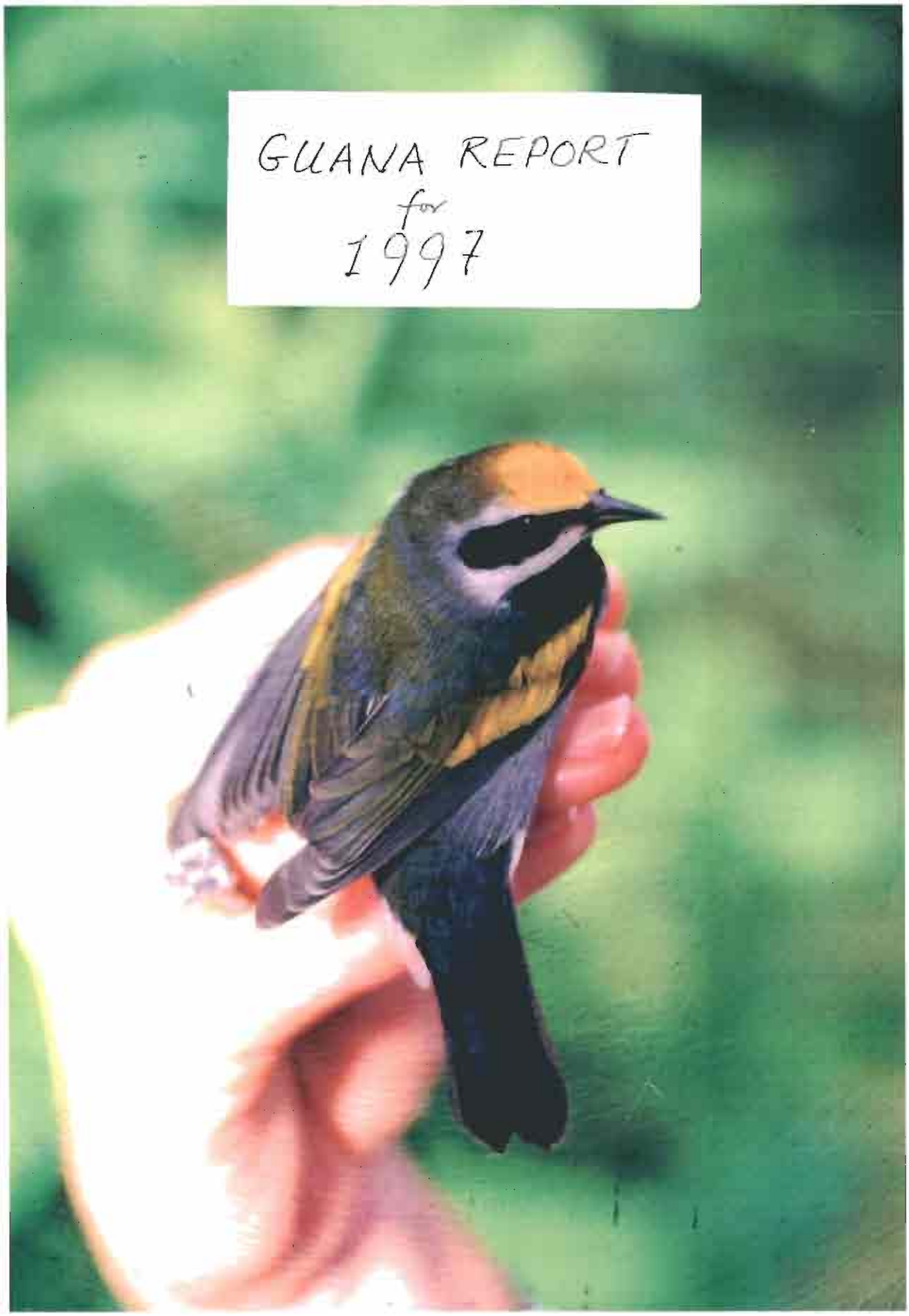
GUANA REPORT
for
1997

The Conservation Agency

Exploration, Education, and Research

President
James D. Lazell, Ph.D.
401-423-2652

30 April 1998

6 Swinburne Street
Conanicut Island
R.I. 02835 U.S.A.

Dr. Henry Jarecki
10 Timber Trail
Rye, NY 10580

Dear Henry:

Herewith a works and progress report for 1997. All of our 1996 "in press" papers are out except a short frog note and the second Anolis lizard physiology article. Some journals are just slow.

Two more frog and two more lizard papers are done and submitted: typescript copies here. One beetle paper is still in press, but Mike Ivie is still holding up the beetle paper Wenhua and he are co-authoring (theoretically) -- for no good reason we can envision. I am not sure what the hold-up is on George Proctor's Flora Guanae; I am on his case.

I have mailed stout iguana articles to Bert Lettsome, Joseph Smith-Abbot, Louis Potter, and GIC. I believe we must begin to get more populations established, and so does the entire scientific community that has considered the issue. No one is going to understand further delays. I have expressed to all concerned our willingness to help with revegetation -- for example, on Fallen Jerusalem -- and provide stock. Of course, you have to give permission for that. I have asked Louis Potter to ask you to do that.

October 1998 will be complex and a bit different, mostly because of the Fish and Wildlife Service project of clearing 100m² plots for total biomass evaluations. This project gives us international exposure because Guana will be the standard of comparison against which other islands, like Guam and Rota, will be compared.

As always, I look forward to your comments and questions.

All the best,

Slip

CONTENTS

Cover Story

The golden winged warbler, Vermivora chrysoptera, is a new record for the Virgin Islands. Dr. Raffaele states: "A rare but regular winter visitor to Puerto Rico. There are no certain records from the Virgin Islands. This species prefers the high mountain forests of the interior." This species is in bad shape on its North American breeding grounds because it lives in open country of the very sort humans utilize for agriculture and urbanization. It is declining and Morse writes that it is "predicted that if the pattern continues, the Golden-Winged Warbler may be rare or even extinct within a century."

This is but one -- and one of the most spectacular -- of the many species of "neotropical migrants" for which information is so badly needed to achieve conservation goals. See Fred Sibley's report and my proposals section, below.

References

Morse, D.H. 1989. American Warblers. Harvard University Press, Cambridge.

Raffaele, H.A. 1983. A guide to the Birds of Puerto Rico and the Virgin Islands. Fondo Educativo Interamericano, San Juan.

West Indies Region

ROBERT L. NORTON

This season produced some high numbers of migrants in the northern part of the Region—particularly evident at Bermuda, a phenomenal migrant trap for Nearctic, Neotropical, and Palaearctic species. However, no island in this Neotropical realm seems to be more strategically located for attracting Palaearctic vagrants, as well as passage migrants, than Barbados. Already, this island may be the responsible portal for the invasion or fusion of two, perhaps three ardeids, in the New World (Cattle Egret, Little Egret, perhaps Western Reef-Heron). Sub-regional contributors Massiah and Frost, relentless in their pursuit of documenting rarities, have documented increased nestings of the "Littles," and are anxious to see if their prediction of a Little Egret explosion in North America will occur in 1997. And you will find their quest for the pratincole, yet another Regional record, paid off. Surveys of the Bahamas by members of the Bahamas National Trust, with the assistance of Ailene Bainton, Tony White, Bruce Hallet, Dave Lee, and many others are also paying big dividends.

The weather in the northern quadrants (Bermuda to Bahamas) was windy and cool. The effects of last year's numerous storms were felt from the Virgin Islands to the Bahamas, particularly by tree-nesting seabirds. While these populations may rebound from natural catastrophes large or small in scale, habitat loss from human endeavors may prove to have lasting effects on land birds (*see woodpeckers, nuthatches, and orioles*).

Abbreviations: Ba (*Bahamas*); Bd (*Barbados*); Be (*Bermuda*); BVI (*British Virgin Islands*); GB (*Grand Bahama*); NP (*New Providence, Bahamas*); El. (*Eleuthera, Bahamas*); SS (*San Salvador, Bahamas*).

Loons to Gulls

A moribund Com. Loon discovered at Dolly's Bay, St. David's, Be Dec. 22 was the first recorded there in 20 years (*fide* AD). A Manx Shearwater seen Jan. 30 off Bermuda was apparently early (AD). Sailing from Green Cay to Royal Island, Ba Feb. 24, Bainton counted about 35 Audubon's Shearwaters resting on the surface before they lifted away. In the Virgin Islands, this shearwater is already on eggs by Feb. 14 at some of the smaller islets (RLN). Red-footed Boobies (three) are hanging on at White Cay, SS, despite storm damage to previous nesting sites (*fide* BH *et al.*). An adult was on a nest Jan. 21, but the contents could not be determined. A Neotropical Cormorant was noted Dec. 12 at N. Great Abaco (DLe, MW-M). A Magnificent Frigatebird was an unusual find at the South Shore, Be Nov. 28 (SD). Rowan Roy of the British Virgin Islands sent a photograph of the hurricane decimated Great Tobago, BVI, frigatebird colony, 2nd largest on the Puerto Rican marine bank. The BVI National Park's efforts to remove goats from the island are critical to the recovery of vegetation and providing essential nesting habitat for this important colony.

NB: "critical," I said, in 1980. No change yet, except for the worse.

The Ornithological Council

PROVIDING SCIENTIFIC INFORMATION ABOUT BIRDS

REPORT ON RESEARCH VISIT TO GUANA ISLAND AND VIRGIN ISLANDS 11-19 October 1997

Submitted by Betty Anne Schreiber

American Ornithologists' Union
Association of Field Ornithologists
Colonial Waterbird Society
Cooper Ornithological Society
Pacific Seabird Group
Raptor Research Foundation
Wilson Ornithological Society

Introduction

During this visit to Guana and the Virgin Islands we surveyed the nesting seabirds of Guana Island and some of the Virgin Islands. Additionally we collected blood samples of seabirds and morphometric measurements for a study of the taxonomic status. We are carrying out a worldwide study of the taxonomic status of some of the pelecaniform birds (frigatebirds, boobies, tropicbirds, pelicans). The original subspecies of these birds were designated simply by assigning all the population in a geographic area to a single subspecies. For instance, in all cases, the Caribbean basin and nearby Atlantic were considered to be a single subspecies of each species simply because of geographic proximity. There are no data to support this designation for any of the subspecies and from our banding data, we believe there is a need for a true evaluation of these designations. For this analysis we are

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collecting blood samples and taking various body measurements for a comparison of the species throughout their range.

