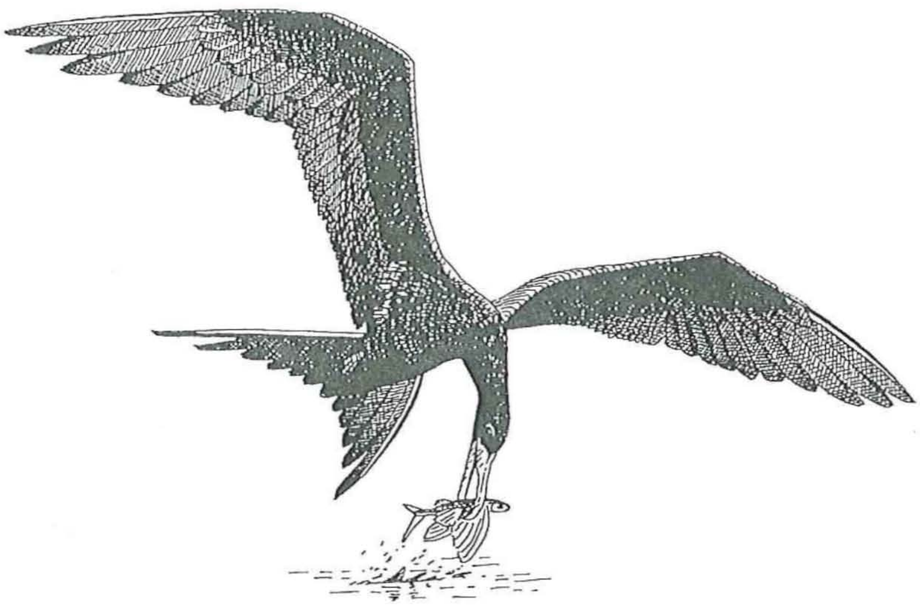

Figure 2. Frigatebirds catch their food in flight; this adult male Magnificent Frigatebird is seizing a flying fish, a characteristic component of the diet. Drawing by Jonathan K. Alderfer.

Non-Game Ecology

Population Demography of Bananaquits

Clint Boal

Bananaquits are small passerine birds common throughout the Caribbean and Central America. They are primarily nectivorous, using their sharply pointed beaks to pierce flowers near their base to drink nectar; they will also readily eat fruit and insects. The fact that they are abundant and have a diverse diet makes them an excellent species to study as a representative of the Caribbean avifauna. I have been studying Bananaquits in the British Virgin Islands since 2003. I am using colored leg bands in unique combinations to mark birds so that individuals may be visually identified without physical recapture. This allows study of sex and age specific survival, site and mate fidelity, and movement or dispersal patterns. I can then use this information to model how short-term weather patterns (droughts or storms) and long-term climate change may influence Bananaquit populations.

I have found Bananaquits can live quite long lives for a small passerine, with numerous individuals living to at least 7 years old. I have identified inconsistencies among years in terms of age ratios of birds: adults may constitute 80% of the population in some years, whereas young-of-the-year birds may account for 50% in others. I am working to identify what environmental factors or events may lead to these inconsistencies in reproductive output. Bananaquit males appear to have high site fidelity; if a male disappears from an area, he has likely died. If a female disappears from an area, however, she may be found with another male elsewhere. This makes sense in that males hold territories that may be ephemeral due to environmental conditions. If conditions are poor in one place, a female may choose to mate with a male in a richer area.

The demographic data of age and sex specific survival, site fidelity, and movement patterns can be correlated to environmental conditions that will, in time, allow a better understanding of how Bananaquits respond to climate change. If Bananaquits are an appropriate representative of other bird species of the Caribbean, we may be able to use these data to develop strategies for Caribbean avifaunal conservation in a changing world.

A color-banded Bananaquit.

Avian Predators of West Indian Reptiles

Robert Powell[1] and Robert W. Henderson[2]

[1]Avila University, Kansas City, Missouri
[2]Milwaukee Public Museum, Milwaukee, Wisconsin

On continents, birds that regularly prey on vertebrates are usually raptors (birds of prey) that exploit abundant and prolific rodent populations. Although other mammals, birds, reptiles, amphibians, and even fish are taken, they rarely comprise the focus of a predator's attention, and are instead taken opportunistically or when seasonally abundant, such as during migration periods. On tropical islands, however, reptiles — especially lizards — often are the most abundant and visible vertebrates, and constitute the principal quarry of raptors and many other birds not usually associated with hunting vertebrates.

In our forthcoming compilation of data pertaining to the natural history of West Indian amphibians and reptiles, we cited 36 references that recorded avian predation on reptiles. These constitute 37 species of birds and 58 species of reptilian prey. In addition, many published accounts speak of avian predation affecting population sizes of lizards, especially on very small islands with minimal cover, or of birds taking anoles (*Anolis* spp.), for example, but without identifying the species of lizard. Others note that a number of large, insectivorous birds were observed eating anoles, but do not identify the predators. Those accounts are not included in the totals above or in the accompanying table, which lists only records of known predators and prey. Particularly in light of the reality that recorded observations are mostly anecdotal (except for a few studies of raptor diets that are included), those listed must reflect but a small percentage of actual predation events. Nevertheless, the number of such records testifies eloquently to both the ability of predatory birds (obligate or facultative) to exploit an abundant and prolific resource and the ability of their prey to maintain population numbers in the face of substantial but obviously sustainable losses.

Acknowledgments

We thank Michael J. Morel (whose photographs also grace the inside front and back covers of this issue), Eladio Fernández, and Brenda S. and R. Duncan Kirby for the use of photographs. That by Eladio Fernández previously appeared in *Hispaniola. A Photographic Journey through Island Biodiversity. Bioversidad a Través de un Recorrido Fotográfico* (2007; reviewed in *Iguana* 14(4): 260), and those by Brenda S. and R. Duncan Kirby in *The Reptiles and Amphibians of the Dutch Caribbean: St. Eustatius, Saba, and St. Maarten* (2005; reviewed in *Iguana* 12(4): 273–274).

BRENDA S. AND R. DUNCAN KIRBY

American Kestrels (*Falco sparvarius*) are small raptors that frequently take insects, especially when abundant and concentrated, as well as small vertebrates. They have been documented as predators of 12 different species of West Indian lizards (ten of them species of anoles). The Puerto Rican Kestrel illustrated on the inside front and back covers is eating a Puerto Rican Ameiva (*Ameiva exsul*). These birds are eating a Statia Bank Tree Anole (*Anolis bimaculatus*, left) and a Statia Bank Bush Anole (*A. schwartzi*; right).

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Table. Avian predators on West Indian reptiles. Predators are listed alphabetically by scientific name in four categories: (1) Raptors (birds of prey that regularly or exclusively take vertebrate prey); (2) Seabirds (primarily marine birds that feed mostly on fish, but may opportunistically take terrestrial vertebrates); (3) Egrets and herons (wading birds that regularly take aquatic and terrestrial vertebrates); and (4) Birds not usually considered to be predators on vertebrates, although several species in this list are known to forage opportunistically for lizards and small snakes, and reptiles may constitute a major component of their diets.

Avian Predator	Prey
Raptors	
Red-tailed Hawk (*Buteo jamaicensis*)	Lesser Antillean Iguana (*Iguana delicatissima*)
	Common Iguana (*Iguana iguana*)
	Puerto Rican Crested Anole (*Anolis cristatellus*)
	Puerto Rican Giant Anole (*Anolis cuvieri*)
	Puerto Rican Emerald Anole (*Anolis evermanni*)
	Yellow-chinned Anole (*Anolis gundlachi*)
	Puerto Rican Spotted Anole (*Anolis stratulus*)
	Puerto Rican Racer (*Alsophis portoricensis*)
Broad-winged Hawk (*Buteo platypterus*)	Lesser Antillean Iguana (*Iguana delicatissima*)
	Puerto Rican Giant Anole (*Anolis cuvieri*)
	Grenada Tree Anole (*Anolis richardii*)
	Leeward Groundsnake (*Liophis juliae*)
Ridgway's Hawk (*Buteo ridgwayi*)	Dominican Giant Anole (*Anolis baleatus*)
	Northern Green Anole (*Anolis chlorocyanus*)
	W-headed Racer (*Ialtris dorsalis*)
	Hispaniolan Lesser Racer (*Antillophis parvifrons*)
	Sharp-nosed Treesnake (*Uromacer oxyrhynchus*)
	Hispaniolan Trope (*Tropidophis haitianus*)
American Kestrel (*Falco sparvarius*)	Stout Iguana (*Cyclura pinguis*) juveniles — Guana I.
	Lesser Antillean Iguana (*Iguana delicatissima*) juveniles
	Common Iguana (*Iguana iguana*) juveniles
	Statia Bank Tree Anole (*Anolis bimaculatus*)
	Cuban Giant Anole (*Anolis equestris*)
	Anguilla Bank Tree Anole (*Anolis gingivinus*)
	Anguilla Bank Bush Anole (*Anolis pogus*)
	Cuban Green Anole (*Anolis porcatus*)
	Saba Anole (*Anolis sabanus*)
	Cuban Brown Anole (*Anolis sagrei*)
	Statia Bank Bush Anole (*Anolis schwartzi*)
	Les Saintes Anole (*Anolis terraealtae*)
	Cuban Ameiva (*Ameiva auberi*)
	Hispaniolan Giant Ameiva (*Ameiva chrysolaema*)
	Puerto Rican Giant Ameiva (*Ameiva exsul*)
	Dominica Ameiva (*Ameiva fuscata*)
	Anguilla Bank Ameiva (*Ameiva plei*)
Cuban Pygmy Owl (*Glaucidium siju vittatum*)	Cuban Ameiva (*Ameiva auberi*)
Puerto Rican Screech Owl (*Otus nudipes*)	Puerto Rican Gracile Boa (*Epicrates monensis*)
Osprey (*Pandion haliaetus*)	Central Bahamas Rock Iguana (*Cyclura rileyi*)
Barn Owl (*Tyto alba*)	Jamaican Giant Anole (*Anolis garmani*)
	Slender Cliff Anole (*Anolis lucius*)
	Haitian Giant Anole (*Anolis ricordii*)
	Jamaican Croaking Gecko (*Aristelliger praesignis*)
	Hispaniolan Giant Ameiva (*Ameiva chrysolaema*)
Seabirds	
Magnificent Frigatebird (*Fregata magnificens*)	Anguilla Black Ameiva (*Ameiva corax*)
Laughing Gull (*Larus atricilla*)	Cuban Iguana (*Cyclura nubila*) eggs and hatchlings
	Anguilla Black Ameiva (*Ameiva corax*)
Royal Tern (*Sterna maxima*)	Cuban Iguana (*Cyclura nubila*) eggs and hatchlings
Brown Booby (*Sula leucogaster*)	Anguilla Black Ameiva (*Ameiva corax*)
Egrets and Herons	
Cattle Egrets (*Bubulcus ibis*)	St. Croix Anole (*Anolis acutus*)
	Grenada Bush Anole (*Anolis aeneus*)
	Puerto Rican Eyespot Sphaero (*Sphaerodactylus macrolepis*)
Snowy Egret (*Egretta thula*)	Mona Blindsnake (*Typhlops monensis*)
Yellow-crowned Night Heron (*Nyctanassa violacea*)	Anguilla Bank Ameiva (*Ameiva plei*)
	Puerto Rican Gracile Boa (*Epicrates monensis*)
	American Crocodile (*Crocodylus acutus*) hatchlings


DANIEL CARDIFF

Red-tailed Hawks are large raptors capable of taking lizards as large as iguanas.


LUIS O. NIEVES

American Kestrel with a Crested Anole (*Anolis cristatellus*) on Puerto Rico.


GRAEME PURDY

Although primarily nocturnal, Barn Owls occasionally take diurnally active lizards.

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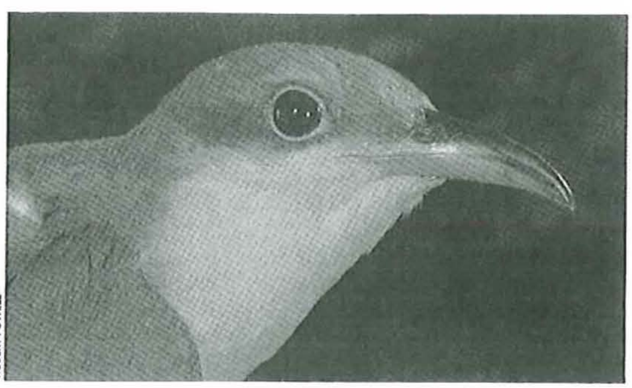
Birds not usually considered predators of vertebrates

Puerto Rican Parrot (*Amazona vittata*)	Puerto Rican Giant Anole (*Anolis cuvieri*)
West Indian Woodpecker (*Centurus superciliaris*)	Cayman Islands Sphaero (*Sphaerodactylus argivus*)
Brown Trembler (*Cinclocerthia ruficauda*)	Dominica Anole (*Anolis oculatus*)
Mangrove Cuckoo (*Coccyzus minor*)	Dominica Anole (*Anolis oculatus*)
Bananaquit (*Coereba flaveola*)	Caymans Blue-fanned Anole (*Anolis conspersus*)
Smooth-billed Ani (*Crotophaga ani*)	Caymans Blue-fanned Anole (*Anolis conspersus*)
	Jamaican Giant Anole (*Anolis garmani*)
	Les Saintes Anole (*Anolis terraealtae*)
Cuban Blackbird (*Dives atroviolaceus*)	Cuban Brown Anole (*Anolis sagrei*)
Zapata Wren (*Ferminia cerverai*)	Cuban Brown Anole (*Anolis sagrei*)
Domestic Chicken (*Gallus gallus*)	Smooth-scaled Worm Lizard (*Gymnophthalmus underwoodi*)
	Southern Green Anole (*Anolis coelestinus*)
	Hispaniolan Stout Anole (*Anolis cybotes*)
	Jamaican Gray Anole (*Anolis lineatopus*)
Pearly-eyed Thrasher (*Margarops fuscatus*)	Common House Gecko (*Hemidactylus mabouia*) — Guana I.
	Statia Bank Tree Anole (*Anolis bimaculatus*)
	Puerto Rican Giant Anole (*Anolis cuvieri*)
	Puerto Rican Emerald Anole (*Anolis evermanni*)
	Anguilla Bank Tree Anole (*Anolis gingivinus*)
	Yellow-chinned Anole (*Anolis gundlachi*)
	Dominica Anole (*Anolis oculatus*)
	Anguilla Bank Bush Anole (*Anolis pogus*)
	Saba Anole (*Anolis sabanus*)
	Statia Bank Bush Anole (*Anolis schwartzi*)
	Puerto Rican Spotted Anole (*Anolis stratulus*)
	Anguilla Bank Ameiva (*Ameiva plei*)
Guadeloupe Woodpecker (*Melanerpes herminieri*)	Guadeloupe Anole (*Anolis marmoratus*)
La Sagra's Flycatcher (*Myiarchus sagrae*)	Caymans Blue-fanned Anole (*Anolis conspersus*)
House Sparrow (*Passer domesticus*)	Cuban Green Anole (*Anolis porcatus*)
	Neotropical Clawed Gecko (*Gonatodes albogularis*)
Hispaniolan Trogon (*Priotelus roseigaster*)	Hispaniolan Twig Anole (*Anolis singularis*)
Carib Grackle (*Quiscalus lugubris*)	Grenada Bush Anole (*Anolis aeneus*)
Greater Antillean Grackle (*Quiscalus niger*)	Cuban Iguana (*Cyclura nubila*) eggs and hatchlings
	Caymans Blue-fanned Anole (*Anolis conspersus*)
	Cuban Brown Anole (*Anolis sagrei*)
Puerto Rican Lizard Cuckoo (*Saurothera vieilloti*)	Puerto Rican Giant Anole (*Anolis cuvieri*)
	Puerto Rican Emerald Anole (*Anolis evermanni*)
	Yellow-chinned Anole (*Anolis gundlachi*)
	Puerto Rican Spotted Anole (*Anolis stratulus*)
Cuban Lizard Cuckoo (*Saurothera merlini*)	Cuban Giant Anole (*Anolis equestris*)
	Cuban White-fanned Anole (*Anolis homolechis*)
	Western Giant Anole (*Anolis luteogularis*)
	Spotted Brown Trope (*Tropidophis pardalis*)
Jamaican Lizard Cuckoo (*Saurothera vetula*)	Jamaican Giant Anole (*Anolis garmani*)
Red-legged Thrush (*Turdus plumbeus*)	Cuban Giant Anole (*Anolis equestris*)
Loggerhead Kingbird (*Tyrannus caudifasciatus*)	Caymans Blue-fanned Anole (*Anolis conspersus*)
	Jamaican Giant Anole (*Anolis garmani*)
Gray Kingbird (*Tyrannus dominicensis*)	Dominica Anole (*Anolis oculatus*)

ROBERT POWELL

Pearly-eyed Thrashers are effective, albeit opportunistic predators of small vertebrates.