We met with the Department of Conservation and Fisheries and the National Parks Trust during our visit to discuss conservation needs and priorities for seabirds. We met with Richard Winchell, Director of the Bermuda Aquarium and Zoo, to discuss flamingo conservation and the population on Anegada. We also spoke on conservation problems of seabirds in the Virgin Island at the annual scientists night.

Unusual Weather Conditions

Beginning with rain all day on 12 and 13 October, an unusual front moved into the area bringing extensive, heavy rain and abnormal, strong westerly winds. Winds ranged around 40 miles per hour with gusts to 50 mph on 14 and 15 October. Conditions began to calm down on 16 October and by 17 and 18 October we were able to visit islands by boat. These unusual conditions were attributed to the ongoing El Nino-Southern Oscillation Event that has been underway in the central Pacific since mid-Spring 1997. ENSO events in the past have also brought a suppression of the hurricane season in the Caribbean.

Owing to the bad weather conditions we were not able to spend as much time in the bird colonies as we had wanted. Thus, our sample sizes for measurements are too small for a good test of significant differences among islands at this point. During some future visit to the area we would plan to increase this sample size.

Guana Island

We surveyed Gauna for seabird nesting activity and found none during this visit. The area along the trail to Long Man's Point where brown pelicans (*Pelecanus occidentalis)*were nesting in 1996 showed signs of successful nesting again in 1997. Some fledglings continued to roost in the area, and there was guano built up around the nest sites. No nests were present at Palm Ghut next to North Beach: another nesting area which was used in 1996. Chicks could have fledged from there this year, too. Other potential pelican nesting sites could not be observed closely enough to determine if successful nesting had occurred. However, the presence of many just-fledged young feeding around the area indicates that they had a very successful nesting season this past year. Patricia Bailey reported about 150 pelican nests on Norman Island during 1997.

We surveyed the area of cliffs along the north side of Long Man's Point where brown boobies (*Sula leucogaster*) are reported to have nested in the past. In watching birds in the area and looking at the site, I believe it is unlikely that brown boobies have nested here, but that they simply use the area as a roost. Brown boobies generally nest on broad, mostly flat, open areas not on cliff ledges. They also tend to space their nests more apart than most other boobies, something that would not be possible on the north cliff face. Seabirds commonly have roost sites from which they foray out to find food during the day, that are different sites from the nesting areas. I believe the north cliff face is one of the local roost sites for brown boobies. Safe roost site are very important to the survival of breeding birds in an area. Birds must spend 2-3 hours per day preening and taking care of their feathers. If they are continually disturbed they cannot do this and will not remain in an area. Guana provides one of the few remaining places in the BVI where birds can roost safely.

Great Tobago Island

Personnel from the National Parks Trust took us to Great Tobago where we were able to asses the number of nesting brown boobies and magnificent frigatebirds (*Fregata magnificens*). We also collected blood samples from both species and took measurements of adults. Goats are still present on the island. We saw 6 just in the top saddle area and estimate that there are 14-20 on the island. Personnel from the Dept. of Conservation and Fisheries told us they had sent policemen out to cull the herd. We did find a large net strung across a ghut on the west side of the island with two goats stuck in it. This could have been put up by the policemen to herd goats into to kill them.

Frigatebirds were in various stages of nesting: some were courting and building nests, others incubating, and a few had small chicks already. I estimate that there were 350-400 nests present and that more will be present by the end of the laying season. In 1996 we estimated that there were about 500 nests on the island. I estimate that there were about 100 brown booby nests on the island. In past years up to 200 nests were present and this reduction in nests could be due to the presence of goats. Since brown boobies nest on the ground they are particularly susceptible to having their nests trampled by goats, killing young and eggs. Nests were in all stages from having eggs to 8 week old chicks.

Goats continue to graze and erode the island causing damage not only to the nesting bird populations but also destroying the surrounding reef with eroded soil. The continued presence of the goats will eventually destroy the island for nesting birds. Currently no new trees are growing and when the nesting trees of frigatebirds are eventually blown down or die, they will have no where to nest. Erosion and continued trampling by goats will wipe out the remaining brown

booby nests. I recommend the immediate removal of the goats. This may take several trips to the island. A large enough group of people should be used so that goats can be herded toward one end.

Beef Island.

Personnel from the Dept. of Conservation and Fisheries took us on a tour of Beef Island and showed us the development plans for the island. There are some very important wetland areas around the island that are currently proposed for development. Development of these wetlands will significantly reduce the productivity of the waters in the BVI. As fishing success of local fishermen declines, these areas become vitally important as some of the last nursery grounds for fish and crustaceans. Developing them will reduce fishing success even more. Wetlands also serve as important buffer zones for hurricanes, absorbing much of the impact of the storm before it reaches inland areas and greatly diminishing the damage they do. From seeing the area and the information the Department provided us, we will be writing a letter to the Chief Minister and others in the BVI government recommending the preservation of the wetlands on Beef Island.

Cockroach Key US Virgin Islands

Personnel from the US Fish and Wildlife Service took us to Cockroach Key where brown boobies and masked boobies (*Sula dactylatra*) nest. Both species are ground nesters. Access to the island is extremely difficult. The surrounding waters are very rough. Access is by swimming ashore and timing the climb out onto rocks between the surges of surf, risking getting smashed on the rocks if you miss. Then you have to climb up a steep cliff to the top plateau. I estimate there were 20 brown booby nests, all but 3 with eggs, and 28 masked booby nests with eggs or

small chicks. The birds nested in single species groups of 2 to 6 pairs. There is dense, 12-24" high sedge over most of the island that is totally unsuitable for nesting by the birds. Thus, the nesting birds are confined to the small areas of no vegetation. It may be that the nesting population would increase if the sedge could be removed. Cockroach provides one of the few safe nesting areas for seabirds in the Virgin Islands owing to the difficulty of people landing there.

Meetings with Dept. of Conservation and Fisheries and National Parks Trust

During meetings with both these agencies we discussed local conservation problems and needs for seabirds. I provided both departments with a list of educational programs, and contacts for them, available for local schools from US agencies. I also provided them with the application forms and directions for applying for assistance from RAMSAR to protect local wetlands areas. Previous to this I had spoken with representatives at RAMSAR in Geneva and been assured that they would help in any way they can to establish some protected wetlands in the BVI. They do however, need to be asked by the local government.

We discussed the importance of posting signs on some islands used by seabirds to protect them from boaters. We also discussed the importance of banding birds as a way of tracking movements, determining survival rates, etc. Mr. Lettsome and Mr. Drayton both spoke of the desire to accomplish this. A representative from the U.S. Fish and Wildlife Service in Puerto Rico has agreed to spend some time this coming May with personnel from the Dept. of Conservation and Fisheries doing roseate tern banding. This is an endangered species in the United States and its status is not well-known in the Caribbean. I provided both organizations

with a set of books I had written on brown pelicans, terns and gulls that can be used for management of these species.

General Conservation Recommendations

There are few places that seabirds can nest safely and successfully in the Virgin Islands. Most islands are visited by boaters and poachers. Visits by boaters during nesting cause desertion of nests. Small chicks and eggs bake in the sun while adults are disturbed off nests and wandering chicks, running from intruders, get pecked to death by neighboring adults. Most birds have been forced onto almost inaccessible islands in order to nest successfully, yet there are few of these islands, and thus many fewer seabirds today.

As ecotourism grows, the natural resources of the British Virgin Islands can be a valuable asset if they are preserved. In other areas of the Caribbean, local fishermen are supplementing their income by taking tourists to see bird colonies. With proper training of guides, and proper regulations in place, this could be done in the BVI, also. I have offered to assist both the National Parks Trust and the Dept. of Conservation and Fisheries with this if they would like.

Recommendations to preserve seabirds:

1) Remove introduced mammalian predators from islands.
2) Set aside some islands as preserves and do not allow tourist visits and boaters on them.
3) Institute and enforce laws that protect seabirds and their designated nesting habitat. This includes having stated penalties for entering colonies without permission. These protected islands should be posted with signs.
4) Set up a program of ecotourism so people can enjoy and learn about wildlife. This could provide funds for further conservation work. The program should be set up in

consultation with biologists familiar with the species involved. Eco-tourism can destroy a nesting colony if not handled properly.

5) Arrange to get training for personnel in wildlife management. There are several programs available to get assistance in doing this.

We are very grateful for the opportunity provided by the Jarecki's, the Falconwood Foundation and The Conservation Agency to conduct research in the British Virgin Islands and on Guana Island. This research is making significant additions to our knowledge of seabird biology and would not have been possible without assistance from the above.

The Ornithological Council

PROVIDING SCIENTIFIC INFORMATION ABOUT BIRDS

12 November 1997

Dr. Skip Lazell
The Conservation Agency
6 Swinburne St.
Conanicut Is, RI 02835

Dear Skip,

Enclosing my report for this past visit to Guana Island. Thanks for all your help. I almost got everything done in spite of the weather. Would like to get a bigger sample size of adult measurements eventually!! And who knows, with Bert getting amenable to banding, maybe he'll eventually allow collecting!!

Also, enclosing an article on sea level rise. An opposing view I've heard before.

Still have the proposed symposium on my mind. Several questions...
Title of?
Possibly - "Biology and Conservation in the BVI".
Or - Natural Resources of the BVI and Their Conservation

What area of coverage?
As in title, or broader area – West Indies?
More useful to locals if we limit it in scope.

Who should participate (do we want to use it to help educate locals)?

I would think it could be very useful to not only invite local people, but ask for several papers from local people. This would make it possible to ask for funding from Herb Raffaele at FWS, etc. Bert could talk on mangrove systems and local threats to them for instance. A talk on needed regulations for protection would be good. Also, it would get more of them to come if some of their own people were participating and they might learn something. Plus papers on science from all of us.

We could have an extended more scientific symp. at Guana itself afterwards for just the scientists. I'd love to hear in more detail what some of the people are doing, and know I could give some more scientific talks that wouldn't be of interest to or help locals with the local conservation stuff.

If we try to do some emphasis on local conservation – we should ask the scientists to make their talk somewhat relevant to that. How does studying physiology of lizards help us to manage their populations...Make management recommendations.

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Publication of proceedings?

This could be very useful for BVI land management and conservation if we designed talks right and included some management topics. I could talk on island protection and management for seabirds for instance.

Logistics?

I liked your idea of having scientists stay on Guana and doing symposium at college for more room. If we do it in Oct. we could arrange for a biology class to get credit for attending. We could each write a question for a test for them, too.

Could run over a Fri-Sat.-Sun. so more people could come (not at work). 3 days is probably maximum length you would want anyway.

I'd be happy to help in any way I can.

Just some thoughts. Hope the rest of the month went well and you got back home safely. Thanks again for everything! I really appreciate the opportunity.

Best regards,

Betty Anne Schreiber

A person who approves of banding.

Thelma Douglas
P.O. Box 805 Cruz Bay
St. John, VI 00831

T, 11
41,

15 Tremblay Ave
Plattsburgh, N.Y. 12901
March 27, 1995

Mr. F. C. Sibley
Peabody Museum Box 6666
Yale University,
New Haven, Conn. 06511

Dear Mr. Sibley:

A black-necked Stilt that you banded (#554-72008) was discovered dead on the edge of the "Small pond at Frank Bay" on March 6, 1995.

I recovered the band and called the 800 Bird Band number. I called again today and received your name and address. Judy Pierce, of the Fish and Wildlife Service in St Thomas has tried to reach you by phone but has not been successful.

The Virgin Islands Audubon Society is trying to get the V I Government to declare the "Small Pond at Frank Bay" a Marine Reserve and Wildlife Sanctuary. The information about the banded Stilt would be of special interest to us.

Would you please send me information on where and when you banded this bird?

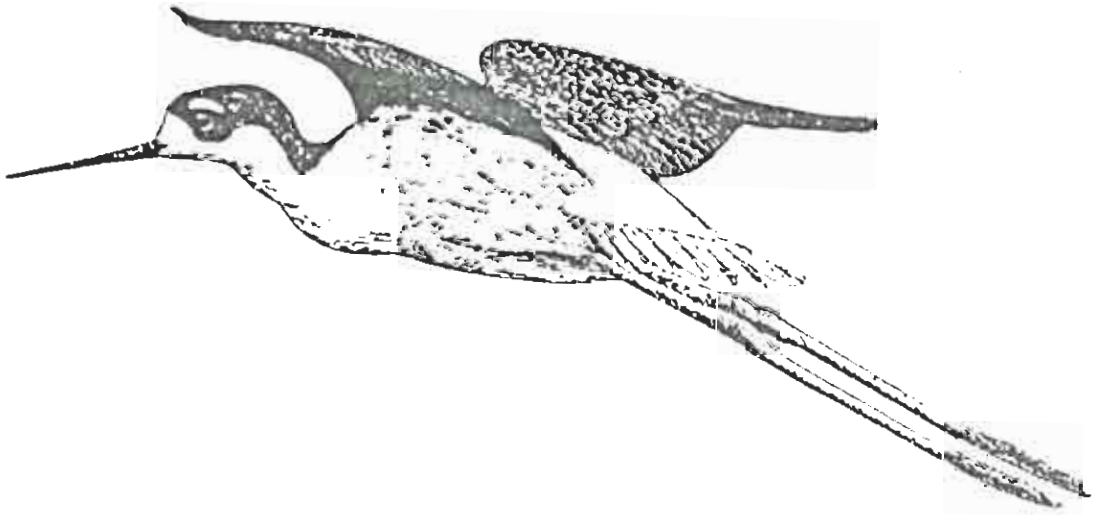
I led bird walks for the National Park Service at "Mary Point Pond" for 14 winters and have lived near the "Small Pond at Frank Bay" for 17 years. This is the first banded bird I've seen on St. John.

I hope you can send me this information

or call me at my home in Pensacola, where I will be after April 2, 1998. My phone is 518-561-4146. The phones on St. John have been even worse than usual since we are in the throes of a change-over from 809 to 340.

Let me know if you ever plan to be on St. John.

Yours sincerely,
Thelma Douglas



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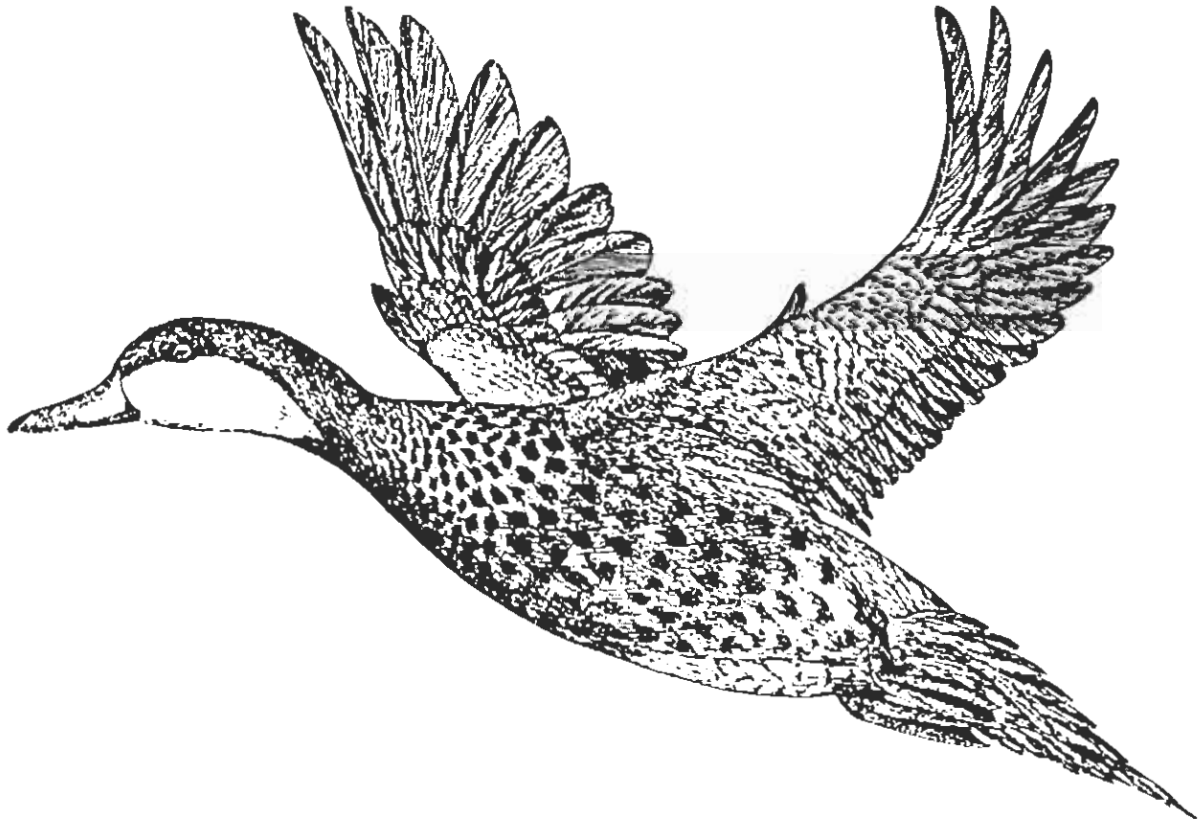
Skip:

Finally got the report on the White Cheeked Pintail. It was banded on St. Thomas* by Judy Pierce USFWS. Banded May 14, 96 and recaptured Oct. 17, 97 on Guana Island. Judy Pierce was involved in the recovery of the Black-necked Stilt.

Fred



* Er, St. John? See Fred's report.

Bird Report - Guana Island - October 10-21, 1997

A very successful year. Of the more routine nature were the addition of three new species to the Guana Island list and one new to the Virgin islands, our first capture of a banded bird and first report from elsewhere of one of our birds. We looked at dragonflies this year and more than doubled the number of species known from the BVI.

Of more importance was the continued work on Bananaquits and migration of Blackpoll Warblers. In Bananaquits we documented the existence of a very brief and highly synchronized nesting period and a reliable sexing technique plus continuing the band/recapture population estimates. On the neotropical migrants, mainly Blackpoll Warblers, enough data has been assembled for a collaborative paper with a researcher from Tall Timbers in Florida on migration in the Lesser Antilles.

This was the wettest October we have seen on Guana Island. Fred and Peggy Sibley were here October 9-20 and Judy Richardson and Allison Oliveri from the 11th-18th. Heavy rains and unheard of sw winds dominated from late 12th to early 15th. Flats remained flooded from 13th through end of stay.

Stilt Sandpiper, Golden-winged Warbler and Blue Grosbeak were added to the island list. The Golden-winged Warbler was new for BVI as well. We had our first foreign recapture of a banded bird - a White-cheeked Pintail from St. Johns - and our first recovery - a Black-necked Stilt found dead on St. Johns.

Bird records from this year were submitted to Robert Norton for inclusion in the Audubon Field Notes section for the Caribbean.

With the sw winds and extensive flooding there was an unprecedented invasion of dragonflies and we recorded nine species for the island and an additional two species on Anegada. There are previously published records for only one species and previous capture of only 3-4 species from the BVI [see report at end of birds].

BIRD NOTES

These cover all our sightings for the period Oct. 10-21

Brown Booby

Very few around White Sands Beach and few seen over ocean but usual numbers roosting on north end of island. Betty Anne Schriber said definitely no nesting.

Brown Pelican

Usual numbers although concentrated in Muskmelon Bay and only seen off White Sands Beach in numbers on the last few days. No check made for nesting. Usual numbers equals feeding flocks of 50-150 and flying birds always in view over the island.

Magnificent Frigatebird

Somewhat lower numbers than last year - always a few in view from the

island. In four years I have never seen them land on Guana. Exceptional group of 20 over Beef Island on 19th.

Little Blue Heron
Three adults and one immature seen most days and probably present every day. Usually feeding on flooded lawn or roosting on north side of salt pond. Not seen on upper levels of the island this trip.

Common Egret
Two present the 13th and one on 14th. Feeding on flooded lawn for most of day.

Cattle Egret
As in other years common on Tortola near Beef Island Bridge and at community college, but none on Guana Island.

Yellow-crowned Night Heron
One immature at east end of pond in late afternoon of the 16th.

Greater Flamingo
Usual 6 birds. Evidently heavy rains had reduced food concentration and the birds spent most of their time standing at south side near where they are normally fed. Water too deep for them to wade all the way across so sometimes seen swimming and more prone to fly than other years.