ROBERT POWELL

Cuckoos are opportunists, feeding on a variety of arthropods, some surprisingly small for such relatively large birds. They often concentrate on seasonally abundant prey, such as caterpillars, for which they frequently function as biological controls. On West Indian islands, however, many cuckoos selectively forage for small reptiles, especially anoles, and may run along the ground "chasing" lizards as well as picking them off arboreal perches. Although species such as this Yellow-billed Cuckoo (*Coccyzus americanus*) may occasionally take small reptiles, a focus on reptilian prey has led to many island forms with the common name of "Lizard Cuckoo."

BRILL

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Short Note

First record of the frog *Eleutherodactylus lentus* in the British Virgin Islands: Conservation implications of native or introduced status

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Abstract
Eleutherodactylus lentus, thought to be endemic to the US Virgin Islands, is now found on Jost Van Dyke in the nearby British Virgin Islands, where previous surveys have failed to note it. This poses an unusual conundrum. If the new record represents human-aided dispersal, then control actions may be appropriate, even though the species is categorized as at risk in its native range. However, it is possible that this population is native to Jost Van Dyke, and was not previously recorded because of methodological issues. In that case, protection would be warranted. Interviews with researchers and locals suggest the former scenario is more likely.

Key words
British Virgin Islands, conservation status, distributional range, *Eleutherodactylus lentus*, Jost Van Dyke, US Virgin Islands.

Eleutherodactylus lentus, sometimes misleadingly called the mute frog, is only known from the US Virgin Islands (USVI; Platenberg and Boulon, 2006). The species is considered Endangered (IUCN et al., 2004) because of its geographically limited range and development-caused reduction of its semi-xeric habitat. However, the species is locally abundant in some areas (Platenberg and Boulon, 2006). The mute frog has never been documented in the British Virgin Islands (BVI; Perry and Gerber, 2006), nor is it documented as invasive elsewhere (Lever, 2003). However, other members of the genus *Eleutherodactylus* are frequently invasive (Lever, 2003).

In early October 2007, I located several specimens of *E. lentus* at Great Harbour (18°26′42″N, 64°45′02″W) on Jost Van Dyke. The first was collected during daylight, under a wooden board in the back yard of Foxy's Bar, at the east end of Great Harbour. This popular beach bar receives visitors, primarily arriving by yacht, from

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throughout the area. A nocturnal visit a few days later showed the presence of many additional frogs at that locality, some of them calling from underneath objects on the ground (despite the inapt common name). Additional specimens were seen and heard, and one collected, at the west end of Great Harbour, a few hundred meters away from the first population. At that location, small puddles of fresh water were present among considerable amounts of refuse. Identity of the frogs (MCZ A-139005 — 139007, Museum of Comparative Zoology, Harvard University) was verified from photographs by Renata Platenberg and Blair Hedges.

Clearly, *E. lentus* now exists on Jost Van Dyke. The question, then, is whether these frogs represent a new colonization or a previously-undiscovered native population. Important policy decisions depend on the answer. If the species is native, it should probably be protected in the BVI, much as it is in the USVI. Conversely, if the species is recently introduced and potentially invasive, it should probably be eradicated before the population expands further to avoid possible impacts to native species. Although both scenarios are plausible, a recent introduction appears to be the more likely explanation. In recent decades, herpetologists have repeatedly surveyed the BVI without finding this species, as part of a multi-year, multi-island herpetological survey program operated out of Guana Island (e.g., Ovaska et al., 2000). Most recently, searching for invasive species has been a focus of these studies, which did not identify any unexpected species on Jost Van Dyke as recently as October 2006 (J. Lazell, pers. comm.; G. Perry, unpubl. data). Moreover, locals on Jost Van Dyke that were questioned about the frog had not noticed it and had no insight about the timing of its arrival or the mechanism involved. In contrast, they spoke knowingly of *Eleutherodactylus* congeners previously found on the island (Ovaska et al., 2000).

There is no indication of ornamental plants being recently introduced to Jost Van Dyke. Recent construction, materials for which are typically brought in by un-sanitized barge from the USVI, suggests a likely source for this population, probably between October 2006 and October 2007. If it is indeed a new arrival, *E. lentus* could conceivably compete with native frogs. The population appears localized, and eradication should be feasible. However, given the status of the species in the nearby USVI, appropriate action is not immediately clear.

Acknowledgements

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First record of *Osteopilus septentrionalis* on Guana Island, British Virgin Islands

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Key data

Osteopilus septentrionalis; Hylidae; Cuban treefrog; individual; British Virgin Islands. Guana Island; 18°28′45″N, 64°34′41″W. 20 October 2005; collected by Gad Perry. Yale Peabody Museum (YPM) 01579. Verified by James Lazell.

Cuban treefrogs are native to Cuba, the Cayman Islands, and the Bahamas, but are increasingly recorded from other locations (Lever, 2003). The species was first collected in the British Virgin Islands (BVI) in 1990 (Owen et al., 2005) and has since spread, with about one new island record per year in the BVI (Owen et al., 2005, 2006; Perry and Gerber, 2006) and new localities in the United States Virgin Islands (Waddle et al., 2005; Platenberg and Boulon, 2006; Perry and Platenberg, 2007). Perry and Gerber (2006) mentioned that the species had been sighted on Guana Island, BVI, but did not provide any information that would allow the significance or circumstances of the event to be evaluated. Those details are provided herein.

At about 2000 h on 21 October 2005, I collected an adult male (SVL = 72 mm) with small nuptial pads, foraging at a night light within the hotel complex on Guana Island. Guana Island is a private wildlife preserve. In the 12 months prior to the reported event, the small hotel on the island had imported relatively large quantities of construction materials and ornamental plants. However, hotel staff had made extensive attempts to prevent the arrival of the Cuban treefrog and other invasive species. These include manual searches of all arriving plants and other materials while still on the barges bringing them to the island, and on-island fumigation within an enclosure into which arriving materials and engine exhaust were introduced (Perry et al., 2006). No additional Cuban treefrogs have been seen on Guana since removal of that individual, despite extensive searches in 2006, 2007, and 2008. Guana Island

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offers few locations where standing fresh water is found, most of them within the hotel complex, but adults could conceivable survive for a while nearly anywhere on the island. Most likely, the frog collected was associated with materials brought to the hotel.

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Snakes

From: Henderson, Robert [mailto:henderson@mpm.edu]
Sent: Wednesday, April 22, 2009 10:16 AM
To: Wenhua Lu
Cc: Robert Powell; Perry, Gad
Subject: RE: Guana planning

Hi Skip,

I hope this finds you and Wenhua well.

Attached is our 2008 report and a long-term plan. As Gad is very busy with his new family members and, since he is the keeper of the snake data, the 2008 report is a bit vague.

Bob P. mentioned that you suggested doing snakes every other year. I do feel that's a mistake. Snake data usually only come with dedicated effort, and to not have that effort (even if it's only for 7-10 days/year) will impact the project.

I do, however, understand that you are under budget constraints. I am confident that Bob P. and Gad will do what they can to add to the database, even in the absence of my inspirational presence. When it's all said and done, the snake project will be one of the stellar products of Science Month on Guana.

We should see proof on our natural history book next month. Again, we really appreciate your soliciting funds for us.

All the best,
Bob H.

From: "Perry, Gad" <gad.perry@ttu.edu>
To: "'Henderson, Robert'" <henderson@mpm.edu>; "Wenhua Lu" <wenhua@ETAL.URI.EDU>
Cc: "Robert Powell" <anolis@swbell.net>
Sent: Wednesday, April 22, 2009 11:04 AM
Subject: RE: Guana planning

Bob,

Thanks for getting this done in the absence of useful support from me. My apologies to all, but twins are a time-consuming hobby.

I want to emphasize Bob's call for an annual program. With recaptures being the key to future progress and remaining uncommon, a bi-annual project would decrease progress by much more than half, since it will reduce both recaps and the marking of new snakes.

Again, my apologies for my decreased ability to help. I will be on Guana for a shorter period than normal this October as well, but do hope to return to something resembling normal for next year.

Cheers to all,

Gad

The Puerto Rican Racer, *Borikenophis* (formerly *Alsophis*) *portoricensis*

Following is a synopsis of the natural history of *Borikenophis portoricensis* based on observations from throughout the species' range, and gleaned from many sources.

Distribution: Puerto Rico Bank, where six currently recognized subspecies occur on much of Puerto Rico and Cayo Santiago (*B. p. portoricensis*), in the British Virgin Islands (*B. p. anegadae*), on Isla Vieques (*B. p. aphantus*), on Buck Island (B. *p. nicholsi*), on Caja de Muertos, Platillo, and in southern Puerto Rico (*B. p. prymnus*), and on Isla Culebra, St. Thomas and satellites, Lovango Cay, Peter Island, Salt Island (*B. p. richardi*).

Habitat: Xerophilic to mesophilic, in a variety of situations, including xeric scrub, gardens, rainforest, *Musa* groves, *Hippomane* woods (St. Thomas), *Cocos* trash (Virgin Gorda), open pasture, rock piles, under active termitarium buried under *Cocos* fronds adjacent to mangrove swamp; on Tortola, along the beaches; on Anegada, along path through sandy, rocky habitat; occasionally edificarian; on Puerto Rico, in an arroyo behind the Coamo Springs Hotel, also under a rock at base of cliff behind "bath house"; snakes readily enter standing water on Guana; primarily ground-dwelling, but will ascend to considerable heights in trees to 18–20 m in rainforest canopy; on Guana, snake (SVL 404 mm) sleeping draped over branches on bush ~75 cm above ground.

Activity: Diurnal, crossing road at 0745 h; on beaches in early morning on Tortola, seldom seen after 1000 h on Water Island; observed foraging only during the day on Puerto Rico; on Guana, activity bimodal with a depression at hottest time of day; also on Guana, observed exploiting night-light niche on hotel grounds after dark, preying on *Anolis*, itself using the artificial light to ambush prey; on Anegada, observed on trail 0700-1200 h. **Behavior**: Raises forepart of body and flattens dorsoventrally; rarely attempts to bite humans, but will occasionally; venom has caused severe (but not fatal) reactions in humans; when handled on Guana Island, may rotate body rapidly and wave tail. **Diet and Foraging**: Active forager, poking head into holes and even turning small rocks; prey movement usually provokes attack; small prey grasped and swallowed almost immediately, for larger prey, venom from Duvernoy's gland injected by chewing on prey and rear maxillary fangs are repeatedly embedded until prey is moribund (snake may use its body to restrain prey while venom takes effect), *Ameiva* may be particularly susceptible to the venom, saliva with high protein content, primary action of venom hemolytic, effects include subcutaneous hemorrhage in mammals and pulmonary and peritoneal hemorrhage in lizards; based on 44 feeding sequences on *Anolis cristatellus*, mean subduction time 834.1 sec and average handling time 883.4 sec (N = 33), lizards gaping and showing signs of respiratory distress a few minutes after being seized suggests that the venom weakens but does not immediately immobilize or kill, on 11 occasions anoles observed struggling inside snake to 414 sec after being completely engulfed, 60 of 61 anoles swallowed head first, constriction occasionally used to subdue prey; faster digestion rates recorded for skin, forelimbs, liver, and lungs of envenomated anoles (*A. cristatellus*) versus non-envenomated anoles, digestion of envenomated anoles is faster than that of non-envenomated lizards; subduction time for *Anolis cristatellus* greater (mean 623.1 ± 151.0 sec) than for *Eleutherodactylus coqui* (242.2 ± 117.9 sec), but swallowing time faster for *A. cristatellus* (174.3 ± 18.8 sec) than for *E. coqui* (538.2 ± 159.2 sec), *Anolis* initially attacked on trunk, and frogs on head or limbs, venom usually not used on frogs (1 of 14 envenomated), but is used on anoles (13 of 17 envenomated), anoles always swallowed head-first, but frogs either head, tail, or side-first, frogs swallowed and regurgitated in the field were still alive several days after being regurgitated; *Thyophis exiguus* and *Typhlops* sp.; a sample of 45 prey items from Puerto Rico and satellite islands included 6 frogs (3 *Eleutherodactylus* sp., 3 *E. antillensis*), 38 lizards (14 *Anolis* sp., 10 *A. cristatellus*, 3 *A. pulchellus*, 2 *A. stratulus*, 2 *Ameiva* sp., 2 *A. exsul*, 3 *Sphaerodactylus macrolepis*), and 1 snake (*Typhlops platycephalus*), a sample of 6 from the U. S. Virgin Islands included 2 *Sphaerodactylus macrolepis*, 2 *Anolis*, 1 *Iguana iguana*, and 1 *Ameiva exsul*, a sample of 7 prey items from the British Virgin Islands included 1 frog (*Eleutherodactylus* sp.) and 6 lizards (1 *Sphaerodactylus* sp., 1 *S. macrolepis*, 3 *Anolis* sp., and 1 *A. stratulus*; also known to take *Eleutherodactylus coqui*, *Sphaerodactylus townsendi*, *Anolis evermanni*, *Thyophis exiguus*, and *Rattus rattus* on Puerto Rico; *Ameiva wetmorei*; *Sphaerodactylus nicholsi*; mouse; snake from Water Island contained 3 "young" *I. iguana*; baby *Cyclura pinguis* on Guana Island; on Guana, a 621 mm SVL, 88 g snake consumed a hatchling *Cyclura pinguis* of 40.4 g, a mass representing 45.9% of the snake's pre-meal mass; cannibalism on Guana Island; on Congo Cay, observed "masticating" small, dried fish (*Hernagula* sp.) lost from a Brown Pelican (*Pelicanus occidentalis*) nest, on Little Saba Cay observed entering nest of ground-nesting Zenaida Dove (*Zenaida aurita*) and position its head over 2 eggs while the adult stood nearby in combative posture (the snake fled when disturbed; on Puerto Rico, *Anolis krugi*; also on Puerto Rico, snake entered the nest of a Bananaquit (*Coereba flaveola*) at a height of 2.5 m in a tree and captured a nestling; on Guana, *Amphisbaena fenestrata*; additional prey species include *Hemidactylus mabouia*, *Sphaerodactylus nicholsi*, *S. roosevelti*, *Diploglossus pleii*, and *Anolis gundlachi*; scavenged discarded chicken bones; juvenile *Bufo marinus*; caudal luring observed in juveniles; struck at foraging *Ameiva exsul* from vegetation bordering open sandy area near beach on Guana Island, British Virgin Islands. **Parasites:** Tick *Amblyomma arianae*; subcutaneous helminths. **Population Density**: Mark-recapture indicates that this species is phenomenally abundant on Guana: 50/ha (and 3.05 kg of biomass/ha) in *Leucaena* plots; on Puerto Rico, mean monthly densities 5.6–11.1/ha at several sites between February 2001 and February 2002. **Predators**: Red-tailed Hawk (*Buteo jamaicensis*; mongoose (*Herpestes javanicus*; house cats, also *Anolis cristatellus* attempted to eat a juvenile; on Guana, very high percentage of snakes with scars on the body and damaged tails (nearly 70%), probably attributable to unsuccessful predation attempts by Soldier Crabs (*Coenobita clypeatus*), larger snakes had higher incidence of scarring and tail damage. **Reproduction**: Gravid March-April, clutch size 4–10 in females 522–612 mm SVL; female produced 12 eggs in lab on 8 May, hatched 28 June. **Size**: SVL to 923 mm.

2008 Activity

Perhaps the most significant event of the 2008 field season was contracting and demarcating our study area for future efforts. Prior to 2008, our study area included virtually all of Guana and we determined that *Borikenophis portoricensis* was found throughout the island. Although this made encountering snakes easy (i.e., you were likely to find snakes wherever you went on the island), it was not conducive to increasing the likelihood of recaptures. By concentrating search efforts in a fairly sharply defined study area (about 20% of the total area of Guana), we should increase the percentage of marked snakes in that area and, presumably, increase the number of recaptures. Every newly marked snake and every recapture adds to our base of knowledge. Considering that the amount of *dedicated* snake research on Guana is usually no more than 7–10 days/year, the number of marked snakes and the increasing number of recaptures is exciting; the number of new (unmarked) snakes encountered remains phenomenal. During 2008, we again made a satisfactory number of recaptures (especially toward the end of the days dedicated to snake work). As recaptures increase, our statistical options expand, and Dr. Brent Bibles is onboard to help with statistically assessing population structure, size, and turnover.