White-cheeked Pintail
Counts of 16 birds on salt pond from 10-12 and then one pair took up residence in the flooded area at the dump and stayed there for rest of our stay while the number of birds on the salt pond declined slowly to 8. One banded bird was caught on the 17th. Originally banded on St. Johns, Virgin islands on May 14, 1996.

Blue-winged Teal
Two on pond for afternoon of 17th and four in late afternoon of 18th. Three others seen on Anegada [The Slob] on 19th.

Red-tailed Hawk
Single birds soaring over island on 12th and 13th.

American Kestrel
Numbers less than last year with usual count being one male and one female on flat. Common on Anegada the 19th.

Sora Rail
One road kill on Anegada the 19th.

Wilson's Plover
Hard to keep track of individuals. With all the flooding the birds were repeatedly flushed by vehicular traffic and unless checked before breakfast were scattered to beach or north side of Salt Pond. Two pairs seen regularly and the banded pair had an immature bird accompanying them.

Black-bellied Plover
One roosting on stone wall at west end of Salt Pond on 12th.

Black-necked Stilt
From the 10th - 14th there were eight birds on the Salt Pond - about the usual resident flock. On the 15th the count jumped to 24 and went back down slowly to 9 on 19th. Seven were banded on the 17th and one was found dead March 6, 1998 on St. John's, American Virgin Islands.

Ruddy Turnstone
Counts started at 14 on 10th and 11th and then dropped to 6-8 for rest of visit. One banded.

Semipalmated Sandpiper
Flock of six on 10th, three on 11th and only one on 12th and 14th.

Spotted Sandpiper
Seemingly three birds present throughout our stay. Two were banded and only one unbanded bird was seen after that.

Solitary Sandpiper
One on 10th at Salt Pond. First recorded for Guana Island last year.

Stilt Sandpiper
One netted and banded on the 17th. A first record for Guana Island.

Lesser Yellowlegs
Counts of 3-7 during our stay. Numbers increased with the increased flooding of lawns. Amazingly none were netted although a frequent catch last year.

Wilsons Snipe
One flushed near east end of White Sands Beach on the 10th.

Royal Tern
An uncommon bird this year. Two sighted on 9th and one on 10th off White Sands Beach. Also eight seen the 19th at the usual roosting place off ne corner of Beef Island Airport.

White-crowned Pigeon
Captive birds in cage at citrus grove had good success this year with two pairs breeding. No wild birds seen.

Scaly-naped Pigeon
Never more than three seen in a day. Evidently well scattered and nesting. Molted feathers found frequently around flat.

Zenaida Dove
Not as conspicuous as other years - probably 10 or so seen during normal days activity. Four banded.

Common Ground Dove
As for the above species but five plus birds seen each day. Only one netted.

Bridled Quail Dove
Numbers way down at feeding area near maintenance shed but Glenn said they were common in Quail Dove Ghut.

Mangrove Cuckoo
One or two calling every day between hotel and flat.

Yellow-billed Cuckoo
One seen most of the 17th on the flat. On Anegada at least six were encountered on the 19th.

Smooth-billed Ani
Never sure of more than two birds and these usually near garden. Common on Anegada - more so than Mockingbird. Gunana Island numbers way down from two years ago.

Green-throated Carib
Several seen each day. One harassing a perched Sparrow Hawk. Several netted.

Antillean Crested Hummingbird
Less common but one seen most days.

Belted Kingfisher
Seen on 14th, 17th, and 19th around Salt Pond. Only seen along coast in other years. Also seen at Beef Island Bridge and on Anegada over Slob.

Gray Kingbird
Usual pattern of pairs scattered over island. Normally eight seen in day. Observed eating flowers and also seeds of one of the acacia type trees. Common all over Anegada.

Caribbean Elaenia
Seen and heard everyday. Four banded and one recaptured. Much more numerous on Anegada - 10 seen and many more heard in part of day there.

Northern Mockingbird
As in other years none on Guana Island but always present at Beef Island Bridge. Several seen and other heard on Anegada.

Pearly-eyed Thrasher
Seemingly less abundant than other years. No real attempt made to census. Four caught and sacrificed. None in breeding condition. One that had had the end of its bill chopped off several years ago was still healthy and still raiding the dining room.

Red-eyed Vireo
One banded on the 14th. A supposedly rare bird in the Virgin Islands, but caught in each of four years.

Yellow Warbler
Not seen on Guana Island although this was the wettest year yet and the last wet year produced several singing males. Present but not common on Anegada.

Blackpoll Warbler

As always the commonest North American migrant. Nine banded this year and present on 5 of 9 days. On Anegada they were more common and outnumbered Bananaquits but not Black-faced Grassquits.

Chestnut Sided Warbler

One seen 18th near sugar feeder.

Golden-winged Warbler

One bird banded on the 14th and another unbanded bird seen on the 18th. This is a first record for the British Virgin Islands and one of the few for the Virgin Islands as a whole.

Northern Waterthrush

One seen near Salt Pond from 10th-13th. Perhaps a second bird on the 13th.

Bananaquit

An interesting year for Bananaquits research. A paper will be prepared for publication covering the four years of research.

This year we banded 62 new birds and had 22 recaptures and this represented about 90% of the birds using the sugar feeder [an estimated population of 100 or less - well below the 120-150 or so estimated in previous years]. However Razi and other reported that there were many more birds using the sugar feeder before our arrival, also the sex ratio of netted birds was out of balance with males outnumbering females 65/19. When we even out the sex ration we are again in the range of 120-150 birds using the hotel feeder. We were initially worried that the presence of foot pox on many of the individuals had reduced the population but this did not seem to be supported by the band return ratios.

In conjunction with the work from previous years there are strong indications that the Bananaquits on Guana Island breed synchronously in a very brief span of time in response either to the rains or the vegetation and insect bloom associated with the rains.

This year and last all the adults were in breeding condition and wing measurements for males and females separate with no overlap. This was not previously known although females average smaller throughout the range of the species. This is certainly a local predictor and not transferable to other areas where the wing measurements of males and females would probably be different although possibly still separated. However, for research in the British Virgin Islands it provides considerable help in sexing birds out of breeding season.

We are building up information on longevity of Bananaquits as we continue to recapture birds from the first year of banding. Twentyfive percent of the adults banded in 1995 and 1996 were recaptured this year.

Blue Grosbeak

One immature male seen in garden area on 10th and 12th. A first record for Guana Island and one of the few for the BVI.

Black-faced Grassquit

More birds at sugar feeder and in garden area than last year. Nine birds banded and by last day all birds at feeder had bands. Most birds in breeding condition.

On Anegada this species and the Bananaquit switch abundance with the Grassquit being conspicuous and common everywhere in the brush [much more conspicuous and common than on Guana Island] and the Bananaquit being very sparsely scattered through the habitat [about the density found on Guana Island away from the hotel].

Bobolink

Two found in tall grass in garden area on 12th and one there on 14th.

DRAGONFLIES *

On first few days there were two species of dragonfly and one of damselfly. With the sw winds and flooding the numbers of individuals and species picked up each day until our departure. [from 3 species and 30 some individuals to 8 [maybe 9] species and 100's of individuals].

Not surprisingly all but one of the species are common, widespread forms in the Caribbean and several are known for long migrations or dispersals. But many of the species would not have gotten here under normal conditions and one of them should not have arrived even under the abnormal winds we had. The invasion of this many species and individuals following a unique weather happening is exciting information giving material for speculation about how island invasion and colonization occurs.

A visit to Anegada on the 19th resulted in capture of 3 species at the Slob, and brief sighting of a 4th. Only males were captured and no egg laying was observed although a few female Orthemis were seen away from the Slob.

Species List

Ischnura ramburii - Rambur's Forktail
Medium sized Damselfly with bright blue tip on male abdomen. Females dull pale greenish.
Single individual seen the 10th but not found again until the 14th when they were fairly common.
4 males and 2 females captured.

Anax junius - Common Green Darner
Large greenish dragonfly
One seen very briefly over Slob on Anegada.

Erythemis vesiculosa - Great Pondhawk
Medium sized green dragonfly - First seen on 11th and not seen again until 14th. Very uncommon - never more than 2 seen in a day, although still 2 present after we had collected 2. Laying eggs on 14th.
2 specimens

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* For the purposes of this report, dragonflies have been reclassified and declared to be "birds." Sh.

Erythrodiplax umbrata - Band-winged Dragonlet
Smallish medium dragonfly - Dark blue almost black body with black bands on wings. Females greenish some without dark bands on wings.
Present throughout stay. Numbers did not increase as rapidly as for Roseate Skimmer. Egg laying observed.
8 male specimens and 3 females

Orthemis ferruginea - Roseate Skimmer
Medium sized red dragonfly.
Certainly commonest species at start of stay - probably losing out to the saddlebacks toward the end.
13 specimens - 6 from Anegada - no females
A magenta form [1 male specimen] may represent an additional species - the two forms behaved differently in field and the complex has been variously split over the years.
Egg laying observed.

Pantala flavescens - Wandering Glider
Medium large yellowish species with no markings on wings. Collected only on Anegada but presumably present in small numbers on Guana. On Anegada there were one of these for each 5 Tramea/Pantala hymenea or 10 Orthemis ferruginea

Pantala hymenea - Spot-winged Glider
Medium large dragonfly - easy to confuse with Tramea - patch of color at base of wing smaller than in Tramea.
3 individuals from Guana and Anegada.

Perithemis domitia - Slough Amberwing
Small amber winged dragonfly
Two were found floating face down and no others were seen. Although looking dead in the water they revived when dried out. In Puerto Rico, where these individuals were presumably blown from there, this is primarily a mountain stream species.

Tramea calverti - Striped Saddlebags
Tramea abdominalis - Vermilion Saddlebags
A medium large reddish species with colorful spot at base of wings - calverti has yellow tinged wings, abdominalis clear wings.
These and Pantala were confused in fields but complex as a whole first appeared on 13th and were over lawn on 14th and laying eggs on 16th and then had a quadrupling of numbers by 18th. Feel Tramea was the more abundant species as on Anegada. More abundant than Orthemis ferruginea on Guana but less so on Anegada.
Striped Saddlebags showed up way north [MA] and west [TX] of their normal range in the US this year so the wandering to the BVI may be part of this population explosion.
6 males and 1 female captured of calverti - 2 on Anegada.
3 males of abdominalis.

FIELD NOTES

THE PAINTED BIRD

Lawn flamingos come to the aid of ecology

Sunrise is two hours away, and it's as dark as it should be with the moon obscured by clouds. Lisa Borgia tromps knee-deep through a half-acre pond about 20 miles west of West Palm Beach, the beam from a headlight perched atop her mosquito hood slicing the gloom. She admits that she prefers *Star Trek*'s ridge-headed Klingon Mr. Worf to Brad Pitt, which may help explain why Borgia, on an internship with the South Florida Water Management District (SFWMD), remains unperturbed by the alligator whose head breaks the surface six feet away. Granted, the reptile is only about two feet long; the big gators eschew the pond, and a more likely source of trouble is the venomous snakes. Even taking Worf into account, the obvious question—What's a nice girl like you doing in a place like this?—takes a backseat to a more immediate query: Why is she carrying those plastic lawn flamingos?

Borgia, fellow flamingo-bearer David K. Kieckhusch and their boss, avian ecologist Dale E. Gawlik, a senior environmental scientist with the SFWMD, have finally found a constructive use for the pink lawn ornaments. A coat of flat white paint transforms the suburban blight into tools for studying how birds use visual cues from their feathered friends to choose feeding sites.

The SFWMD's 15 ponds are perfectly situated for controlled field research on wild subjects—egrets, herons, ibis and wood storks naturally fly in from the adjacent Loxahatchee National Wildlife Refuge. "We focused on things like water depth and prey density," Gawlik says of earlier, flamingo-free experiments aimed at teasing out the relation between wading birds and water supply. The researchers altered environmental factors in the ponds easily—gravity flow from a higher reservoir or into a lower one changes the water level of any pond in minutes. But some of the social cues that determine feeding choices among wading birds remained unknown.

Perhaps decoys could reveal how birds rely on their feathered friends for dining recommendations, the researchers thought. When Borgia found out that hunters' heron decoys run a prohibitive $30 each, she consulted with Kieckbusch, who had pink flamingos at home, and discovered that the plastic lawn ornaments could be had for $5.40 a pair. Painted, they make passable egrets.

Previous trials using the fake flamingos showed that birds bypass empty ponds in favor of those with decoys. This mid-November day's experiment will fine-tune the data. Borgia and Kieckbusch set the lawn decorations in either scattered or clustered arrays in ponds of various depths. "The spacing of the flock is an additional cue related to social behavior," Gawlik says.

As we move through the water—a fast, bowlegged waddle helps to minimize sinking into the soft bottom—the mosquitoes attack mercilessly. As well as a nuisance, they're probably more

PLASTIC FLAMINGOS (foreground) *bring in ibis.*

dangerous than the gators and snakes: the area is under an encephalitis watch. "If you face into the wind," Borgia advises this slap-happy reporter, "the mosquitoes will gather on your lee. You can keep them off your face." Flamingos set, Borgia and Kieckbusch climb to the decks of separate observation towers, each with a view of half the ponds.

Shortly after first light, real birds join the plastic ones. Like an overwhelmed air-traffic controller, Borgia frantically records the arrivals and departures: "Glossy ibis and tricolor heron leaving [pond number] 8.... Two little blue herons on 9.... Large group of snowies coming in to 8, estimate 60.... Great blue on 11.... Two glossy ibis on 11.... One great and one snowy leaving 11."

The attempt to note the decisions of hundreds of birds continues for almost an hour, by which point the sheer number of real birds drowns out the decoy effect. Borgia and Kieckbusch abandon their roosts and head back into the muck to wrangle the flamingos. They will randomize the water levels and arrays and repeat the experiment all week. Then they and Gawlik will analyze the data, hoping to fill in another small piece of the large puzzle that is the Everglades ecosystem. Water management decisions critical for the region's wildlife and people depend on such detailed information. The lowly lawn flamingo finally has reason to preen. —*Steve Mirsky*

AFTER THE MORNING COUNT
Lisa Borgia rounds up the decoys.

The Conservation Agency

Exploration, Education, and Research

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Dr. Lisa G. Sorenson
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Dear Dr. Sorenson:

We were interested to read your article in El Pitirre on WIWD, but disappointed that there was no mention of restoration. WIWD occurred as a breeding bird in the British Virgin Islands (BVI) until just after World War II. It was hunted to extirpation.

Today there is no hunting in the BVI, and excellent habitat remains. We have been successful (so far) in restoring flamingo and white-crowned pigeon, both also simply shot out decades ago. We believe WIWD is a perfect candidate for restoration. How can we obtain breeding stock?

Sincerely,

Jim Lazell

James Lazell, Ph.D.

cc: David O. Hill
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Courtship behavior and vocalizations of the frog *Eleutherodactylus schwartzi* (Anura, Leptodactylidae) from the British Virgin Islands

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Key words: *Eleutherodactylus schwartzi*, Leptodactylidae, courtship behavior, parental care, reproduction, vocalizations, West Indies

The genus *Eleutherodactylus* (family Leptodactylidae) consists of over 700 species in Central and South America, and West Indies (Lynch 1996), with major centers of endemism occurring on the islands of the Greater Antilles (Hedges 1989). Existing knowledge of vocal repertoires of the vast majority of these species is limited to the descriptions of advertisement calls. Detailed studies of a handful of species, including *Eleutherodactylus coqui*, a common Puerto Rican species that has received intensive study, have demonstrated a surprising complexity of vocalizations and their functions. These include graded aggressive calling, defense of diurnal retreats, nest sites, and calling territories, and calls used only during courtship and mating (Stewart and Rand 1991, 1992, Michael 1996, Ovaska and Caldbeck 1997a & b). This diversity in call structure and function potentially renders the genus an excellent model system for comparative studies of the evolution of acoustic communication.

Recent studies of vocal repertoires and call note function of *E. coqui*, *E. antillensis*, and *E. cochranae* from the Puerto Rico bank have revealed interesting patterns (Michael 1996, 1997, Ovaska and Caldbeck 1997a & b). In the presence of receptive females, males of all three species produce calls of a relative low dominant frequency, consisting of repeated elements of the advertisement call. These courtship calls, as well as aggressive calls, show striking structural similarities across species, although their advertisement calls are very different. Courtship calls can be expected to be widespread among *Eleutherodactylus* and other terrestrially-breeding frogs, and information is needed on a wider range of species.

Here we describe courtship vocalizations of *E. schwartzi*, a species endemic to the British Virgin Islands (BVI; Schwartz and Henderson 1991). We also report on the accompanying courtship behavior, which has not been previously documented, and on subsequent parental care

of eggs, based on observations in captivity. The advertisement call of *E. schwartzi* is a two-note call ("co-qui" or "bo-peep"), similar to that of its sister species, *E. coqui* (Thomas 1966). Based on courtship calls of *E. coqui, E. antillensis*, and *E. cochranae*, we predicted that the courtship call of male *E. schwartzi* would consist of a rapid repetition of the first, lower frequency note of the advertisement call (i.e. "co-co-co...").

On the night of 11-12 October 1997, we collected six gravid females (eggs visible through the abdominal wall) and four calling males of *E. schwartzi* from Tortola, BVI. To observe their courtship behavior, we kept the frogs in various combinations in five laboratory cages on the adjacent Guana Island. Three of the cages were of semi-transparent plastic (40 x 26 cm in area, 22 cm high), and two were similar-sized, glass aquaria. Tops made of mosquito screening provided air flow. Each cage contained leaf litter and a bromeliad (*Tillandsia* sp.) for nesting and retreat sites. Several times each day, we misted the vegetation in the cages with water. We fed the frogs *ad libitum* with termites (*Nasutitermes* sp.), and augmented this diet with moths of various species caught at lights at night. The temperature in the laboratory remained relatively constant at 27°C throughout the duration of the study from 12 to 26 October 1997.

We placed each male in a separate cage with a female. After a female had laid eggs, we replaced her with another gravid female; we also rotated females between cages if a female appeared to be ready to oviposit (based on the large size of eggs) but had not mated within several days. We kept unpaired females together in a separate cage. Each night, except on 15, 17, 19, 23 and 25 October, we listened to calls of males and observed frogs under dim red light for various periods from approximately 1730 h until 0200 h. We recorded vocalizations of frogs using a Sony Professional Walkman (WM-D6C) fitted with an Electret unidirectional condenser

microphone (SME V-6502) and analyzed the calls using Canary software (Version 1.2.1, Cornell Laboratory of Ornithology, Ithaca, New York).

Two of the males mated once (on 14 and 16 October), and one male mated twice (on 13 and 26 October), each mating resulting in an egg clutch. One female laid two of the clutches (on 14 and 26 October) with two different males. The fourth male did not mate and never called in captivity; nor did the remaining three gravid females mate.

All courtships took place very shortly after sunset, and three began at 1830 h, 1745 h, and 1822 h, while we were observing calling males. In each case, the female initiated the courtship by first looking towards and then approaching the male, who was calling from a raised perch on a bromeliad leaf. The female then touched the male either with her snout or with her fore-feet, and moved beside him. One female stroked the back of the male several times with her fore-foot. When approached, the male produced soft (often barely audible from a distance of 30-50 cm), multi-note courtship calls. These calls were interspersed with two-note advertisement calls that were also soft. In two cases, the pair remained in close proximity for several minutes, after which the male began moving slowly away, closely followed by the female. Both pairs disappeared into spaces in leaf axils near the center of the bromeliads, where we found an egg clutch the following morning. A male was in attendance with each clutch. In the third case, after approaching the male and touching him with her snout, the female positioned herself in front of the male and backed underneath him. The male never left his original calling site. The chin of the male was on the female's back, and he was partially on top of her but did not grasp her. The frogs were still in this position 5 h later, and the following morning we discovered an egg clutch, attended by the male, at this location on the bromeliad leaf.

The fourth courtship, on 16 October, occurred at some time between 1850 h and 2100 h, when we discovered the pair together in a bromeliad axil with the chin of the male resting on the back of the female. We experimentally removed the female and placed her on the opposite side of the bromeliad circa 25 cm from the male. Immediately, the male emerged from the retreat site and began moving towards the female while producing soft advertisement calls, interspersed with even softer, multi-note courtship calls. He also produced courtship calls when the female approached him a few minutes later and then lead her to the nest site. The male was attending an egg clutch the following morning.