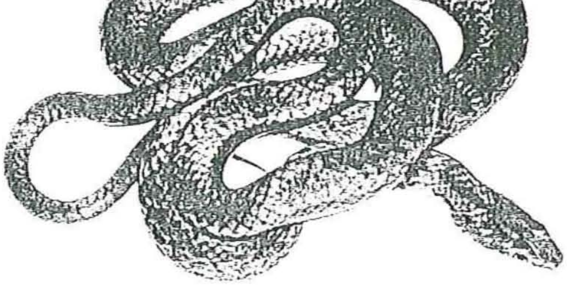
Long-term Plan

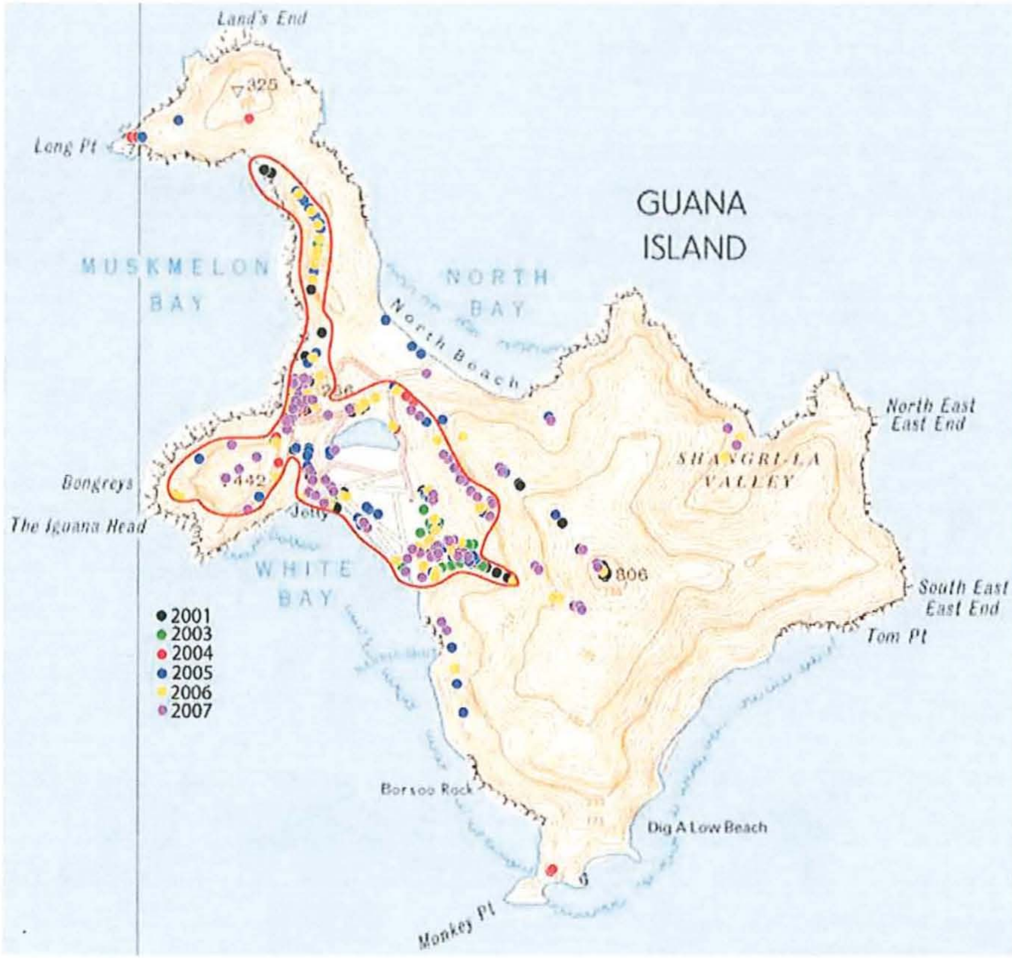
If allowed to continue for at least another five years, the capture-mark-recapture (CMR) project with the Puerto Rican Racer (*Borikenophis portoricensis*) will prove to be one of the highlights that result from Science Month on Guana. Few long-term (5–10+ years) CMR snake projects have been conducted anywhere in the world. In the West Indies, in terms of duration, only Peter Tolson's work with *Epicrates monensis* rivals what we are doing with *B. portoricensis*. In terms of snakes processed and marked, we far surpass Tolson's project. What we lack are more recaptures.

Field research with snakes is time-intensive. Although *B. portoricensis* is ubiquitous on Guana, it does not occur in the high localized population densities often found in lizard species (*Anolis*, *Sphaerodactylus*). With approximately 500 snakes micro-chipped, and the potential of continuing to add more marked animals during the next four years (2009–2012; the 2013 field season would be devoted to recaptures only), we have the potential for accumulating data on a West Indian snake species that are totally lacking for any other species in the Antilles (if not for the entire Neotropics). This project will produce data on morphology, population structure, population size and density, habitat, habitat use, movements, daily activity, growth, longevity, predation pressure, and various aspects of behavior (e.g., thermoregulatory, defensive). Although having dietary data specific to the Guana population of *B. portoricensis* would be of interest, sacrificing a minimum of 100 animals in order to get a fairly reliable assessment of diet is not desirable. We do have dietary data (e.g., *Cyclura*, *Anolis*) collected incidental to our ongoing project, and food data are available from *B. portoricensis* populations elsewhere in the species' range (see species synopsis above).

If the number of recaptures continues to increase with time, and if funding for Science Month continues, it would be exciting to continue the project beyond 2013. If the project is terminated at the end of the 2013 field season, we still will have made a giant step toward understanding the ecology and population dynamics of a West Indian dipsadid snake.

R. W. Henderson
G. Perry
R. Powell





Records of snake captures. Note that many dots from earlier years are obscured by those from more recent years. The red outline shows the approximate extent of the area in which studies were concentrated beginning in 2008.

EPICRATES MONENSIS GRANTI (Virgin Islands Treeboa). BRITISH VIRGIN ISLANDS: GREAT CAMANOE ISLAND: Near boat dock, on stone wall in a drainage culvert (18.46293°N, -64.53426°W; NAD83), 50 m elev., 2200 h. 20 October 2008. Collected by Brittany S. Barker. Verified by J. Lazell. Milwaukee Public Museum Herpetology Photo Collection Catalogue No. MPM-P 740. First documented record for island. Lazell (1983. *In* Rhodin and Miyata [eds.], Advances in Herpetology and Evolutionary Biology: Essays in Honor of Ernest E. Williams, pp. 99–117. Mus. Comp. Zool., Harvard Univ., Cambridge, Massachusetts) reported a sight record, but no voucher was collected. The snake was a male sub-adult (SVL 662 mm) found ~1.75 m above the ground, perched vertically on a rock wall, facing downward. The surrounding vegetation was subtropical dry forest. The snake was released at the site of capture. Financial support for this work was provided by The Conservation Agency through a grant from the Falconwood Foundation.

Urban Herpetology. J.C. Mitchell, R.E. Jung Brown, and B. Bartholomew, editors
Herpetological Conservation 3:xx-xx.

Effects of Artificial Night Lighting on Amphibians and Reptiles in Urban Environments

Gad Perry[1], Bryant W. Buchanan[2], Robert N. Fisher[3], Mike Salmon[4], and Sharon E. Wise[2]

Abstract — Amphibians and reptiles have evolved with natural lighting cycles. Consequently, alteration of natural variation in diurnal and nocturnal light intensities and spectral properties has the potential to disrupt their physiology, behavior, and ecology. We review the possible effects of night lighting on many species of amphibians and reptiles, noting that few studies of the consequences of artificial lights to amphibians and reptiles have been conducted to date. The one exception is the information available on the negative impacts of artificial lights on hatchling sea turtles, which have received considerable coverage in both scientific and popular media. In many studies that might be relevant, researchers have not recorded the illumination or irradiance at which experiments were conducted. We identify light pollution as a serious threat that should be considered as part of planning and management decisions in the maintenance or conservation of urban areas containing amphibians and reptiles. However, we consider it too early to precisely gauge the effects of artificial night lighting on other taxa found in light-polluted environments or provide specific management recommendations, beyond pointing out the urgent need for more information.

Key words — Activity Pattern, Amphibians, Behavior, Conservation, Ecology, Invasive Species, Light Pollution, Night Lighting, Photopollution, Physiology, Reptiles, Suburban, Urban

This excellent paper cites the several Guana night-light publications we have published over the years, but nothing new for Guana. We are not acknowledged, so I deem the abstract sufficient for our purposes herein. JDL.

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Radio Transmitter Weight: Impacts on Home Range, Vertical Habitat Use, Body Condition, and Jumping Ability in Male Crested Anoles

Krista Mougey, Gad Perry, Matthew Gifford, and Clint Boal

Radio telemetry technology is used extensively in wildlife research, but the number and scope of studies on the impacts of telemetry on reptiles is fairly limited. During October, 2008, we conducted a study to determine how additional weight impacts home range size, vertical habitat use, body condition, and jumping ability of male crested anoles on Guana Island, in the British Virgin Islands. During the first portion of the month we captured and measured 33 mature males, uniquely marking each for identification purposes. Attempts were made to re-sight each male twice a day, once in the morning and once in the afternoon. Information on the location and vertical position of the males was recorded each time an individual was seen, and the site was mapped for home range analysis. Males that had sufficient re-sightings were later caught, re-processed, and assigned to a weight treatment group that ranged from 0 to 20% of that individual's body weight. A second round of visual recaptures was then conducted. At the end of the month, the lizards were caught and measured again; then, each underwent five consecutive jump-distance tests from a standard height post.

We did not find differences in the home range sizes or vertical habitat use of the lizards regardless of added weight. However, we recorded a significant decrease in body weight over the season for individuals carrying as little as an additional 5% of their body weight. Control males maintained or gained weight throughout the month, while weighted males lost as much as 12% of their starting weight. Jump distance was also significantly decreased as weight was added.

It has traditionally been accepted that transmitters weighing up to 10% of an individual reptile's body weight could be used without appreciable negative impacts to the normal behavior, physiology, reproduction, or locomotion of that organism. Our data suggest that this standard rule may be inappropriate for some reptilian species, as it violates this key assumption of remote monitoring studies. We are now conducting studies to examine whether this phenomenon also occurs in other species, including the Texas horned lizard.

Male Crested Anole, showing the colorful dewlap under his throat.

The Anoles (*Anolis*) of Guana Island: 2008 Activity

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Aptly named Crested Anoles (*Anolis cristatellus*) is abundant in many areas on Guana Island.

The three species of anoles (*Anolis*) found on Guana are all abundant. The Crested Anole (*Anolis cristatellus*) has been the most studied, with efforts focusing on abundance, territorial size, foraging behavior, diet, movement patterns, water loss, and more. The species is common and apparent in many areas, including the hotel itself. The territorial behavior of males, which display often and occasionally engage in fights that can last for over 30 minutes and involve much posturing, biting, and even knocking rivals off the tree. Feeding primarily on invertebrates, Crested Anoles occasionally take small fruits. Anoles, in turn, are eaten by a number of the island's residents, including birds (Kestrels and Pearly-eyed Thrashers) and snakes. The smaller Saddled Anole (*A. stratulus*) is equally abundant in many places. They often seem fearless, allowing people to approach very closely. On Puerto Rico, they often range very high into the crowns of trees, but on Guana, where trees are shorter, they are usually encountered at face level and even on the ground. The third anole on the island, the Puerto Rican Grass Anole (*A. pulchellus*) is both the most attractive and the hardest to see. Its elongated form merges imperceptibly with the narrow stems on which it lives. Like other members of the genus, however, males have well-established territories that they fiercely defend from other males.

In 2008, using techniques outlined in Heckel and Roughgarden (1979. A technique for estimating the size of lizard populations. *Ecology* 6: 966–975), I sampled population densities at four sites, and also documented microhabitat use during late morning hours (~1000–1200 h) by recording perch heights and diameters, orientations, and insolation. Size classes of both species were defined as: Class 1 (large adult males), class 2 (subadult males and adult females, which are difficult to distinguish at a distance), and class 3 (juveniles). I recorded perch characteristics where an anole was first sighted — unless it was already moving when seen. All perch data were collected for each observation (except as noted), including those for individuals previously marked. Although this could lead to pseudoreplication of results, I content that an individual's perches on separate days are independent events, determined largely by factors other than individual preferences and that treating them as such is justifiable.

All data were log10-transformed prior to statistical analyses to assure normality. All means are presented ± one standard error (SE), except population estimates based on Heckel and Roughgarden, which are presented ± one standard deviation (SD).

Study sites were near White Bay Beach: Area #1: Open mixed Sea Grape (*Coccoloba uvifera*) and Acacia (*Acacia* sp.) woodlands bordering the beach. Area #2: Open Acacia (*Acacia* sp.) woodland between the beach and the dump. Area #3: Largely shaded artificial rock pile near the orchard, bordered by secondary scrub forest. Area #4: Densely shaded closed-canopy ghut forest shading a rockslide on the hillside near the large cistern.

Saddled Anoles (*Anolis stratulus*) tend to perch higher than Crested Anoles.

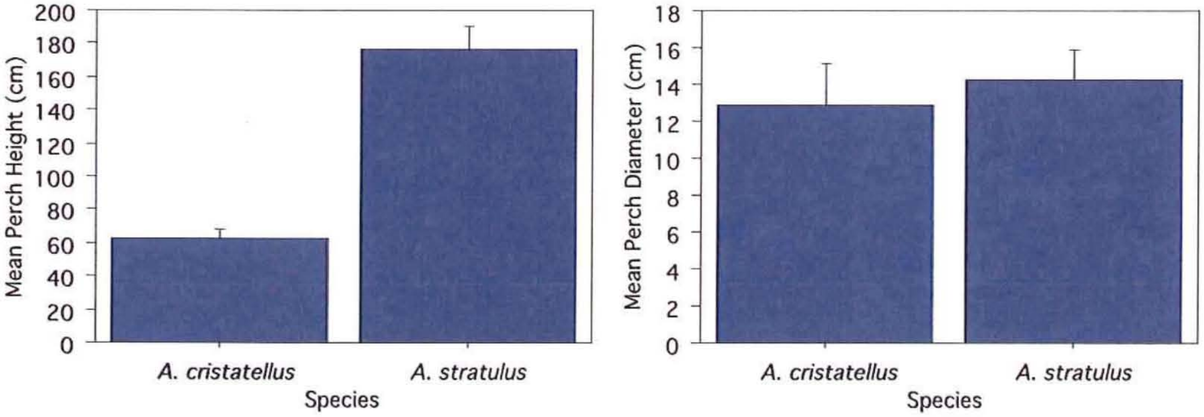
Only *Anolis cristatellus* and *A. stratulus* were found in the study plots. Results are presented in the following tables and figures. Population estimates should not be considered absolute values since they are based on anoles observed from ground level, and anoles, especially *A. stratulus*, often range high into the crowns of trees. However, the numbers are valid for comparative purposes and can be used for comparisons of densities in various habitats.

In general, *Anolis cristatellus* ($N = 89$ observations) was more abundant in more densely shaded, closed-canopy situations (although *A. stratulus* may have been out of sight high in the treetops) and *A. stratulus* was more commonly encountered in more open woodlands with smaller trees. *Anolis stratulus* ($N = 52$ observations) perched higher than *A. cristatellus* (ANOVA, $df = 1$, $F = 60.64$, $P < 0.0001$), although individuals of both species used perches from ground level to high in the canopies. Neither species showed any clear preference for perches of smaller or larger diameters ($F = 2.68$, $P = 0.11$), essentially exploiting whatever was available in the habitat. Neither perch heights nor diameters differed significantly by area for *A. cristatellus* (height, $df = 3$, $F = 2.40$, $P = 0.07$, although the difference between areas 1 and 4 was significant, $P = 0.01$; diameter, $F = 2.73$, $P = 0.06$, with differences between areas 1 and 3 and between 1 and 4 significant, $P = 0.03$ and 0.01, respectively). For A. stratulus, perch heights did not differ by area ($F = 0.39$, $P = 0.76$), but diameters did ($df = 1$, $F = 3.90$, $P = 0.01$, with differences between areas 1 and 2 and between 2 and 3 significant, $P = 0.02$ and 0.005, respectively). *Anolis cristatellus*, however, was much more likely (38 observations) than *A. stratulus* (2 observations) to use rocks (when available at areas 3 and 4). One *A. cristatellus* and two *A. stratulus* were on a vehicle at the edge of area 3.

Larger individuals of *A. cristatellus* perched higher than smaller lizards ($df = 2$, $F = 23.65$, $P < 0.0001$) and used perches of larger diameter ($F = 9.86$, $P = 0.0004$). Neither trend was obvious for *A. stratulus* (perch height, $df = 2$, $F = 1.33$, $P = 0.28$; diameter, $df = 1$, $F = 2.19$, $P = 0.15$). The most common orientation was down for individuals on trees and horizontal for those on rocks. Relatively few animals faced up, an orientation often associated with basking, All but three lizards of both species were in filtered light or full shade (and those were basking after periods of rain), although basking in full sun might have been observed if surveys had been conducted during early morning hours.