Throughout the duration of the study, all males continued attending their nests by either covering the eggs with their body or remaining within a few centimeters of the eggs. Occasionally, after dark, we observed a male away from the clutch, foraging or calling. Two of the three males continued calling for brief periods at night after mating. We observed Male 1 calling on six of 13 and Male 2 on two of 12 nights after mating; Male 3 did not call on any of the 10 nights after mating. Male 1, which mated twice, shifted his attention from the first nest to the second nest after remating 13 days later. Based on movements within the eggs, the first clutch appeared to be close to hatching at this time. These observations confirmed male parental care, including double clutching, as previously reported for *E. schwartzi* under natural conditions (Ovaska et al. 1997).

The courtship calls of all three males were similar and, as predicted, consisted of a repetition of a note that resembled the first note of the advertisement call (Fig. 1). The number of notes in the courtship call ranged from 1 to 6 ($\bar{x}$ = 2.3, SD, = 1.0, n = 39 calls by three males). The duration of the call varied from 61 ms to 1215 ms, depending on the number of notes, and the

average note duration was 101 ms (SD = 21 ms, n = 85 notes in 39 calls by three males). All notes in the courtship call were of similar dominant frequency, the average being 1852 Hz (SD = 84 Hz).

To compare the dominant frequency of the advertisement call and the courtship call, we randomly selected 10 advertisement calls from the first 3 min of the recording of vocalizations of each male. For analysis, we combined the courtship calls of Male 1 that mated twice from both courtships. For each of the three males, the dominant frequency of the courtship call was indistinguishable from that of the first note in the advertisement call (Male 1: $\bar{x}$ (SD) of courtship call = 1917 (103) Hz, n = 11; $\bar{x}$ (SD) of Note 1 of advertisement call = 1995 (103) Hz, n = 10; z = -0.77, P = 0.44; Male 2: $\bar{x}$ (SD) of courtship call = 1774 (61) Hz, n = 8; $\bar{x}$ (SD) of Note 1 of advertisement call = 1795 (55) Hz, n = 10; z = -0.58, P = 0.56; ; Male 3: $\bar{x}$ (SD) of courtship call = 1848 (47) Hz, n = 20; $\bar{x}$ (SD) of Note 1 of advertisement call = 1882 (55) Hz, n = 10; z = -1.89, P = 0.06; *Mann-Whitney Test*).

The average dominant frequency of the first note of 30 advertisement calls by the three males, as recorded in captivity, was 1891 Hz (SD = 110 Hz). The dominant frequency of the second note was 3559 Hz (SD = 214 Hz). These frequencies were well within the range of dominant frequencies of advertisement calls recorded under natural conditions on Tortola using the same equipment ($\bar{x}$ (SD) of Note 1 = 1999 Hz (102); $\bar{x}$ (SD) of Note 2 = 3532 (96 Hz), n = 40 calls by 8 males). This indicates that the frequencies of the calls recorded in captivity were not fundamentally different from those recorded in nature. However, many of the calls were less distinct (i.e. there was scatter in the frequencies and amplitudes within notes) than those recorded in nature, possibly due to distortion of sound by the cages.

Observations in captivity are useful because they allow the documentation of behavioral patterns that under natural conditions would be very difficult to obtain. Also, observations in nature, such as those of courtship behavior of secretive *Eleutherodactylus*, are often dependent on serendipitous encounters. Data obtained in captivity, however, contain two types of potential biases. Mechanical biases include distortion of calls by containers, as well as physical limitations posed by the experimental set-up, such as restrictions to movements and to the selection of nesting sites. More seriously, the behavioral patterns themselves may be altered by captivity. However, relatively stereotypic behavior. such as vocalizations of *Eleutherodactylus*, are likely to remain unchanged by conditions in captivity. This is supported by the similarity of courtship calls of *E. antillensis* and *E. cochranae* both in captivity (Michael 1996) and under natural conditions (Ovaska and Caldbeck 1997a).

Observations in captivity allowed us to document the courtship of *E. schwartzi*, a behavior which we have been unable to observe under natural conditions despite searching for courting pairs each October for five years. In contrast, we have located courting *E. antillensis* and *E. cochranae* during this period (Ovaska and Caldbeck 1997a and unpublished data). The very soft courtship calls of *E. schwartzi* (many of which were too faint to be digitized when recorded from a distance of 30-50 cm), and the relatively short periods when males produced these calls during the courtship probably contributed to our inability to locate courtships in nature.

The courtship of *E. schwartzi* also differed from that of *E. antillensis* and *E. cochranae* in the extent of physical contact between the male and female prior to mating. In *E. schwartzi*, the male and female frequently remained in close contact for several minutes after the female approached the male. In contrast, males of both *E. antillensis* and *E. cochranae* immediately

moved towards the nest site after being approached, and physical contact between the pair was restricted to fleeting moments (seconds rather than minutes; Ovaska and Caldbeck 1997a). The extent to which this behavior of *E. schwartzi* reflected conditions in captivity is unknown.

The structure of the courtship call of *E. schwartzi* and its relationship to the advertisement call were similar to those reported for *E. antillensis*, *E. cochranae*, and *E. coqui* (Michael 1996, Ovaska and Caldbeck 1997a & b). In all four species, the courtship call consists of a repetition of a relatively low dominant frequency note that resembles the first note of the advertisement call. The context in which males produce courtship calls is also similar across species. Male *E. schwartzi*, like males of the other species examined, appeared to produce courtship calls either when the female first approached him, or when the female subsequently moved close to him after lagging behind while following him to the nest site.

In the future, captive breeding, supplemented by field observations, might prove useful in examining courtship calls and behavior of other species of *Eleutherodactylus*. Documenting courtship calls of species with advertisement calls that differ in structure from those of the species examined so far, such as the multi-note click calls of several Puerto Rican species, would be particularly useful. Also, information is needed on courtship calls of *Eleutherodactylus* species with different phylogenies, such as those from Central and South America.

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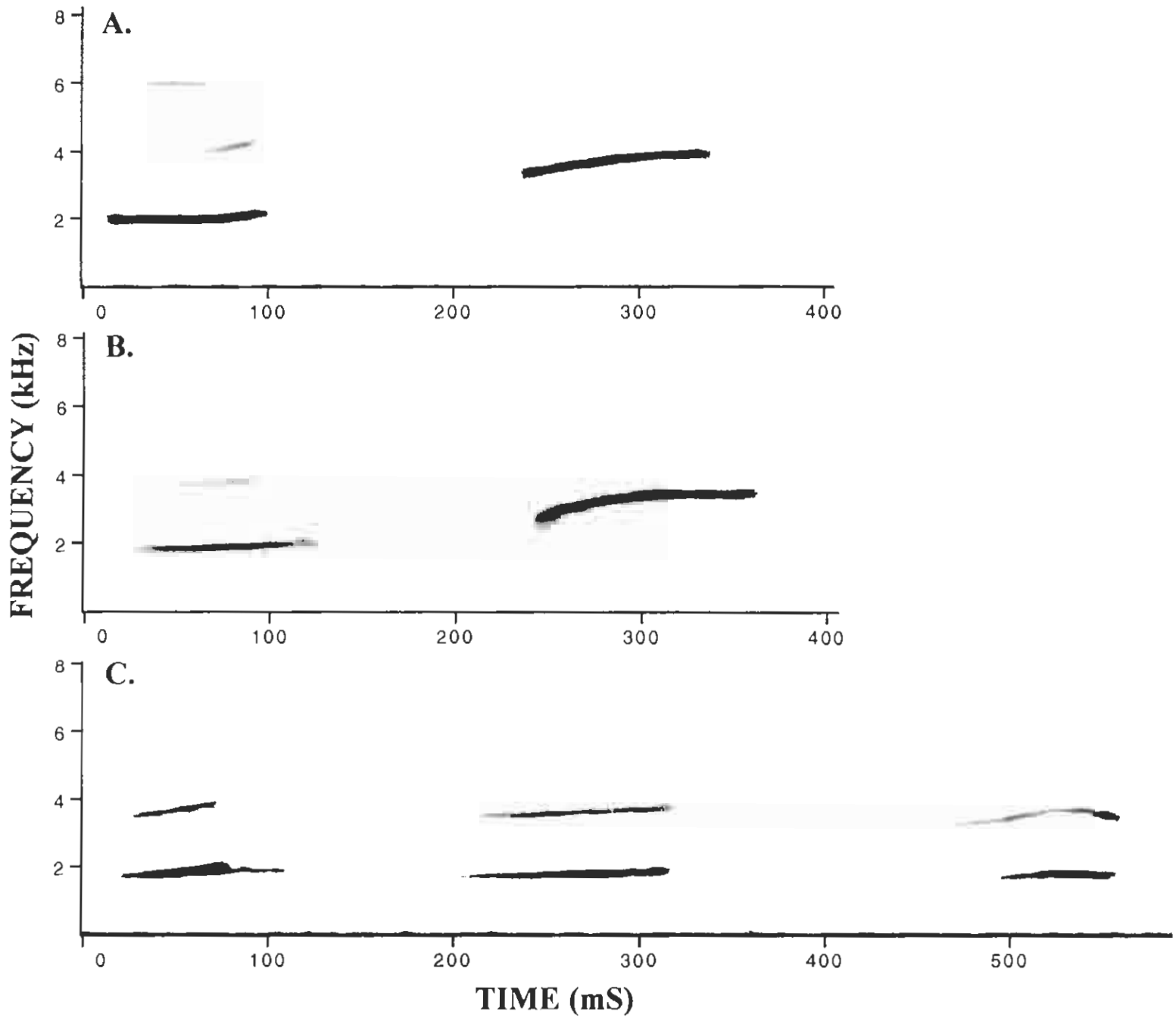
FIGURE LEGENDS

Fig. 1. Sonagrams of advertisement and courtship calls of *Eleutherodactylus schwartzi* from the British Virgin Islands. A - advertisement call recorded under natural conditions on Tortola, B - advertisement call recorded in terrarium, B - courtship call recorded in terrarium. Calls B and C were produced by the same male.