Area and Species	Heckel and Roughgarden (± one SD)	Schnabel (± one SE)
1 *A. cristatellus*	20.0 ± 8.1/144 m^2 (1389/ha)	20.5 ± 0.2/144 m^2 (1424/ha)
A. stratulus	37.5 ± 16.9/144 m^2 (2604/ha)	30.1 ± 0.2/144 m^2 (2090/ha)
2 *A. cristatellus*	7.5 ± 5.3/144 m^2 (521/ha)	14.7 ± 0.3/144 m^2 (1021/ha)
A. stratulus	33.4 ± 12.1/144 m^2 (2319/ha)	34.8 ± 0.2/144 m^2 (2417/ha)
3 *A. cristatellus*	64.4 ± 4.5/144 m^2 (4472/ha)	34.0 ± 0.2/144 m^2 (2361/ha)
A. stratulus	28.3 ± 23.6/144 m^2 (1965/ha)	25.3 ± 0.2/144 m^2 (1757/ha)
4 *A. cristatellus*	43.1 ± 12.5/144 m^2 (2993/ha)	77.6 ± 0.1/144 m^2 (5389/ha)
A. stratulus	—*	—*

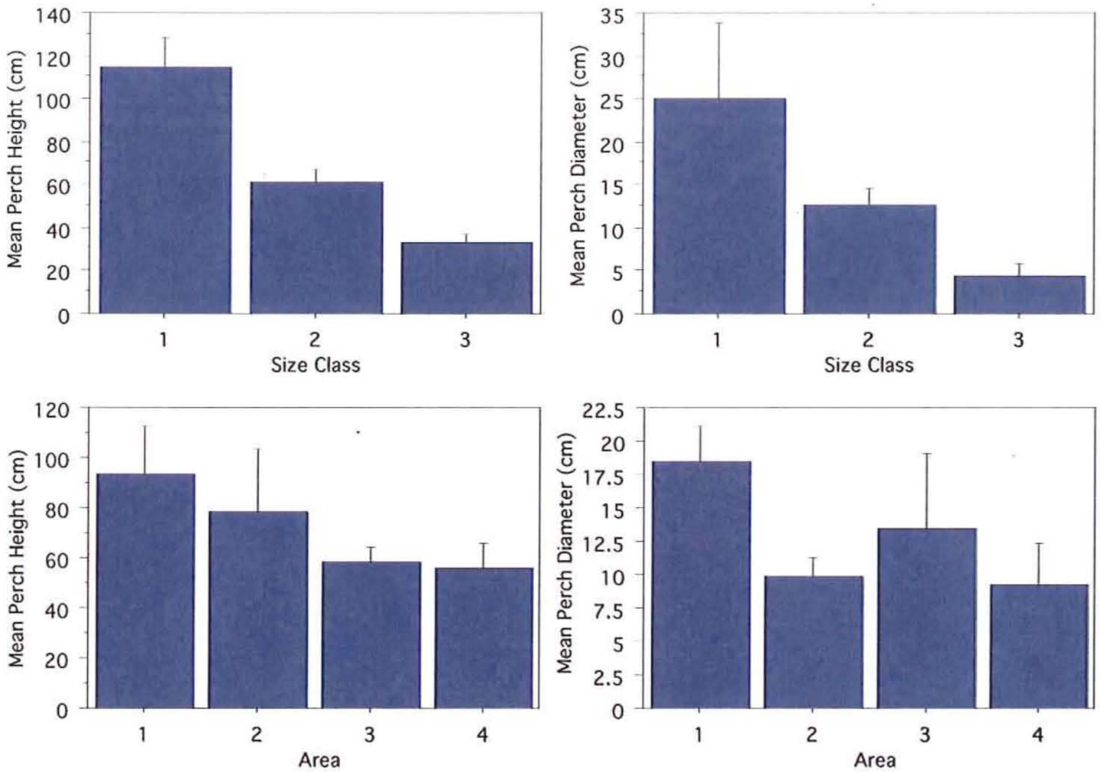
Estimated population densities at four areas (see text) on Guana Island. The asterisk indicates that too few individuals were observed (N = 2) to estimate population size and density.



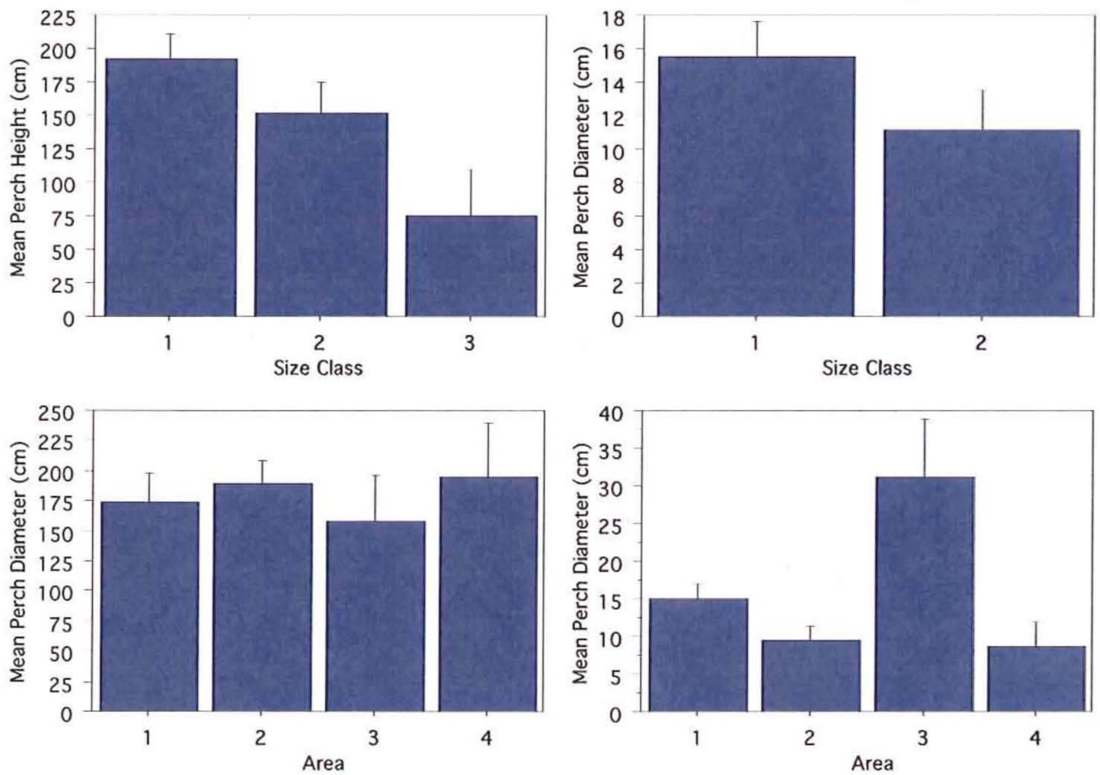
Mean perch heights for *Anolis cristatellus* and *A. stratulus* of all sizes and at all areas sampled.

Area, Species, Size Class	Perch Height (cm)	Perch Diameter (cm)
1 *A. cristatellus* (class 1)	145.0 ± 35.5 (75–190) N = 3	16.7 ± 5.2 (7–25) N=3
A. cristatellus (class 2)	82.5 ± 15.6 (45–115) N = 4	22.5 ± 4.2 (12–32) N = 4
A. cristatellus (class 3)	39.0 ± 6.0 (33–45) N = 2	13.0 ± 3.0 (10–16) N = 2
A. stratulus (class 1)	176.1 ± 30.6 (10–450) N = 14	14.6 ± 2.0 (8–28) N = 14
A. stratulus (class 2)	165.0 ± 43.3 (45–280) N = 5	16.2 ± 4.6 (4–26) N = 5
2 *A. cristatellus* (class 2)	78.0 ± 25.2 (35–175) N = 5	9.8 ± 1.5 (7–15) N = 5
A. stratulus (class 1)	205.0 ± 20.9 (35–370) N = 13	10.2 ± 2.6 (2.5–40) N = 13
A. stratulus (class 2)	152.7 ± 41.8 (18–295) N = 6	8.2 ± 2.6 (2.5–20) N = 6
3 *A. cristatellus* (class 1)	92.0 ± 18.3 (60–160) N = 5	44.0 ± 36.0 (8–80) N = 2 (3 on rocks)
A. cristatellus (class 2)	61.9 ± 8.4 (0–170) N = 24	12.1 ± 4.5 (1.5–35) N = 7 (17 on rocks)
A. cristatellus (class 3)	36.7 ± 6.9 (10–100) N = 12	3.0 ± 0.4 (2–4) N = 5 (6 on rocks, 1 on vehicle)
A. stratulus (class 1)	198.3 ± 57.2 (35–440) N = 6	38.2 ± 4.2 (28–45) N = 4 (1 on rock, 1 on vehicle)
A. stratulus (class 2)	120.0 ± 50.0 (70–170) N = 2	2.5 (2.5) N = 1 (1 on rock)
A. stratulus (class 3)	75.0 ± 35.0 (40–110) N = 2	— (1 on rock, 1 on vehicle)
4 *A. cristatellus* (class 1)	119.2 ± 21.9 (55–190) N = 6	20.7 ± 9.7 (10–40) N = 3 (3 on rocks)
A. cristatellus (class 2)	44.3 ± 10.6 (20–150) N = 12	8.1 ± 3.0 (2.5–18) N = 5 (8 on rocks)
A. cristatellus (class 3)	26.2 ± 1.8 (20–30) N = 8	1.8 ± 0.6 (0.3–3) N = 4 (4 on rocks)
A. stratulus (class 1)	240 (240) N = 1	5 (5) N = 1
A. stratulus (class 2)	150 (150) N = 1	12 (12) N = 1

Perch heights and diameters used by anoles at four areas (see text) on Guana Island.



Mean perch heights and diameters for *Anolis cristatellus* at four areas (see text) on Guana Island.



Mean perch heights and diameters for *Anolis stratulus* at four areas (see text) on Guana Island. Both juveniles (size class 3) were on perches (a rock or a vehicle) for which diameters were not recorded.

Species and Size Class	Orientation (↑) — (→) — (↓)	Insolation Shade — Mosaic — Shade
A. cristatellus (class 1)	1 — 9 — 4	0 — 7 — 7
A. cristatellus (class 2)	4 — 26 — 14	2 — 21 — 21
A. cristatellus (class 3)	4 — 16 — 2	1 — 16 — 5
A. stratulus (class 1)	3 — 4 — 30	0 — 19 — 18
A. stratulus (class 2)	0 — 1 — 12	0 — 8 — 5
A. stratulus (class 3)	1 — 1 — 0	1 — 0 — 1

Orientation of anoles and insolation of perches on Guana Island.

Future Plans

Because comparisons from year-to-year may vary according to weather conditions (e.g., dry versus wet years), I would like to repeat the study at the same sites for at least one more year. I also am open to sampling other sites on the island to test relative species abundance in a wider variety of habitats. However, this study can be completed as an adjunct to those dealing with Guana's Ground Lizards (*Ameiva exsul*) and Racers (*Borikenophis portoricensis*) and the only expendable item (paint) has already been acquired, no special accommodations are necessary to continue the investigation.

Acknowledgments

I thank the Jarecki family and the Falconwood Foundation for providing the opportunity to conduct research on Guana Island. By maintaining Guana Island as a nature preserve and permitting and actively supporting research, they have rendered a tremendous service to science and to scientists with an interest in the dynamics of West Indian island biotic communities. James (Skip) Lazell and Gad Perry have encouraged and facilitated my efforts. Matt Gifford helped lay out the 12 x 12 m sampling sites. Elisabeth Hills helped spot animals and recorded data in the field.

The Ground Lizards (*Ameiva exsul*) of Guana Island

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Puerto Rican Ground Lizards (*Ameiva exsul*) readily coexist with humans. This brightly colored adult male was foraging on the walkway near the dining area.

Puerto Rican Ground Lizards (*Ameiva exsul*) are widely distributed across the Puerto Rico Bank, but are absent or rare on islands with introduced Indian Mongooses (*Herpestes javanicus*). Primarily associated with dry habitats, smaller individuals are more vulnerable to water loss than large adults, possibly restricting them to moister microhabitats or curtailed activity periods. These diurnal lizards forage actively on insects and other small arthropods, but are facultative omnivores, eating fruits, other vegetable matter, and even small vertebrates. We have observed a large male on Guana Island foraged actively in leaf litter for Puerto Rican Dwarf Geckos (*Sphaerodactylus macrolepis*), a subadult jumping into the air to catch a flying moth, and two other individuals eating red berries of *Cordia polycephala*.

Maximum known snout-vent length (SVL) for males is 201 mm and for females 103 mm, although lizards on Guana to not appear to reach those sizes. These lizards are most active at high temperatures, emerging from dens as temperatures rise in the morning and returning to shelter in late afternoon when temperatures drop. Our data to date suggest a unimodal activity pattern on Guana, although bimodal activity has been observed in populations of other species of West Indian *Ameiva*.

Ground Lizards are not territorial and range widely while foraging, with home ranges of males and females often overlapping. Females lay 4–7 eggs in shallow burrows, with reproduction closely associated with the rainy season in dry habitats of southwestern Puerto Rico, but less seasonal elsewhere in the species' range.

Principal predators include snakes (e.g., Puerto Rican Racers, *Borikenophis portoricensis*), predatory birds (e.g., Red-tailed Hawks, *Buteo jamaicensis*, and American Kestrels, *Falco sparvarius*), feral dogs and cats, and mongooses. On Guana, we observed a Puerto Rican Racer strike unsuccessfully at a juvenile Ground Lizard from ambush along the edge of vegetation along White Bay Beach.

On Guana Island, Ground Lizards exploit most available habitats, including those altered by human activity, but are most abundant in Sea Grape (*Coccoloba uvifera*) leaf litter along beaches and open forests on hillsides essentially islandwide. Population densities have been estimated at 200 lizards/ha in optimal habitat, but preliminary estimates based on encounter rates on Guana Island were lower (34/ha in forest and 52/ha along White Bay Beach).

2008 Activity

During October 2008, we captured 76 lizards (compared to 58 in 2007), 67 were permanently marked; nine (2 females, 7 males) were recaptures from 2007. Most were collected from the same three informal transects used in 2007: (1) Pyramid = Along the Pyramid trail, primarily along the eastern side; (2) Iguana = Beginning near the resort, down the Iguana Trail and continuing along the Guanaberry Trail; (3) Beach = From the end of the Guanaberry Trail, past the beach house, along the ruins, behind the dump, and continuing on to the large cistern. In 2007, the Pyramid transect was sampled during only the second week of the study (8 animals marked in 2007, 17 in 2008); this year, all transects were sampled with approximately equal intensity.

Adult males (N = 42); mean SVL = 132.2 ± 18.6 mm (SD), range = 70.4–153.9 mm
Adult females (N = 12); mean SVL = 74.7 ± 14.3 mm (SD), range = 58.9–107.6 mm
Juveniles (N = 22); mean SVL = 48.72 ± 5.67 mm (SD), range = 40.3–55.2 mm

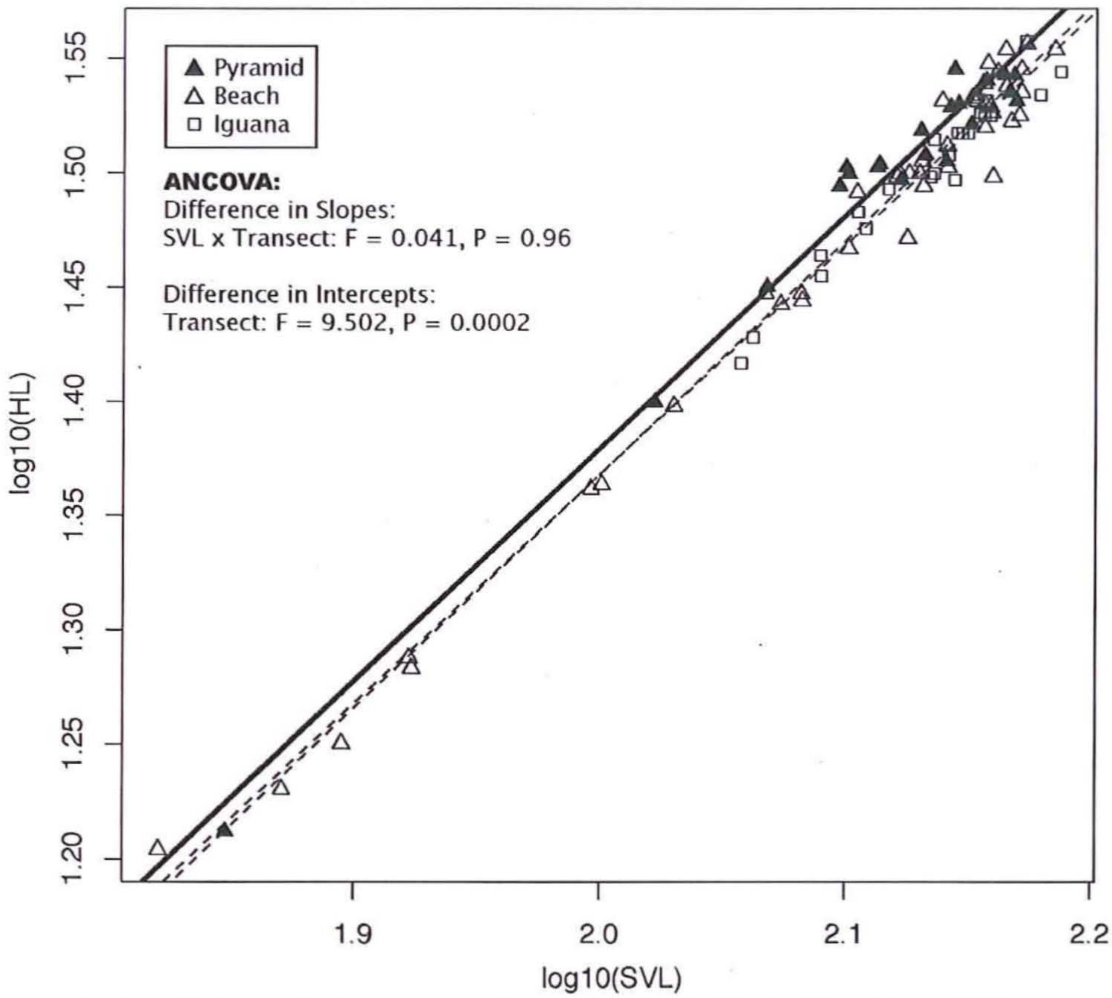
Eight of 9 recaptures were caught within ~10–15 m of their initial sites of capture. Only one animal was recaptured >20 m from its initial site of capture (initially at the spa and recaptured at the tennis court).