A.
B.
C.
8
6
4
2
0
100
200
300
400
500
FREQUENCY (kHz)
TIME (mS)

CO OR QUI?
THE PUZZLE OF CALL NOTE SIGNIFICANCE IN *ELEUTHERODACTYLUS*

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A NUMBER of frog species have been studied in sufficient detail to serve as model systems for understanding acoustic communication and its role in various evolutionary processes, including the development of reproductive isolation mechanisms, sexual selection, and the evolution of mating strategies. Frogs are attractive subjects for such studies because their communication systems are relatively simple when compared to other vertebrate groups, such as birds or primates, thus facilitating analyses. This simplicity has encouraged a reductionist approach towards studying anuran vocalizations. Specifically, what do the individual call components of relatively stereotyped, species-specific calls signify to both the sender and the recipient, and what are the predominant selective pressures that have shaped the communication systems? This approach has led to the development of useful models regarding the interpretation of individual call components. Yet, vocalizations of many anuran species contain sufficient structural and functional complexity to confound simple interpretations. Here, we use a comparative approach to identify conserved features of vocal communication and their behavioral correlates in several closely related species, and use this information to reassess the acoustic communication system of *Eleutherodactylus coqui* and related species.

ELEUTHERODACTYLUS COQUI AS A MODEL SYSTEM

Eleutherodactylus coqui, a common Puerto Rican species, has played a prominent role in studies of acoustic communication and call function, and many aspects of its vocal behavior have been studied in detail. Males of *E. coqui* produce loud advertisement calls during year-round breeding (Thomas, 1966; Rivero, 1978). Coqui (pronounced co-ki), the onomatopoeic common name of this frog, is derived from the advertisement call, which consists of an initial lower frequency "co" note, followed by a higher frequency "qui" note. Early work by Narins and Capranica (1976, 1980) focused on the significance of each of the two notes to both male and female frogs. In a series of technically demanding neurophysiological experiments, they showed that the male frogs' ears contained more fibers responsive to the frequency of the first, lower pitched note, whereas the ears of the female frogs had more fibers responsive to the frequency of the second, higher pitched note (Narins and Capranica, 1976, 1980). When given a choice between the two notes,

female frogs, which were presumed to be receptive, were preferentially attracted to the second note. This led to a model (referred to here as the Narins-Capranica model) where the first note of the advertisement call was predicted to function as an agonistic signal to repel other males from the caller's territory, whereas the second note was predicted to function in attracting females. This model has been widely accepted as describing a plausible mechanism for simultaneously sending two different signals in one acoustic unit, one component directed towards females and the other towards males.

A contradiction to this model arose when Stewart and Rand (1991, 1992) reported that, in response to the invasion of their diurnal retreat sites by another frog, males of *E. coqui* produce a modified call. This call consists of the addition of a series of repeated second notes to the two-note advertisement call (co, qui, qui, qui, qui...). The retreat defense calls are graded, with the number of "qui" notes increasing with increasing threat (Stewart and Rand, 1991, 1992). Thus, in agonistic encounters, males of *E. coqui* use a repetition of the call note that, under the Narins-Capranica model, should function in attracting females. These observations are directly contradictory, as the model predicts that the first note should carry the aggressive and territorial significance. Although originally the Narins and Capranica model was not meant to encompass all aspects of call function by *E. coqui*, which may vary according to context, there is a clear discrepancy between the predictions of the model and the observations of call use. Resolution of this discrepancy has not been absolutely achieved; however, we will discuss a possible unifying hypothesis based on recent work on other species of *Eleutherodactylus* from the Puerto Rico Bank, including the context in which males produce different calls.

VOCAL BEHAVIOR OF OTHER SPECIES OF *ELEUTHERODACTYLUS*

A problem with single species models is that they rely on data from only one system. Often a comparative approach can be used either to identify other systems where complex questions can be more easily answered, or to generate a common, unifying hypothesis. The neotropical genus *Eleutherodactylus* is the largest monophyletic vertebrate genus in the world with over 700 described species (Lynch, 1996). More species continue to be described (Estrada and Hedges, 1996; Flores and Rodriguez,

1997), and the total number of species may well exceed 800. Although the majority of *Eleutherodactylus* species occur in Central and South America, there are major centers of endemism on the islands of the West Indies. Each of the Greater Antilles has an endemic assemblage of species that is apparently derived from a common ancestor (Hedges, 1989). There are 17 described species from the Puerto Rico Bank, of which all except two (*E. schwartzi* and *E. lentus*) occur on the island of Puerto Rico (Schwartz and Henderson, 1991). The advertisement call of each of these species has been documented (Thomas, 1966; Drewry, 1970; Rivero, 1978; Drewry and Rand, 1983; *E. lentus* has no advertisement call; Schwartz and Henderson, 1991). Advertisement calls, however, are not the extent of the vocabularies of these species. New investigations of the vocal repertoires of other *Eleutherodactylus* species from the Puerto Rico Bank have yielded interesting information that sheds light on the paradox involving call note function in *E. coqui*.

Observations both in captivity and in the natural habitat have revealed that males of three species, *E. coqui*, *E. cochranae*, and *E. antillensis*, produce a soft, repetitive call during courtship and mating (Townsend and Stewart, 1986; Michael, 1996: Ovaska and Caldbeck, 1997a,b). Recent observations in captivity have shown that males of a fourth species, *E. schwartzi*, also produce a similar courtship call (Ovaska and Caldbeck, unpubl. data). In addition, aggressive calls have now been described in detail for *E. cochranae* (Michael, 1997) and *E. antillensis* (Ovaska and Caldbeck, 1997a), and are also known from several other species of Puerto Rican *Eleutherodactylus* (Stewart and Rand, 1991). The advertisement, courtship, and aggressive calls of these species show several similarities (Fig. 1). Surprisingly, the courtship calls of all three species are repetitions of a single note with a relatively low dominant frequency (Fig. 1). In *E. coqui* and *E. antillensis*, the frequency of this note is indistinguishable from the first note of the advertisement call. The courtship call of *E. cochranae*, the advertisement call of which consists of a whistle, sometimes followed by one or more clicks, is also of a relatively low dominant frequency. Males of all these species produce courtship calls only in the presence of a receptive female and when leading a female to a nest site. This call appears to elicit a following and possibly a mating response from the female. Also similarly, calls

with agonistic function given during retreat and territorial defense are repetitions of a relatively high frequency note, similar to the second note of the advertisement call of *E. antillensis* and *E. coqui*, and to the clicks in the advertisement call of *E. cochranae* (Fig. 1). Clearly, the advertisement calls of these species consist of distinct notes that can be repeated separately to signify either aggression or a willingness to mate. The observed context in which the frogs use these calls is directly contrary to the predicted functions from the original model proposed by Narins and Capranica. This has now been established in three different species by three independent groups of investigators.

TOWARD A UNIFYING MODEL

A hypothesis that takes into account the particulars of the natural history of these species may help to resolve the discrepancies between the observed behavior and the Narins-Capranica model. Species of *Eleutherodactylus* are completely terrestrial and undergo direct development with no aquatic larval stage. Many species show parental care of the developing eggs and young (reviewed in Townsend, 1996). *Eleutherodactylus coqui* is a prolonged breeder (Townsend and Stewart, 1994), and males defend territories that contain both calling and retreat sites. The frogs use these retreat sites, which provide protection from predators and dehydration, both as diurnal shelters and as nesting sites. The availability of retreat sites is a limiting resource for *E. coqui* populations (Stewart and Pough, 1983). Both male and female *E. coqui* defend territories, are aggressive, and will invade other frogs' territories and cannibalize eggs (Townsend et al., 1984; Michael, 1995; Stewart and Woolbright, 1996). The main selective pressures that have shaped the ecology of this species appear to be related to finding suitable retreat and nest sites, and possibly also finding a mate that controls access to such sites. These same selective pressures are probably also important for other *Eleutherodactylus* that have similar life histories, including those species addressed here. We propose that call functions of these frogs can best be interpreted in light of these selective pressures, which are radically different than the pressures faced by North American pond breeding frogs.

To best ensure the survival of offspring, it might be critical for a gravid female *Eleutherodactylus* to find a mate who controls a territory with a high-quality nesting site.

It is therefore reasonable to assume that females use acoustic cues to determine which males control the most attractive territories. This information might be gained by listening for aggressive interactions between males competing over retreats. Likewise, males may gain information on nest sites and their relative value for females by listening for vocalizations accompanying courtship by other males. By identifying which males are successfully attracting mates, rival males could identify prime retreat sites that they might try to usurp, as well as gain opportunities to intercept matings (Ovaska and Hunte, 1992; Ovaska and Caldbeck, 1997a), or to cannibalize eggs, a common behavior noted under natural conditions and in captivity (Townsend et al., 1984; Michael, 1995; Stewart and Woolbright, 1996). These assumptions lead to a very different model than the one originally proposed by Narins and Capranica. They also point out that extreme caution must be used in interpreting the results of playback experiments and the functional significance of observed behavioral patterns, which may be highly dependent on context.

Under our hypothesis, the female's ear would be most sensitive to the aggressive, higher frequency notes of the advertisement call, facilitating the detection of territorial disputes, which could lead to improved breeding opportunities. Thus, females might be preferentially attracted to these aggressive calls during playback experiments as shown by Narins and Capranica (1976, 1980). Conversely, the male's ear would be most sensitive to those frequencies corresponding to courtship and mating calls, providing opportunities to usurp or parasitize rival males. Supporting this, playback experiments by Ovaska and Caldbeck (1997a) showed that males of *E. antillensis* responded to the courtship call of other males by silently approaching the playback speaker. This is also supported by the observation that courtship calls of all three species are very soft and quiet, suggesting that there is selection for secrecy in mating behavior (Stewart and Townsend, 1986; Michael, 1996; Ovaska and Caldbeck, 1997a,b).

The vocal repertoires of the species of *Eleutherodactylus* discussed here appear to consist of differential combinations of just two notes distinguished by different dominant frequencies. The resulting calls, however, are surprisingly complex with subtle variation in both structure and context, which allows the transmission of not only very different messages but also of graded intensities of these messages (Fig. 2). The model presented

here is based on recent information regarding the vocal repertoires of these frogs, including the context of these calls both in the natural habitat and in captivity, as well as improved knowledge of their natural history. While this model refutes the original assignment of call note significance by Narins and Capranica, it supports their observations of sexual dimorphism in the auditory systems of these species, as well as their fundamental theory of call note significance dichotomy.