A juvenile Puerto Rican Ground Lizard (*Ameiva exsul*) basking in a patch of sun near White Bay Beach, Guana Island.

Combining thermal data from 2007 and 2008, cloacal temperatures remain consistently higher than air or substrate temperatures (Means: cloacal = 37.89°C, air = 29.6°C, substrate = 30.5°C).

Differences in body conditions observed in 2007 were not as obvious in 2008 (conditions on the Pyramid, where individuals in 2007 exhibited poorer body conditions, apparently were better in 2008). All morphological traits exhibited different scaling relationships between males, females, and juveniles. For males (largest data set), few morphological differences are evident between transects (ANOVA, SVL, F = 1.39, P = 0.254; mass, F = 1.68, P = 0.192). ANCOVA analyses controlling for SVL are included in the table below. In each case, the test for homogeneity of slopes could not be rejected. Head length is the only morphological trait that differs between transects; lizards from the Pyramid have significantly longer heads, for their body size, than lizards from the other two transects.

Trait	F	P
Mass	1.584	0.211
Head Length	**9.502**	**0.0002**
Head Width	2.404	0.097
Head Height	0.633	0.534
Femur Length	0.765	0.469
Tibia Length	1.145	0.323
Metacarpus Length	2.342	0.103
Hind Limb Length	0.961	0.387



Results of ANCOVA comparing head lengths of male *Ameiva exsul* among transects (Pyramid, Beach, and Iguana).

Data from animals captured in 2007 suggested a highly skewed sex ratio of 15:1. We felt that this was a consequence of biased sampling effort in favor of large male lizards. In 2008, we made a concerted effort to capture as many female lizards as possible. The 2008 sex ratio was 3.5:1 (M:F). This sex ratio is much less skewed, and may be closer to an accurate representation of the natural sex ratio of populations on Guana. Additional sampling over the next 2–3 years will help to clarify this issue.

Future Plans

Based on preliminary estimates of longevity, we would like to continue the study for another 4–5 years in order to develop a life history table for Guana Ground Lizards (no life history tables exist for any West Indian population of *Ameiva*). Two persons are necessary to effectively collect lizards. However, consequent increases in efficiency will allow adequate levels of sampling in a one-week period each year. Incidental encounters with snakes during sampling periods will contribute to that ongoing study and one person can also continue sampling anoles (*Anolis*) at established sites to track trends in population densities and microhabitat use.

Development of a life history table requires the continuation of the mark-recapture study along the three transects established during the previous two years. Data over the next few years will also build a survival data set that can be correlated with morphological and habitat variables.

This adult male Puerto Rican Ground Lizard (*Ameiva exsul*) had been foraging in leaf litter near White Bay Beach when he was disturbed by our presence. Note the regenerated tail, possibly the result of a predation attempt or consequence of an occasionally violent male-male conflict. The white mark on the tail indicates that this individual had already been captured.

Complementing the ongoing mark-recapture study, we also propose to collect tissues from animals in other areas on Guana to examine the genetic structure of the island's populations. Recent work on the Ground Lizards of Dominica (*Ameiva fuscata*) suggests that subpopulations exist in close geographic proximity without substantial interaction. If this is true, populations on different parts of Guana should exhibit slightly different genetic profiles. These data also can be compared with those for populations elsewhere in the British Virgin Islands and across the entire Puerto Rico Bank.

During the last year of the study, we propose to collect ~20 animals from each transect for dietary analyses. These will shed light on habitat associations and predator-prey relationships that currently rely entirely on anecdotal observations such as those cited in the introduction. Data from years 1 & 2 suggest that removal of this many animals will have minimal impact on populations capable of rapid recruitment. These specimens also will provide material for skeletochronological analyses that could reveal additional information about longevity, growth, and responses to annual variations in these variables as they respond to varying habitat conditions (e.g., drought or years of abundant rainfall).

Acknowledgments

We thank the Jarecki family and the Falconwood Foundation for providing the opportunity to conduct research on Guana Island. By maintaining Guana Island as a nature preserve and permitting and actively supporting research, they have rendered a tremendous service to science and to scientists with an interest in the dynamics of West Indian island biotic communities. James (Skip) Lazell and Gad Perry have encouraged and facilitated our efforts.

Variation in the *Sphaerodactylus macrolepis* Species Complex in the British Virgin Islands

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Introduction

Dwarf geckos in the genus *Sphaerodactylus* comprise the third most speciose genus in the West Indies, with a total of 89 currently recognized species (Henderson & Powell, 2009). This number will surely grow as new molecular techniques are applied to taxa distributed over several islands or island banks (e.g., Thorpe et al., 2008). One such complex is *S. macrolepis*, which is distributed throughout the Puerto Rico Bank (Schwartz & Henderson, 1991). Variation within this group has been previously acknowledged by the recognition of nine subspecies (Thomas & Schwartz, 1966). Ongoing analyses of mtDNA and nDNA are indicating that several species-level taxa exist within the complex (S. B. Hedges, personal communication).

Figure 1. An adult female *Sphaerodactylus macrolepis* from Guana Island (British Virgin Islands), one of the island populations represented in this study. Photograph by Robert Powell.

Figure 2. An adult male *Sphaerodactylus macrolepis* from Carval Rock (British Virgin Islands). The discovery of this population led to the current study. Photograph by Alejandro Sánchez.

This evaluation of *Sphaerodactylus macrolepis* (Fig. 1) populations in the British Virgin Islands (BVI) was triggered by anecdotal observations suggesting that the Carval Rock (8,100 m^2) population (Fig. 2) is distinct at the species level from other populations in the region. Perry & Gerber (2006) noted: "The Carval Rock dwarf gecko population appears morphologically distinct but is yet to be described."

That species may evolve on isolated islets as small as Carval Rock has been demonstrated by descriptions of *Anolis ernestwilliamsi* (Lazell, 1983) and *Mabuya macleani* (Mayer & Lazell, 2000) on comparably sized Carrot Rock. Mayer & Lazell (2000) suggested that: "The presence of endemic lizards on such a small, poorly isolated, and young island as Carrot Rock may be a striking case of rapid divergence of insular populations."

Materials and Methods

We examined preserved specimens collected on Carval Rock and museum specimens on loan from the Museum of Comparative Zoology (Harvard University) and the National Museum of Natural History (Smithsonian Institution). For each animal, we recorded sex (based on the presence of a distinct escutcheon in males; fig. 3) and aspects of color pattern, measured snout-vent length (SVL) and head length, width, and depth using digital calipers (Mitutoyo CD-15DC, Mitutoyo UK Ltd., Telford, UK; precision 0.01 mm), counted scales (Table 1), and evaluated the appearance of the scales, noting if they were smooth, keeled, flat, imbricate, acute, and, in the case of subcaudals, whether laterally expanded or not.

For statistical analyses, we used JMP Version 7.0.2 (SAS Institute, Cary, North Carolina). To assure normality, all data were log_{10}-transformed prior to analysis. Following Thorpe et al. (2008), we used a multivariate analysis of principal components to compare populations from different islands. All means are presented ± one standard error (SE). For all tests, $\alpha = 0.05$.

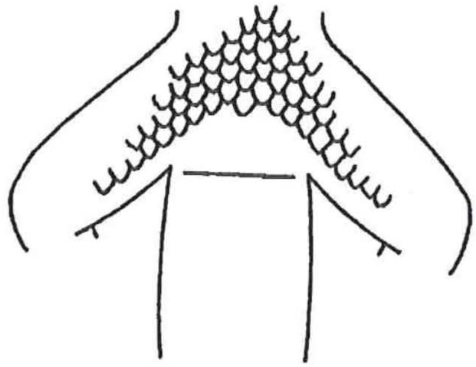

Figure 3. The escutcheon of a male *Sphaerodactylus*.

Table 1. Scale counts used in evaluating variation in *Sphaerodactylus macrolepis* from the British Virgin Islands.

Dorsal scales from axilla to groin (from behind the front leg to in front of the back leg)
Ventral scales from axilla to groin (belly scales from the front leg to the back leg)
Scales around midbody
Internasals (scales between the nares/nostrils across the front of the snout)
Upper labials to mideye (scales along the upper lip from the rostral scale to the middle of the eye)
Escutcheon width and height (formation of lighter scales located ventrally between the back legs; Fig. 3)
Fourth-toe lamellae (scales from the base of the toe to the base of the toe pad on the longest toe)

Results

We recorded data (Table 2) from 32 males, 33 females, and 2 specimen of undetermined sexes (either juveniles or damaged specimens) from six islands: Carval Rock (CR), N = 13; Guana Island (GU), N = 26; Carrot Rock (RR), N = 1; Shark Rock (SR), N = 1; Tortola (TO), N = 25; and Virgin Gorda (VG), N = 1. No single character was diagnostic for any island population, and although variation exists in scale characters (smooth, keeled, etc.) and color patterns, none were exclusive to any island.

An analysis of variance (ANOVA) of principal components (Figs. 4–5, Table 4) showed: PC1: $F_{2,27} = 17.21$ ($P < 0.0001$; CR–TO: $P > 0.05$, CR–GU: $P < 0.05$, GU–TO: $P < 0.05$); PC2: $F_{2,27} = 1.37$ ($P = 0.272$); PC3: $F_{2,27} = 1.13$ ($P = 0.336$); PC4: $F_{2,27} = 3.196$ ($P = 0.057$; CR–TO: $P < 0.05$, CR–GU: $P > 0.05$, GU–TO: $P > 0.05$); PC5: $F_{2,27} = 1.189$ ($P = 0.320$), indicating that populations on CR and TO differ from that on GU on PC1. A Tukey HSD Post Hoc Test suggested that lizards from CR and TO are larger, are more likely to have enlarged subcaudal scales, more toe lamellae, and more labials to mid-eye. No other PC axes differ significantly in the whole model; however, PC4 approached significance. A Tukey HSD Post Hoc Test for this axis (describing variation in midbody scale rows) showed that CR lizards have significantly more scales around midbody than those from TO, but no other comparisons were significant.

Table 2 (following page). Morphometric (mm) and meristic data for *Sphaerodactylus macrolepis* in the British Virgin Islands. The top value in each column is for adult males, the second for adult females, and the third for individuals of undetermined sex. All means are presented ± one SE followed by ranges and N in parentheses).

Character	Carval Rock	Guana Island	Carrot Rock	Shark Rock	Tortola	Virgin Gorda
SVL	**24.8 ± 1.1**	**23.4 ± 0.3**	—	—	**25.2 ± 0.3**	—
	23.5–28.0 (4)	20.7–24.9 (15)	—	—	23.8–26.6 (13)	—
	23.6 ± 1.0	**23.2 ± 0.5**	**25.6**	—	**23.5 ± 0.5**	**23.9**
	19.5–27.6 (8)	20.9–25.8 (11)	— (1)	—	19.6–27.4 (12)	— (1)
	14	—	—	**9.8**	—	—
	— (1)	—	—	— (1)	—	—
Head length	**6.3 ± 0.2**	**6.0 ± 0.1**	—	—	**6.1 ± 0.1**	—
	5.8–7.0 (4)	5.5–6.6 (15)	—	—	5.6–6.4 (13)	—
	6.0 ± 0.2	**6.0 ± 0.1**	**6.9**	—	**5.8 ± 0.1**	**6.0**
	5.4–6.9 (8)	5.6–6.3 (11)	— (1)	—	5.1–6.5 (12)	— (1)
	3.3	—	—	**3.3**	—	—
	— (1)	—	—	— (1)	—	—
Head width	**4.3 ± 0.1**	**3.9 ± 0.1**	—	—	**4.2 ± 0.04**	—
	4.1–4.7 (4)	3.3–4.3 (15)	—	—	3.8–4.5 (13)	—
	3.9 ± 0.1	**3.9 ± 0.1**	**4.1**	—	**3.9 ± 0.1**	**4.1**
	3.5–4.7 (8)	3.5–4.2 (11)	— (1)	—	3.4–4.5 (12)	— (1)
	2.8	—	—	**2.2**	—	—
	— (1)	—	—	— (1)	—	—
Head depth	**3.0 ± 0.1**	**2.8 ± 0.1**	—	—	**3.0 ± 0.05**	—
	2.9–3.2 (4)	2.2–3.6 (15)	—	—	2.7–3.3 (13)	—
	2.7 ± 0.1	**2.8 ± 0.1**	**2.7**	—	**2.8 ± 0.04**	**3.0**
	2.3–3.1 (8)	2.5–3.0 (11)	— (1)	—	2.6–3.2 (12)	— (1)
	1.8	—	—	**1.4**	—	—
	— (1)	—	—	— (1)	—	—
Internasals	**2.0 ± 0.4**	**1.3 ± 0.1**	—	—	**1.3 ± 0.2**	—
	1–3 (4)	1.0–2.0 (15)	—	—	1.0–3.0 (13)	—
	1.9 ± 0.2	**1.1 ± 0.1**	**2**	—	**1.5 ± 0.1**	**1**
	1–3 (8)	1.0–2.0 (11)	— (1)	—	1.0–2.0 (12)	— (1)
	1	—	—	**1**	—	—
	— (1)	—	—	— (1)	—	—
Labials to mideye	**3**	**1.5 ± 0.2**	—	—	**2.9 ± 0.1**	—
	— (4)	1.0–3.0 (15)	—	—	2.0–3.0 (13)	—
	3	**1.3 ± 0.2**	**3**	—	**2.8 ± 0.2**	**1**
	— (8)	1.0–3.0 (11)	— (1)	—	1.0–3.0 (12)	— (1)
	1	—	—	**3**	—	—
	— (1)	—	—	— (1)	—	—
Dorsals (axilla–groin)	**23.8 ± 0.6**	**22.0 ± 0.6**	—	—	**23.6 ± 0.6**	—
	22–25 (4)	18.0–25.0 (15)	—	—	20.0–28.0 (13)	—
	22.0 ± 0.8	**20.9 ± 0.7**	**20**	—	**23.4 ± 0.5**	**21**
	19–25 (8)	17.0–26.0 (11)	— (1)	—	20.0–26.0 (12)	— (1)
	21	—	—	**21**	—	—
	— (1)	—	—	— (1)	—	—
Ventrals (axilla–groin)	**23.0 ± 1.3**	**22.8 ± 0.7**	—	—	**22.8 ± 0.7**	—
	20–26 (4)	19.0–29.0 (15)	—	—	19.0–28.0 (13)	—
	22.0 ± 0.8	**23.0 ± 0.6**	**24**	—	**23.1 ± 0.8**	**23**
	18–24 (8)	20.0–26.0 (11)	— (1)	—	18.0–29.0 (12)	— (1)
	21	—	—	**28**	—	—
	— (1)	—	—	— (1)	—	—
Scales around midbody	**45.0 ± 1.0**	**38.6 ± 0.6**	—	—	**37.8 ± 0.9**	—
	42–46 (4)	35.0–42.0 (15)	—	—	32.0–43.0 (13)	—
	43.4 ± 0.7	**39.0 ± 1.2**	**36**	—	**37.3 ± 1.3**	**43**
	41–46 (8)	32.0–47.0 (11)	— (1)	—	30.0–43.0 (12)	— (1)
	46	—	—	**39**	—	—
	— (1)	—	—	— (1)	—	—
Escutcheon width (males only)	**20.3 ± 0.9**	**17.7 ± 0.8**	—	—	**18 ± 1.1**	—
	18–22 (4)	12.0–24.0 (15)	—	—	10.0–23.0 (13)	—
Escutcheon depth (males only)	**4.3 ± 0.3**	**4.7 ± 0.2**	—	—	**4.3 ± 0.2**	—
	4–5 (4)	4.0–6.0 (15)	—	—	3.0–6.0 (13)	—
4th-toe lamellae	**10.8 ± 0.3**	**9.5 ± 0.2**	—	—	**10.2 ± 0.2**	—
	10–11 (4)	9.0–11.0 (15)	—	—	9.0–11.0 (13)	—
	10.5 ± 0.4	**9.8 ± 0.3**	**9**	—	**10.1 ± 0.3**	**10**
	9–12 (8)	8.0–11.0 (11)	— (1)	—	8.0–12.0 (12)	— (1)
	11	—	—	**9**	—	—
	— (1)	—	—	— (1)	—	—

Table 3. Scale characters of *Sphaerodactylus macrolepis* in the British Virgin Islands.

Character	Carval Rock	Guana Island	Carrot Rock	Shark Rock	Tortola	Virgin Gorda
Dorsals	13 acute keeled	1 acute strongly keeled 23 acute keeled 1 acute weakly keeled	1 acute keeled	1 acute keeled	24 acute keeled	1 acute keeled
Gulars	2 smooth 7 weakly keeled 4 strongly keeled	18 smooth 3 some smooth/some keeled 2 weakly keeled 3 strongly keeled	1 some smooth/some keeled	1 smooth	16 smooth 4 some smooth/some keeled 4 weakly keeled	1 smooth
Dorsal caudals	11 strongly keeled 2 weakly keeled	2 strongly keeled 3 weakly keeled 20 some smooth/some keeled	1 strongly keeled	1 strongly keeled	3 strongly keeled 1 undetermined 20 some smooth/some keeled	1 some smooth/some keeled
Subcaudals	all smooth	all smooth	all smooth	all smooth	23 smooth 1 weakly keeled	all smooth
Enlarged	3/13	2/25	0/1	0/1	7/24	1/1

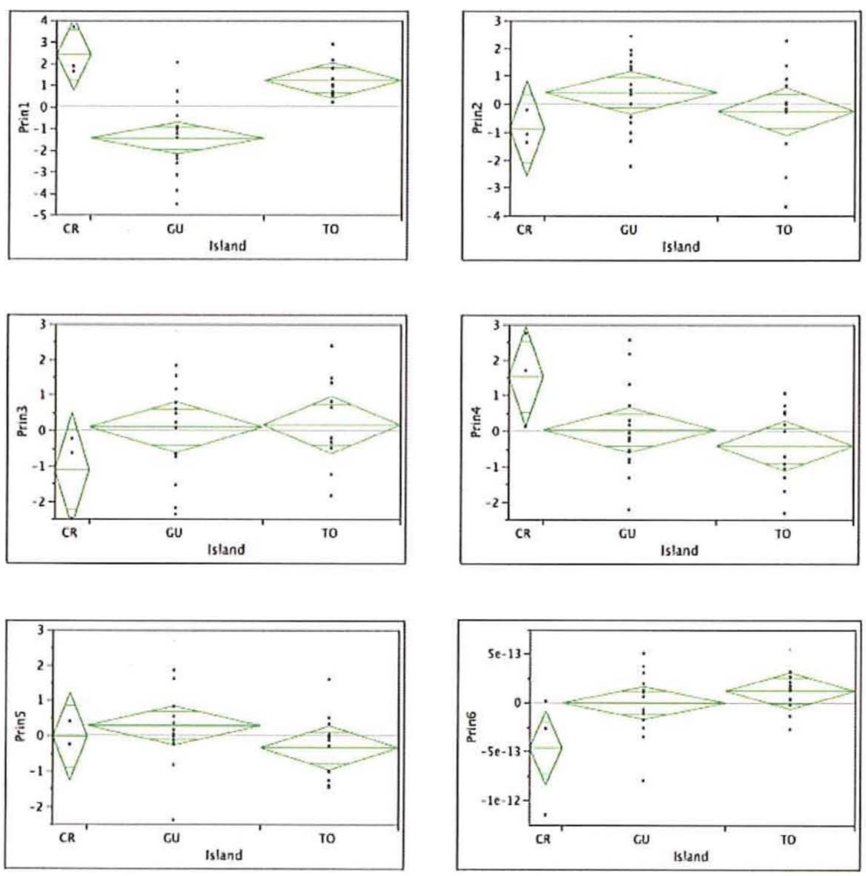

Figure 4. Principal components by island (CR = Carval Rock, GU = Guana, TO = Tortola): Prin1 (Eigenvalue = 4.07, Percent = 24.00, Cumulative Percent = 24.00), Prin2 (2.13, 12.53, 36.52), Prin3 (1.85, 10.88, 47.40), Prin4 (1.64, 9.65, 57.05), Prin5 (1.10, 6.50, 63.54), Prin6 (1.00, 5.88, 69.43).

Table 4. Loading of principal components (PC). Significant loadings (loadings >0.500) in bold. Signs provide an indication of which direction the trait values vary (if a population has a negative loading for a trait, then increasing PC scores for that trait mean decreasing values and vice versa for positive loadings).

Eigenvectors	PC1		PC2		PC3		PC4		PC5	
SVL	0.335	**0.676**	-0.010	-0.014	0.100	0.137	-0.233	-0.298	-0.065	-0.069
HL	0.320	**0.646**	-0.001	-0.001	0.148	0.202	-0.154	-0.198	0.148	0.156
HW	0.405	**0.818**	-0.030	-0.043	-0.072	-0.099	-0.282	-0.360	0.224	0.235
HD	0.344	**0.695**	0.126	0.184	-0.133	-0.180	-0.109	-0.140	0.057	0.060
Dorsals	0.130	0.262	-0.016	-0.023	0.278	0.378	0.187	0.240	0.576	**0.606**
Axilla-Groin (D)	0.257	0.519	0.013	0.018	0.320	0.435	0.376	0.481	-0.083	-0.087
Axilla-Groin (V)	0.072	0.145	-0.080	-0.117	0.476	**0.648**	0.315	0.403	0.010	0.011
Caudals	0.016	0.032	-0.235	-0.343	0.396	**0.538**	-0.248	-0.318	0.258	0.271
Midventrals	-0.330	**-0.667**	0.027	0.040	0.004	0.006	-0.074	-0.095	0.450	0.473
Gulars	0.022	0.044	-0.469	**-0.684**	-0.222	-0.302	0.324	0.414	0.221	0.232
Midbody scales	0.007	0.015	-0.043	-0.063	-0.110	-0.149	0.550	**0.705**	-0.045	-0.047
Internasals	0.134	0.271	0.045	0.066	-0.520	-0.707	0.106	0.136	0.403	0.423
Labials to mideye	0.412	**0.833**	-0.089	-0.129	-0.140	-0.190	0.061	0.078	-0.130	-0.137
Escutcheon depth	0.029	0.059	0.592	**0.864**	0.137	0.186	0.075	0.097	-0.014	-0.015
Escutcheon width	0.186	0.376	0.507	**0.740**	-0.095	-0.129	0.236	0.303	0.128	0.134
4th-toe lamellae	0.286	**0.577**	-0.285	-0.416	-0.058	-0.079	0.064	0.082	-0.257	-0.270

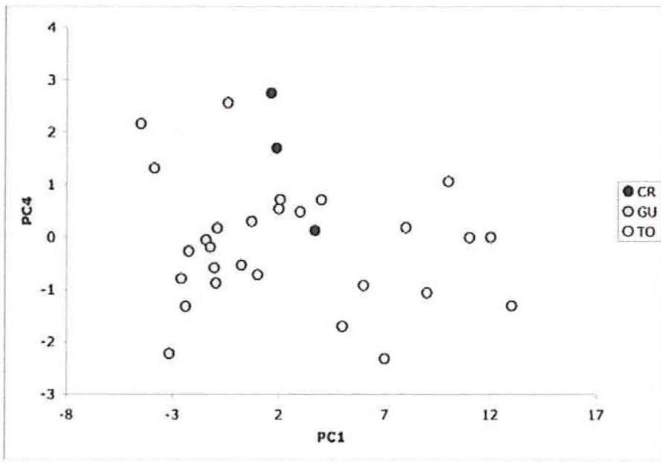

Figure 5. Comparison of populations of *Sphaerodactylus macrolepis* from Carval Rock (CR), Guana (GU), and Tortola (TO) in the British Virgin Islands along principal components axes PC1 and PC4 (see text).

Discussion

Variation exists among the populations of *Sphaerodactylus macrolepis* inhabiting the BVI, suggesting that different selective pressures are operative on islands of varying sizes, topographies, and climatic conditions. Although these could eventually result in populations distinct at the species level, that does not appear to be the case at this time. The initial observations that triggered this investigation and that led Perry & Gerber (2006) to suggest that the CR population was distinctive were based on very small sample sizes. An examination of a larger numbers of specimens, however, revealed that no characters were unique and capable of diagnosing any one island population in the region.

Nevertheless, the trends revealed by this study are indicative of adaptations by populations to local climatic conditions and are worthy of further examination. In particular, differences in head shapes and proportions, variable degrees of pigmentation, and sizes, characters, and numbers of scales might indicate exploitation of different prey, exposure to different predators, use of different microhabitats available on the islands, and varying degrees of resistance to desiccation, particularly important for small animals in dry habitats. Lizards in very dry habitats often have large, overlapping scales, thought to reduce water loss through skin exposed between scales (e.g., Calsbeek et al., 2006 and references therein), but exceptions exist, notably the small granular scales of some desert-dwelling geckos). Trends toward larger or smaller scales in varying habitats tend to be consistent within (Kerfoot, 1968) and between (Soulé and Kerfoot, 1972) species.

Carval Rock animals were larger, had relatively long, slender heads, high numbers of small body scales, gular keeling extending farther onto the venter, and color patterns more likely to consist of broken stripes reduced to series of dots, giving the impression of lighter, generally less intensely pigmented dorsal and lateral regions. Of particular interest might be the high number and small size of body scales in lizards from CR, presumably the most xeric environment among those on the three islands from which adequate samples were available. Although individuals from GU and even from much more mesic TO had high mid-body scale counts that overlapped (and, in one instance, exceeded) the range seen in CR animals, this seemingly incongruous state is intriguing — although MacLean (1985) suggested that very small lizards, such as dwarf geckos (*Sphaerodactylus* spp.) might merely be more adept at selecting more mesic microhabitats.

Soulé (1966) demonstrated that a negative correlation existed between island size and scale size in populations of *Uta* on deepwater islands in the Gulf of California and attributed this trend to presumably cooler climates on smaller islands and associated selective influences of heat absorption and radiation. Although no such evidence exists for lizards in the genus Sphaerodactylus or for any West Indian populations of lizards, the presence of consistently smaller scales in lizards from CR certainly suggests that further investigations are warranted.

Acknowledgements
Fr. Alejandro Sánchez provided the Carval Rock specimens and photo. The Museum of Comparative Zoology (Harvard University) and the National Museum of Natural History (Smithsonian Institution) loaned specimens from other islands. Fieldwork in the BVI by RP was funded by the Conservation Agency through a grant from the Falconwood Foundation.

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The big wildlife attraction on Guana is the Stout Iguana (*Cyclura pinguis*).

The Herpetofauna of Guana Island: An Annotated Checklist and Travelogue

Gad Perry[1] and Robert Powell[2]

[1]Department of Natural Resource Management, Texas Tech University, Lubbock, Texas 79409, USA
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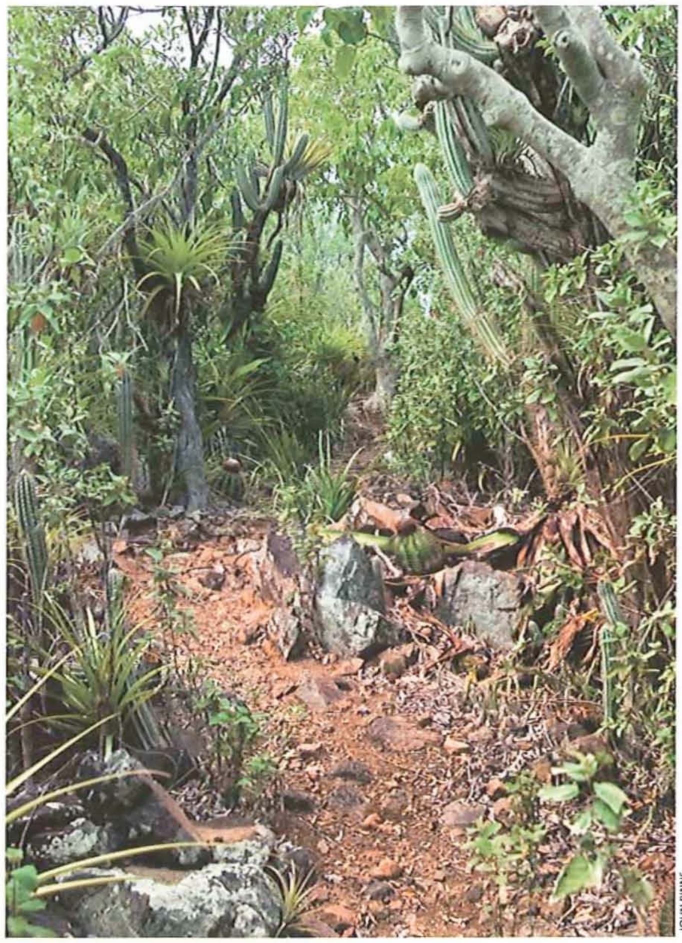
Guana Island is a remarkable place. A high-end working hotel much of the year (www.guana.com), this privately-owned island in the British Virgin Islands (BVI) is also an informal wildlife sanctuary. Each year in October, it serves as the home base for scientists studying everything from plants to bats. During "science month," Guana is the headquarters for scientific work that extends well beyond the island's shores. What allows all of this to happen is the generosity of the owners, who have supported the research for many years and are committed to the continued protection of the island and its remarkably diverse plant and animal life. Biological work on Guana was initiated in 1980 by Dr. James ("Skip") Lazell, and remains under his direction today. Herpetology is a major focal point of the work, but the scope is extensive and includes studies of soils and topography, plants and fungi, invertebrates, and all vertebrate groups. Disciplines represented have been heavily ecological and conservation-oriented, but also include archeology, ethology, physiology, remote sampling, and a broad range of systematic studies.

GOOGLE EARTH

Despite its relatively small size, Guana is a polyglot of varied elevations and habitats.



JOHN BINNS

Although ghuts (draws or arroyos) may be relatively humid, many of Guana's slopes and ridges are quite dry and are characterized by succulents and other xeric-adapted species.

GAD PERRY

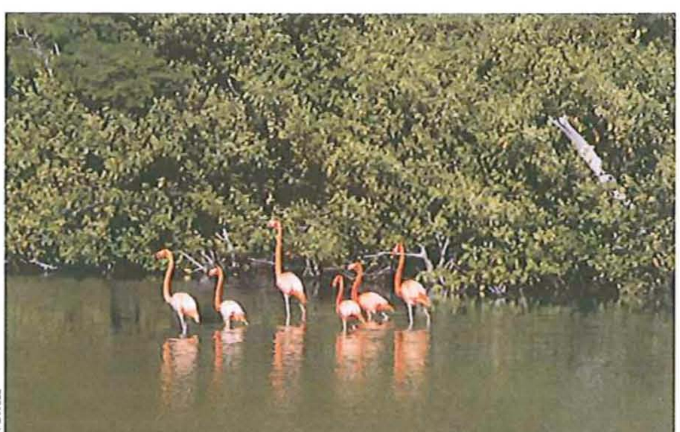
The dry tropical forest of Guana is home to several cacti, as well as trees and shrubs. The white stains on the rocks are guano from sea birds.

We have been fortunate to conduct work on this unique island for some years now, and to observe the work of many others. In the realm of herpetology, this includes basic inventories, descriptions of new species, and detailed studies of ecology, ecophysiology, and ethology. Conservation, including the restoration of the highly endangered

JOHN BINNS

With the hotel restricted to a small area along a single ridge and other visitor-frequented areas largely limited to the beach and nearby recreational areas (tennis, croquet, etc.), the vast majority of Guana serves as a nature reserve. Tortola is visible in the distance.

Stout Iguana (*Cyclura pinguis*), is a major focus as well. Finally, the scientists involved engage in varied educational efforts for groups ranging from the younger members of the owners' family, through school-aged local kids, to students from the local community college and from Texas Tech University. In this article, we present a travelogue, focusing on the island as a destination, discuss herpetologically oriented educational activities, and present an annotated checklist of its amphibian and reptilian species.



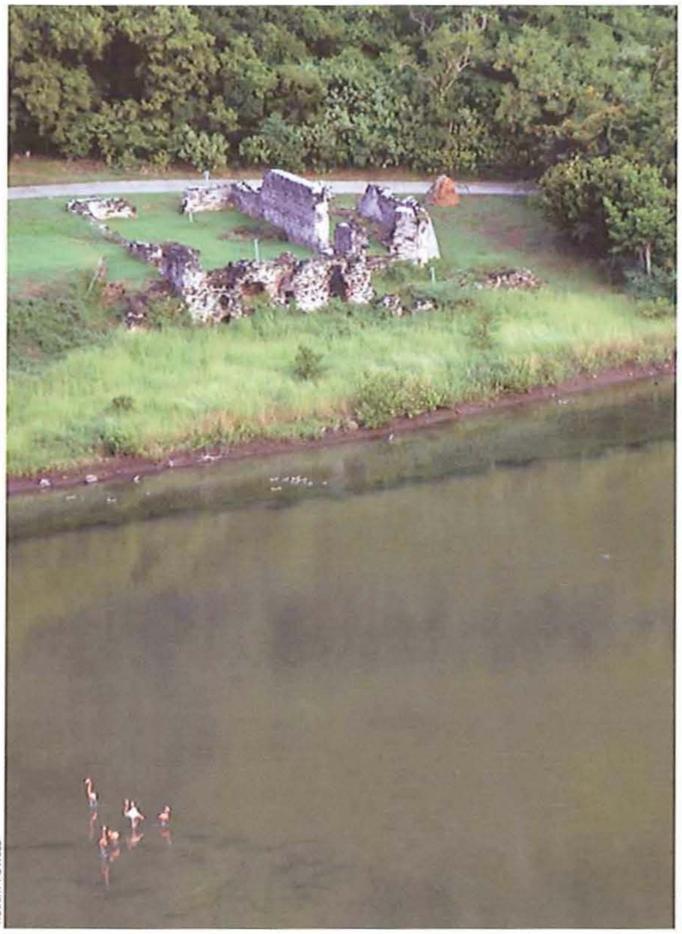
ROBERT POWELL

A small flock of Greater Flamingos graces the mangrove-bordered salt pond on Guana.

An Introduction to Guana Island

Purchased by the current owners in the 1970s, only a tiny portion of Guana is in any way developed. Most of the island is covered by tropical dry forest, a vegetation type that is more endangered but less often discussed than tropical rain forest. Also present are sandy and rocky beaches, a small patch of mangroves, and two types of ghut (the local name for arroyo) vegetation, one of which includes larger trees whereas the other contains a large number of native palms. Signs of the 18th-century Quaker habitation remain, primarily in the form of overgrown ruins readily exploited by today's reptiles; however, the Quakers engaged in very little cultivation and much of the island was untouched. Few Caribbean islands have been so effectively protected for so long. As a result, wildlife of all kinds abounds.

For paying guests, the small hotel offers a high-end experience focused on simplicity and nature. The rooms do not have air conditioning, large TVs blaring CNN, or constantly ringing phones. The number of guests is kept small, and no disco or casino disturbs the natural ambiance. On the other hand, the rooms are tasteful, the beds are very comfortable, the service is great, and the food is wonderful. Walking trails cover the island. The package that guests receive when they arrive includes a backpack, a diving mask, and a snorkel. They fall asleep to the sounds of the wind, the sea, and calling frogs. They



The ruins of an 18th-century Quaker sugar mill grace the shore of the salt pond.

wake up refreshed, and if they can't remember what day of the week it is, so what?

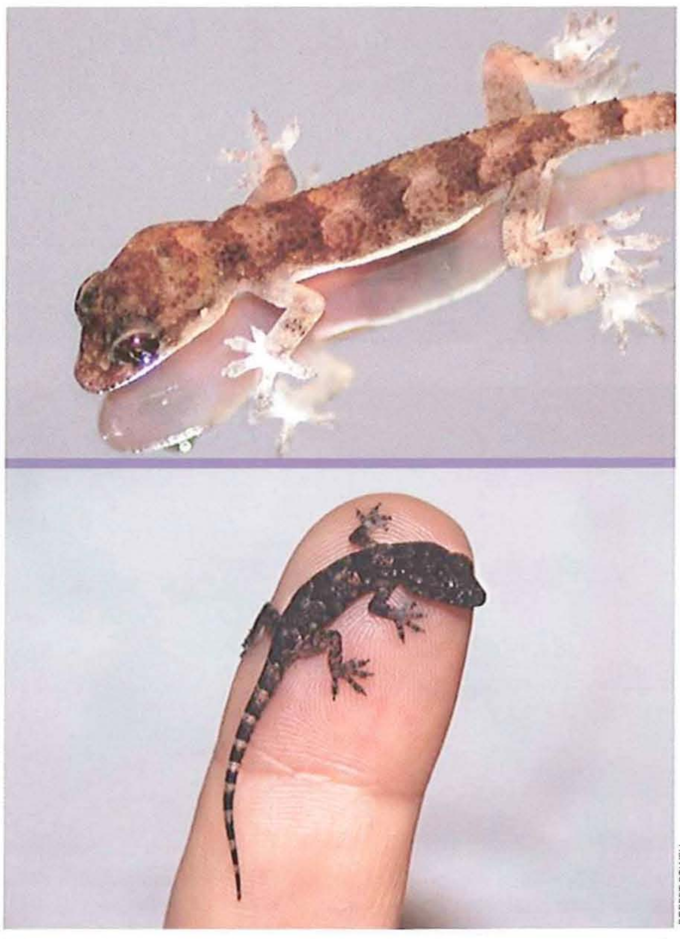
The Amphibians and Reptiles of Guana Island

Only one species of frog resides on Guana, the Puerto Rican Rainfrog, *Eleutherodactylus antillensis.* It is small, active mostly at night, and likes humidity. The call sounds like "chew-weep, chew-weep," but males also have a clicking call that they use to warn competitors away. A single Cuban Treefrog (*Osteopilus septentrionalis*) — an invasive species that is rapidly spreading in the region — has been captured on the island, but the owners have been quite aggressive in checking arriving plants and construction materials to make sure that this indiscriminant predator does not become established. No other Cuban Treefrogs have been seen, even as the species continues to spread, affecting native frogs and lizards on other islands in the area.

The waters around Guana are a good place to look for, and often find, sea turtles, especially the endangered Hawksbill (*Eretmochelys imbricata*). Few nesting attempts have been documented on the island, but several other sea turtle species can be found in the waters of the BVI, including gigantic Leatherbacks (*Dermochelys coriacea*), locally known as "trunk." The origin of the Red-footed Tortoise (*Chelonoidis carbonaria*) is still being debated. They may have dispersed to this area naturally, or they may have been introduced by early human settlers. Either way, the species had been eradicated from many of the islands in the region, but was restored to Guana through the work of Skip Lazell. Finding the tortoises is quite difficult; despite their relatively large size and colorful legs, they blend remarkably well with the dappled shade of the forest.

Another elusive resident is the Virgin Islands Worm Lizard (*Amphisbaena fenestrata*). When Lazell first came to the island, old-timers told him about an "earthworm with teeth." This eventually turned out to be a blind, burrowing lizard that does indeed resemble an earthworm. Like most other subterranean reptiles and amphibians, little is known about the biology of this species. They emerge after heavy rains, can be seen under rocks at some elevations at other times, and have very little resistance to water loss — but little else is known about them.

Two species of geckos occur on Guana. Puerto Rican Dwarf Geckos (*Sphaerodactylus macrolepis*) can be seen scurrying wherever leaf-litter and shade are abundant. Unlike most geckos, they are active during the day, on the ground, and lay a single egg instead of the customary two. Very small, these colorful creatures must protect themselves from excessive water loss and are most often seen during wet periods. Remarkable, despite their tiny weight — an individual weighing half a gram is a giant among sphaeros — the numbers of these lizards can be so high that their combined biomass exceeds that of wild game in the African savannah! Indeed, the Guana population was described as the world's densest terrestrial vertebrate a few years ago, with numbers in optimal habitat about 67,600 per hectare. The other species is the Cosmopolitan House Gecko (*Hemidactylus*



Cosmopolitan House Geckos (*Hemidactylus mabouia*) readily coexist with humans. These juveniles shared a room with one of the scientists, exploring the bathroom mirror at night.

mabouia), which resembles many other members of the genus in being nocturnal, climbing, and closely associated with humans. House Geckos are uncommon in the forest but can often be seen darting after insects on buildings at night. Most likely the species was introduced here hundreds of years ago, but the exact time of arrival has not been established. The larger South American Turnip-tailed Gecko (*Thecadactylus rapicauda*) has never been seen on Guana, despite being common on some of the Virgin Islands.

The three anoles found on Guana are all abundant. The Crested Anole (*Anolis cristatellus*) has been the most studied, with efforts


ROBERT POWELL


GAD PERRY


GAD PERRY

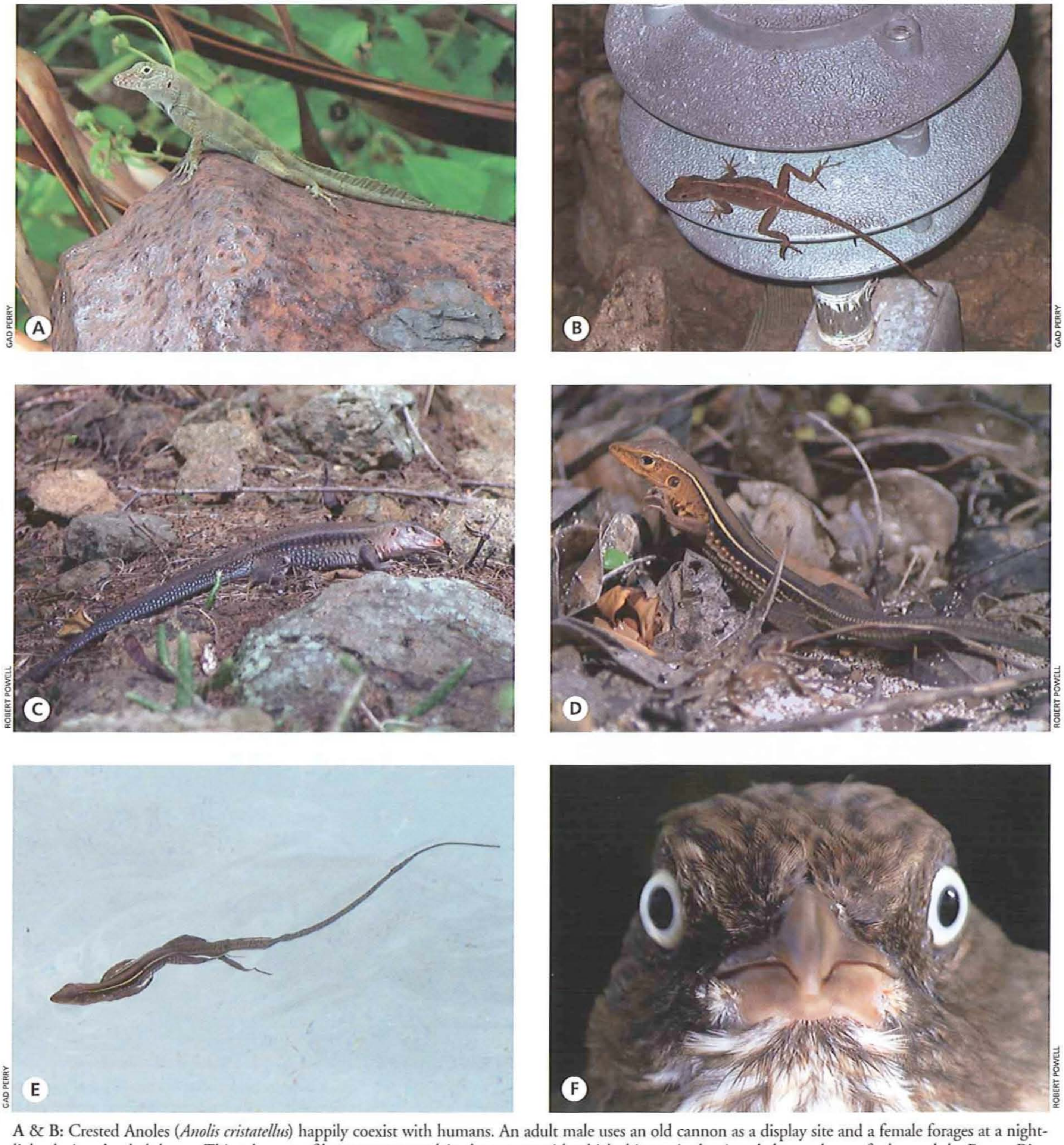

GAD PERRY


ROBERT POWELL


GAD PERRY

A: Locally known as the "Bo-peep" Frog, *Eleutherodactylus antillensis* is the only amphibian species on Guana. B: The team that inspected a barge full of ornamental plants bound for Guana to ensure that no Cuban Treefrogs hitched a ride. C: A young Red-footed Tortoise (*Chelonoidis carbonaria*) faces the world. Although historically present, tortoises had to be reintroduced onto Guana after disappearing for unknown reasons. D: An amphisbaenian (*Amphisbaena fenestrata*) making a rare aboveground appearance. E: Diminutive Dwarf Geckos (*Sphaerodactylus macrolepis*) may have the greatest population density of any vertebrate in the moist Sea Grape leaf litter near the beaches on Guana. F: A shiny Slipperyback (*Mabuya sloanii*). These skinks are not uncommon, but are rarely captured because of the alacrity with which they hide in dense (often spiny) vegetation or rock crevices.

focusing on abundance, territorial size, foraging behavior, diet, movement patterns, water loss, and more. The species is common and apparent in many areas, including the hotel itself. Males of this species are territorial, displaying often and occasionally engaging in fights that can last for over 30 minutes and involve much posturing, biting, and even knocking rivals off trees. Feeding primarily on invertebrates, Crested Anoles occasionally take small fruits. Anoles, in turn, are eaten by a number of the island's residents, including birds (Kestrels, two species of cuckoos, Pearly-eyed Thrashers) and snakes. The smaller Saddled Anole (*A. stratulus*) is equally abundant in many



A & B: Crested Anoles (*Anolis cristatellus*) happily coexist with humans. An adult male uses an old cannon as a display site and a female forages at a night-light during the dark hours. This tolerance of humans may explain the success with which this species has invaded several areas far beyond the Puerto Rico Bank. C: Adult male Puerto Rican Ground Lizards (*Ameiva exsul*) are encountered in patches of sunlight throughout the island. D: Ground lizards are sun-lovers and like it hot. When foraging in forested areas, they frequently pause in patches of sunlight to bask. E: No one had observed a ground lizard swimming before this photograph was taken of a young animal that jumped off a barge when chased, then swam back to safety. F: Aptly named Pearly-eyed Thrashers are aggressive predators of small lizards, birds, and insects, but also eat fruits.

places. Saddled Anoles often seem fearless, allowing people to approach very closely. On Puerto Rico, they often range very high into the crowns of trees, but on Guana, where trees are shorter, they are usually encountered at face level and even on the ground. The third anole on the island, the Puerto Rican Grass Anole (*A. pulchellus*) is both the most attractive and the hardest to see. Its elongated

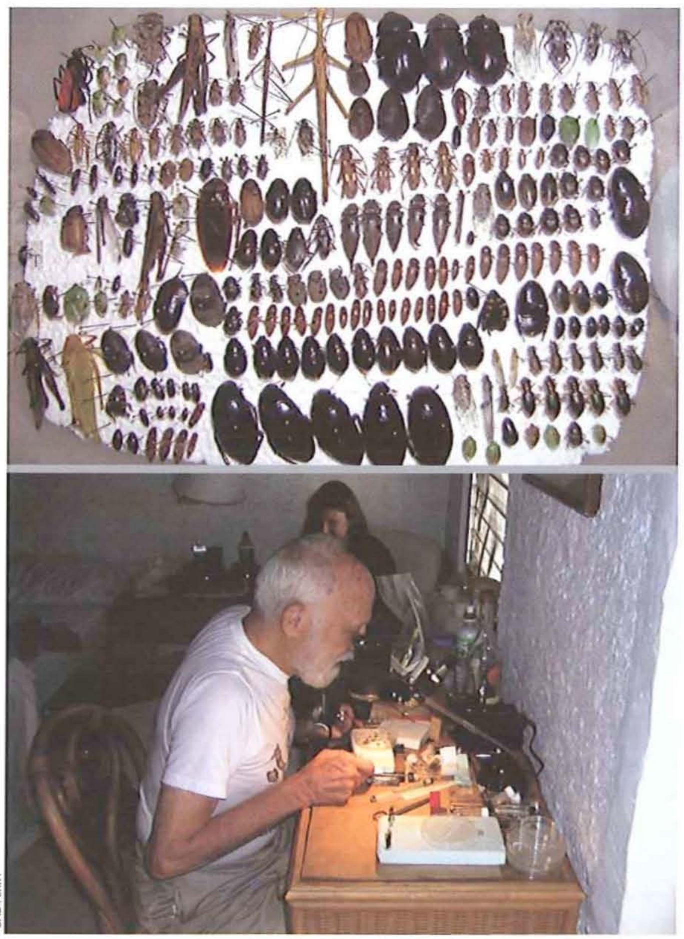
A: Lynford Cooper, Gad Perry, and James "Skip" Lazell (from left to right) insert an electronic tag in the tail of an adult Stout Iguana (*Cyclura pinguis*). B: Hatchling Stout Iguanas (*Cyclura pinguis*) are frequently seen on Guana during the hatching season in September and October. Hatchlings are captured, measured, injected with an electronic marker, numbered (this is No. 19), and released in order to gather data on growth, survival, and movements. C: Little is known about the biology of the burrowing blindsnake *Typhlops richardii.* Note the spiked tail tip, which is used as an anchor when burrowing and with which the snake will try to establish traction when handled. D: The Puerto Rican Groundsnake (*Arrhyton exiguum*), sometimes called the "Small Racer," is most frequently encountered on Guana after dark, but other populations are known to be active by day. E: Some but not all Puerto Rican Racers (*Alsophis portoricensis*) respond to threats with a cobra-like display. F: Although apparently rare, cannibalism does occur in the Puerto Rican Racer. Here, the larger snake died after ingesting the smaller one.

form merges imperceptibly with the narrow stems on which it lives. Like other members of the genus, however, males have well-established territories that are fiercely defended from other males.

Three more species complete the lizard list. First is a skink known locally as the Slipperyback (*Mabuya sloanii*). Like many other skinks, its scales are smooth and shiny. This species is most often found in shady, rocky areas. They quickly scurry into the vegetation or a crevice, and little is known about their biology. Some evidence suggests that what appears to be a single species in the BVI is actually comprised of several similar, but genetically distinct forms. The Carrot Rock population was described as a separate species some years ago, and analyses of other populations are ongoing. The Puerto Rican Ground Lizard (*Ameiva exsul*) is very conspicuous on sunny days — striped juveniles roam the ground, pushing their pointy snouts into leaf litter or crevices in search of insects to eat, while the more colorful and much larger males search for bigger prey and females. A few years ago, we documented, for the first time, that these lizards can and will choose to swim; we observed several individuals leap off a barge into the sea to avoid capture, swim like Marine Iguanas, then climb back onto the boat.

The big attraction among lizards is, of course, the Stout Iguana (*Cyclura pinguis*). One of the most endangered species in the world, even the most optimistic population estimates do not exceed 500 individuals. Half that number may be more realistic, and about half of them live on Guana. At one point, these iguanas were found throughout the greater Puerto Rico Bank (Puerto Rico proper, its satellite islands, and the U.S. and British Virgin Islands with the exception of St. Croix). Although even the experts disagree about the cause — some suggest that predation by humans and introduced predators is primarily responsible, whereas others implicate climatic changes — by the time 20th-century biologists arrived on the scene, the only iguanas still living were all on Anegada in the BVI. By the 1970s, their situation was becoming grim due to human persecution, predation by introduced cats, and competition from introduced ungulates. Hunters seeking food had long since extirpated flamingoes from Anegada, so, in the early 1980s, Dr. Lazell engineered a swap. In exchange for flamingoes, donated by the owners of Guana, eight iguanas were brought to Guana from Anegada. These began reproducing, and the Guana population has in the meantime both grown and become the seed for reestablishing the species on additional islands. Whenever it is sunny, iguanas are a common sight on Guana Island trails — especially after the juveniles emerge in September and October. Happily, the iguanas have been reintegrated into the local ecosystem and are eaten by both snakes and birds of prey.

Three snake species occur on Guana, but two of them are rarely encountered. One (*Typhlops richardii*) is a blind snake. Although quite common, it is rarely seen above ground, and its ecology is poorly understood. Another, the Small Racer (*Arrhyton exiguum*), is uncommon and secretive. On Guana, it is frequently seen at night, but the very small sample size — we normally see only one or two during our study season — means that we know relatively little about them. At the Sage Mountain Reserve on nearby Tortola, the highest



GAD PERRY

Dr. Barry Valentine, entomologist par-excellence, studying the day's catch. Above is part of his seasonal booty.

GAD PERRY

Dr. Kate LeVering holding the largest Racer ever caught on Guana. The kind of tail damage (inset) is common, but its cause remains unclear.

ROBERT POWELL

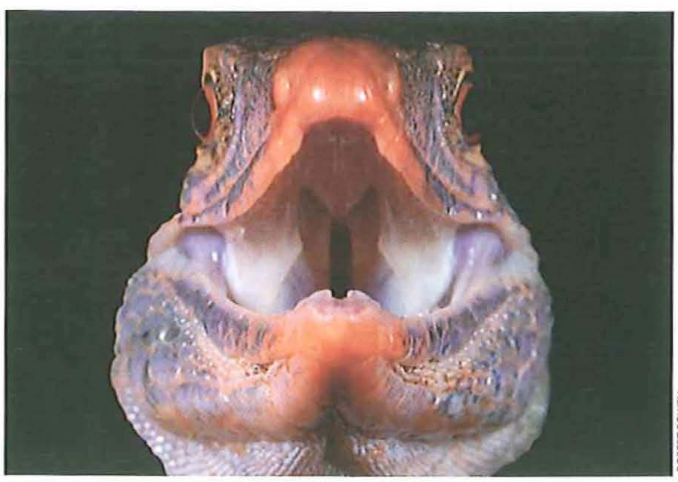
Male Saddled Anoles (*Anolis stratulus*) are fiercely territorial. Their dewlap displays add a splash of bright color to the dry forests of Guana.

ROBERT POWELL

Slender Puerto Rican Grass Anoles (*Anolis pulchellus*) often are hard to see among blades of grass.

and wettest spot in the Virgin Islands, this species is much more common and active during the day, suggesting that high rates of water loss may be a limiting factor on Guana.

The Puerto Rican Racer (*Alsophis portoricensis*) is abundant on Guana. On many islands in the region, the introduction of cats and especially mongooses has decimated the populations of ground-dwelling snakes and lizards, but Guana has no mongooses. Consequently, anyone walking the trails of Guana with their eyes open is virtually guaranteed to encounter at least one of these animals. In the last few years, we have been part of a project that individually marked and measured some 500 individual animals, and we are a long way from having a complete inventory — low rates of recapture suggest that the population is in the thousands. These snakes are active throughout the day and seem to exploit every available habitat on Guana. Because of the high densities and intensive effort, we have been able to document previously unobserved behaviors such as swimming, cannibalism, and feeding on baby iguanas. We have noted that some individuals will flatten their necks in a cobra-like display when threatened, although we do not yet know how this helps the animals or why only some snakes do it. We also noted that virtually all adults are missing the tips of their tails, but are not yet sure what is responsible.



ROBERT POWELL

Adult Puerto Rican Ground Lizards (*Ameiva exsul*) have powerful jaws and can inflict a painful bite.

One final snake closes this list, the Virgin Islands Boa (*Epicrates monensis*). This endangered snake was reported from Guana many decades ago, but has not been seen since then despite repeated searches. Suitable habitat appears to be present, and we do not know if we simply have not yet found this nocturnal snake, whether the original record was erroneous, or if the species was once present on Guana but has since disappeared for an unknown reason. That the species is relatively common on nearby Tortola gives us hope that it may yet be found on Guana.

ROBERT POWELL

Two male Crested Anoles (*Anolis cristatellus*) fighting over a territory centered on a date palm. This battle lasted over 30 minutes and ended with the slightly larger invader displacing the former resident.

ROBERT POWELL

Puerto Rican Racers (*Alsophis portoricensis*) appear to exploit every habitat on Guana, including the hotel grounds — which illustrates the ability of humans and snakes to coexist when the latter are not persecuted.

Herpetological Education on Guana Island

Research is important, but disseminating knowledge is just as crucial. One part of that mission is accomplished by articles such as this and by more technical publications in other journals. Another part, however, is educating people face-to-face. Over the years, participants in the Guana Island science month have done this in many ways. For the general public, scientists present their work on Guana and elsewhere at an annual symposium held at the H. Lavity Stoutt Community College on Tortola. This event attracts residents from throughout the BVI. Several local groups, ranging from boy scouts to college students, come to Guana each year and interact with the scientists. The hope is that a better-educated public is more inclined to support conservation action throughout the BVI, most of which remains poorly protected.

Another important educational effort centers on US-based students. Over the years, both undergraduates and graduate students have come to Guana. Undergraduate classes are typically diverse, combining lectures with hands-on experiences. Graduate classes are research-oriented, teaching not only about tropical ecology and conservation but also how to conduct group research and get it published in the peer-reviewed literature. Herpetological projects have focused on anoles, ground lizards, and dwarf geckos. In addition, individual students have been involved in projects on racers, iguanas, and Crested Anoles, and some of those studies have led to published articles.

The final group with which we work on a regular basis includes the children and grandchildren of the island's owners. As they will make the decisions about the management of the island in the future, we want them to learn to love it and its inhabitants. In 2008, we spent close to a week teaching them about herpetology, with Jennifer

ROBERT POWELL

The recent discovery of the Virgin Islands Boa (*Epicrates monensis*) on a nearby island lends credence to reports of the species on Guana, where it has not been seen since an unverified report many decades ago.

GAD PERRY

Joydeep Bhattacharjee talks about invasive Saltcedar trees at the annual symposium held at the H. Lavity Stoutt Community College on Tortola.

ROBERT POWELL

Dr. Matt Gifford talks to Pathfinders from Tortola about Guana's ground lizards.

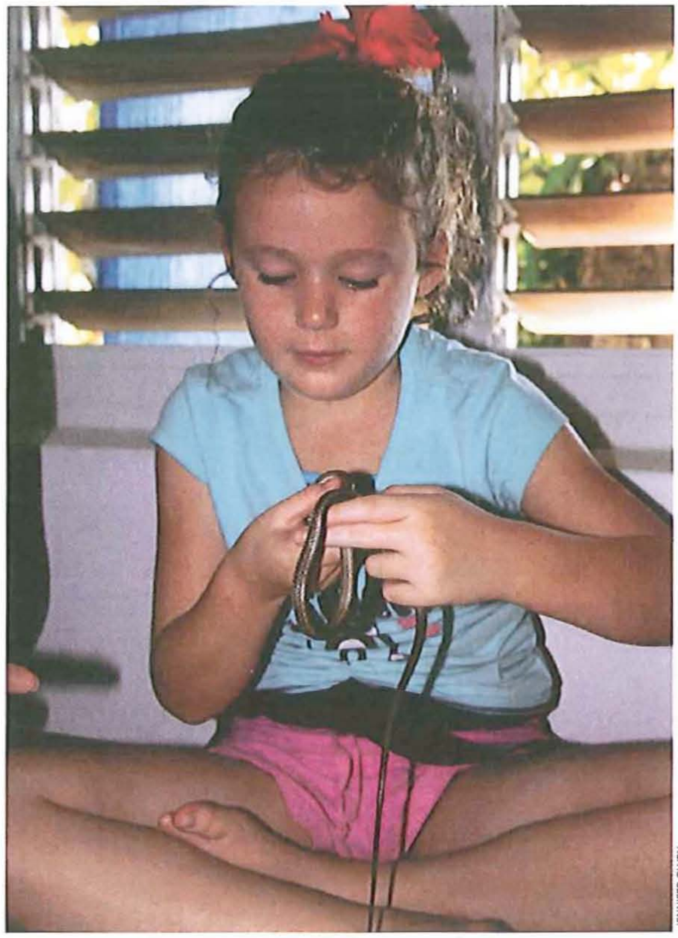
JENNIFER OWEN

The children meet a hatchling Stout Iguana marked #6.

Owen leading the program. The "boxes" on the facing page present some of their comments in their own words.

Acknowledgements

We are indebted to the owners of Guana Island for allowing us repeated access to this unique place. Support for this project was provided by The Conservation Agency through a grant from the Falconwood Foundation, and by Texas Tech University. The Guana Island staff deserves special thanks not only for putting up with the strange requests of scientists all these years, but also for getting into the spirit of things and helping with the work. This is manuscript T-9-1160 of the College of Agricultural Sciences and Natural Resource Management, Texas Tech University.



JENNIFER OWEN

Mckenzie Jarecki gets to know a Puerto Rican Racer (*Alsophis portoricensis*).

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Emily Chandler – age 8

This year on Guana Island, we worked with herpetologists to find out more on reptiles and amphibians. At first we all sat down and briefly discussed the different categories of animals in the world. Then we talked about the way scientists classify animals and played a few games to teach us which animals go in which categories. We each designed our own pretend reptile on paper and shared it with everyone before we started learning about real reptiles. The biggest category of reptiles on Guana is snakes and lizards. We learned how to make our own nooses and went out catching lizards, such as anoles. Then we learned how to mark, measure, weigh, and inject a tag into the animal to help track its information in the future because we hope to catch it again. Then the scientists wrote down all their information, called data, in a book. If they catch the same animal again, they can learn about how much it has grown, how much it has eaten, if any predators have gotten to it, and how far it moved.

We divided into groups to study different animals. My group studied the Bo-Peep Frog (*Eleutherodactylus antillensis*). I got my information by interviewing a scientist who studies these frogs. I asked her where it lives, what the scientific name is, what it eats, what its predators are, what calls it makes, what it looks like, what it is attracted to, how long it lives, and what places it might be found in. She answered all these questions for me and from that we made a PowerPoint presentation of the information.

James Chandler – age 9

On Guana Island this year, we studied herpetology, which is the study of reptiles and amphibians. The scientists introduced us to all of the different classes of animals, and we reviewed how animals are classified, which we had learned the year before. Then we started to zero in on reptiles and amphibians. We studied the different groups of reptiles first, which are turtles & tortoises, crocodilians, snakes & lizards, and the last living species, called the Tuatara, from an extinct group.

While we were doing this, the scientist split us into groups for our separate projects to come later. Mine was the Rock Iguana (*Cyclura pinguis*).

Some of the things we learned were how to tag and mark lizards and snakes and how they are tracked with radio transmitters. We were also lucky enough to watch the life and (natural) death of a snake and all the things scientists do to it, such as marking, weighing, measuring, recording the information, and setting it free in hopes of capturing it again later. In the case of the one that died, we were able to watch it being preserved and prepared for shipment to a museum. We discussed the idea of scientific ethics and trying not to hurt animals.

Then we got to work on our own projects. My group got our information by interviewing the scientists who study the Rock Iguana in real life. The Rock Iguana is endangered and is only found in the Caribbean. There are about 300 left on Guana Island, about 150 on Anegada, and about 100 on Necker Island. We learned about its habitat, what it eats, and what eats it (predators). Together we made a PowerPoint presentation explaining our information.

Diana Chandler – age 12

This year over the course of five days, I worked on a project with a herpetologist and our main topic was male Crested Anoles. We studied the size of the anole's territory by looking at their movement patterns. To get the data, we learned to catch the anoles with nooses and mark them with nail polish on the back so they could be identified when we caught them again. We then took measurements of the tail, body, and head, weighed them, and recorded all our information. Then, we had to put them back right where we found them so that we could see how far they had moved when we (hopefully) caught them again. We caught approximately 30 anoles, including recaptures, in all. The conclusion that we drew was that male Crested Anoles can expand their territory in one day up to 40 feet, though sometimes their territory remains a single tree. Also, even the ones that traveled tended to prefer remaining in trees.

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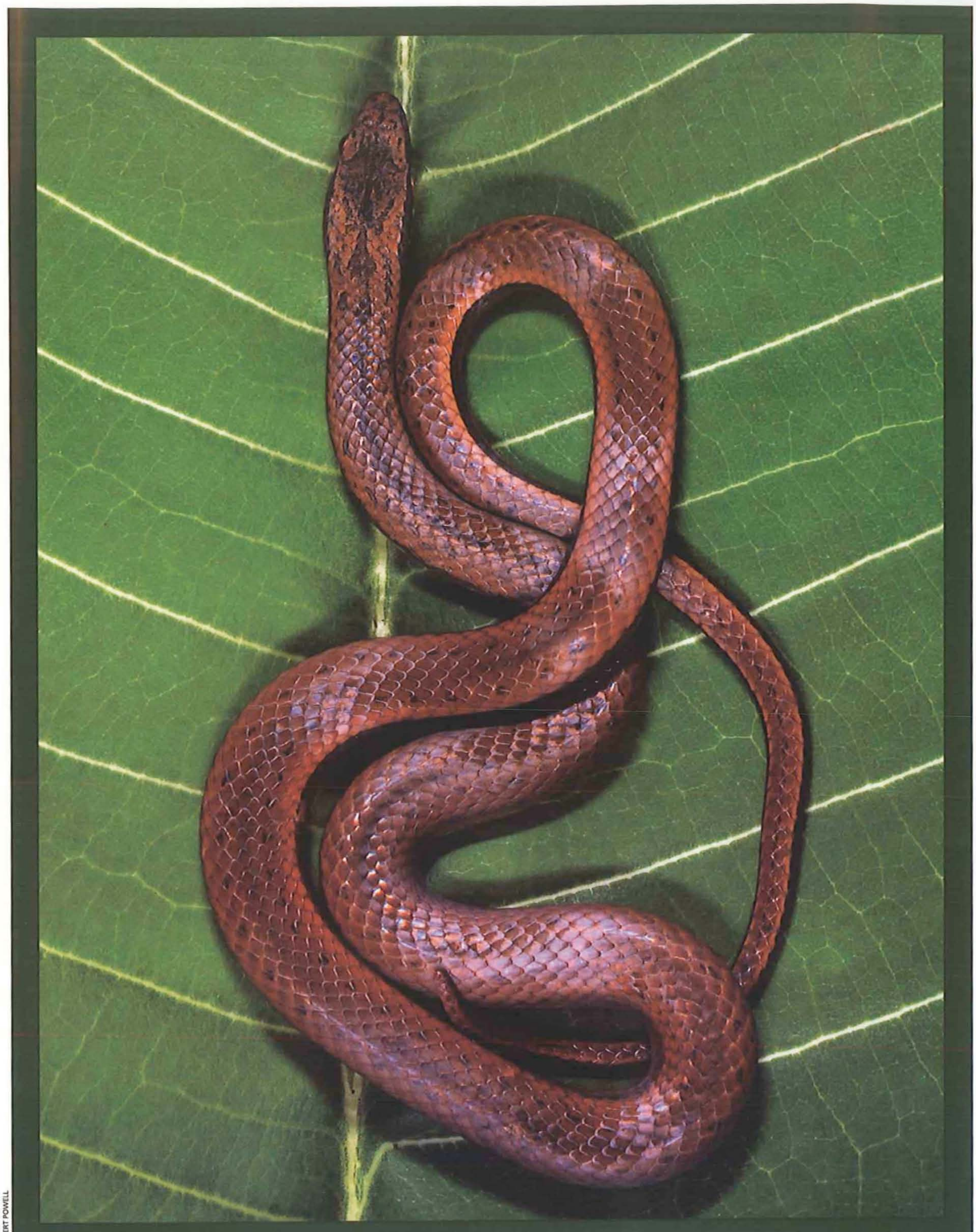

ROBERT POWELL

Puerto Rican Groundsnakes or Small Racers (*Arrhyton exiguum*) are uncommon and secretive on Guana Island in the British Virgin Islands. However, at the Sage Mountain Reserve on nearby Tortola, the highest and wettest spot in the Virgin Islands, these snakes are much more frequently encountered, suggesting that the dry conditions on Guana may limit activity and numbers. See article on p. 6.