FUTURE DIRECTIONS

The hypothesis proposed here is attractive in that it accounts for the behavioral as well as the neurophysiological observations. Experiments are needed, however, to test it. The behavior of females towards the simultaneous presentation of courtship calls and agonistic calls in playback experiments would be of particular interest. This hypothesis predicts that receptive females (as determined by subsequent mating) would be attracted to the lower frequency courtship call, whereas non-gravid, sexually-mature females, as well as gravid females that are not ready to mate, would be attracted to the higher frequency agonistic call. Documenting the natural movements of females with respect to males' territories would shed light on how females sample territories and their resident males, and how they select mates. Such experiments and observations, however, are not easy to conduct under natural conditions because, in general, females are inconspicuous, difficult to locate in sufficient numbers, and easily disturbed. Innovative techniques and new approaches will be required to face this challenge.

Further clarification is also needed to understand species-specific variations in the structure of calls and their use. Although differences in advertisement calls between Puerto Rican species of *Eleutherodactylus* can be largely explained by a selection pressure to reduce acoustic interference (Drewry and Rand, 1983), there are other call differences that are not well understood. For example, *E. cochranae* frequently does not use the second note during typical bouts of advertisement calling, but the functional significance of adding or leaving off the second note is not understood. The function of the single, loud "co" notes that males of *E. coqui* often produce at the beginning of calling bouts and occasionally in small choruses is also poorly understood. More work is

also needed to understand the significance of vocalizations by females. The only well documented examples of vocalizations of female *Eleutherodactylus* are aggressive calls by *E. coqui* and *E. cochranae*, but this phenomenon could be widespread within the genus. Furthermore, the complete vocal repertoires of even the best studied species have not been documented. For example, both juvenile *E. coqui* and *E. antillensis* produce single, chirp-like notes during feeding that have not been investigated (Michael, pers. obs.; Stewart, pers. obs.). In addition to the species discussed here, other Puerto Rican species have very different advertisement calls, consisting of trill-like vocalizations, which may have a completely different structural relationship to the courtship and agonistic calls. Finally, the vocal repertoires of the majority of species on other West Indian islands, as well as those of the enormous number of mainland species, are virtually unknown. We hope that the ideas presented here on acoustic communication of *E. coqui* and related species will provide a framework for the continued study of other members of this genus and perhaps generate insights into the adaptive radiation of these interesting frogs.

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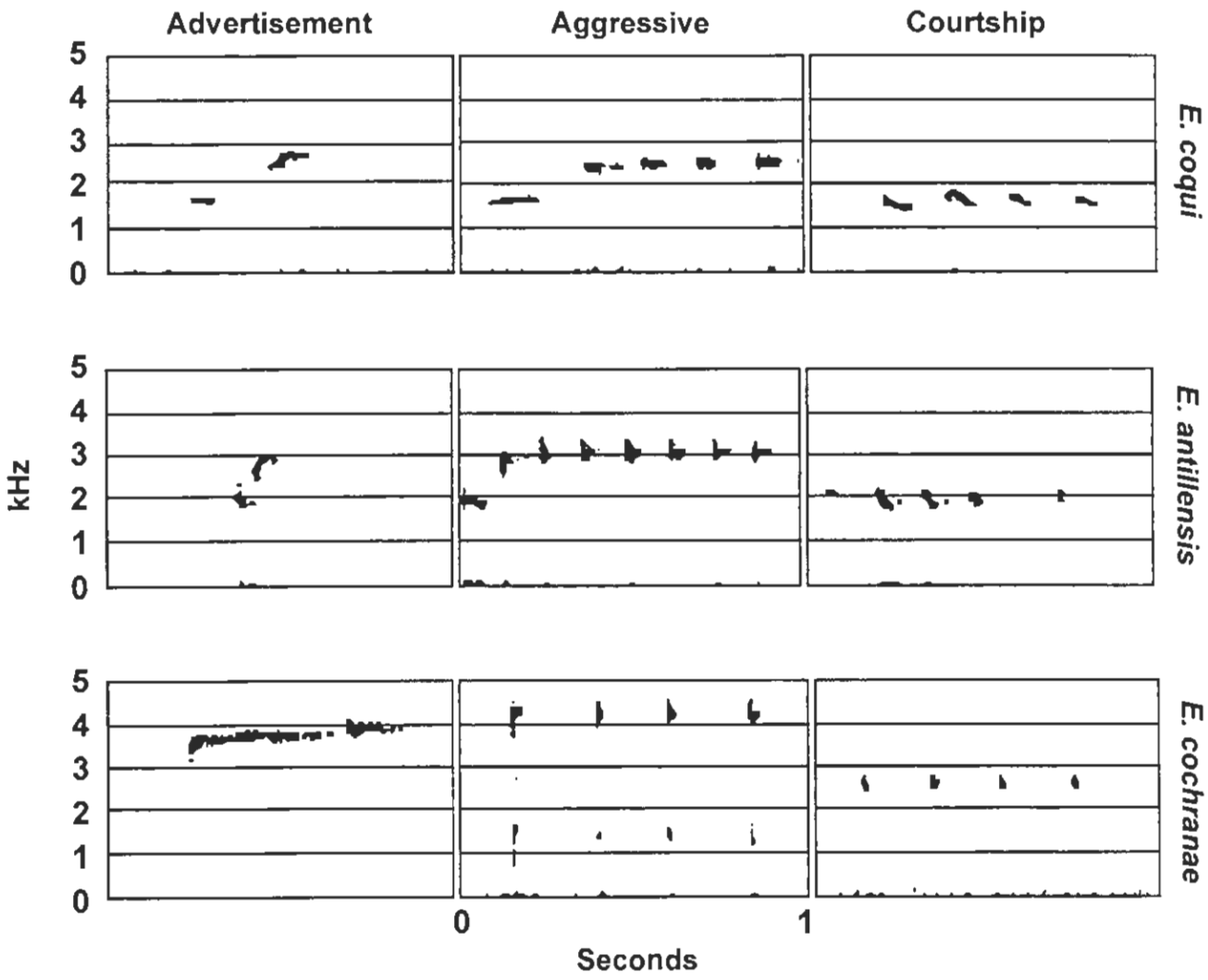
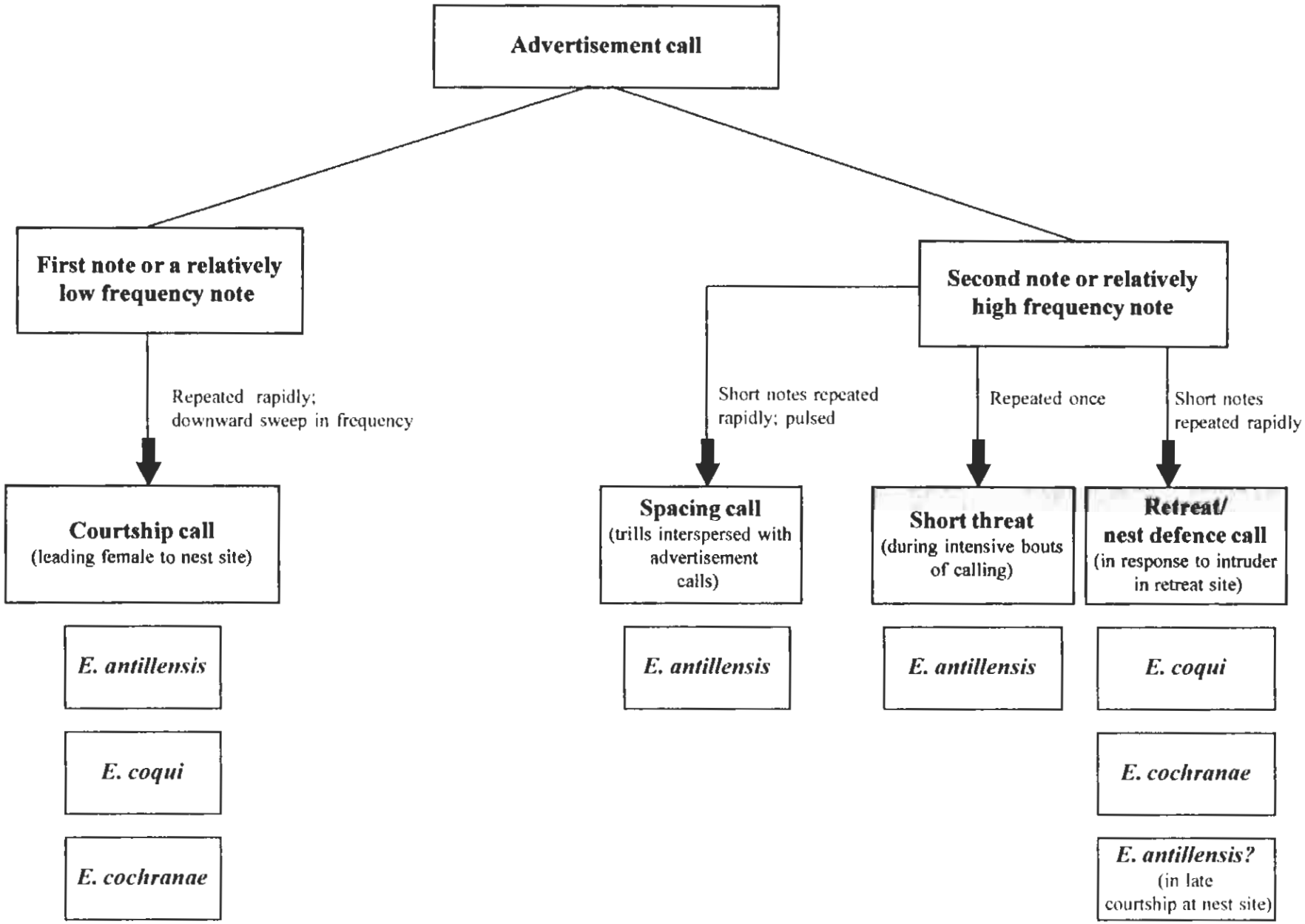
FIGURE LEGENDS

Figure 1. Sonagrams of typical advertisement, aggressive, and courtship calls of *E. coqui*, *E. antillensis*, and *E. cochranae*. The calls shown were recorded in captivity as described in Michael (1996).

Figure 2. Structural relationships between the advertisement call and the aggressive and courtship calls of *E. coqui*, *E. antillensis*, and *E. cochranae*. The hypothesized functions and the context of the calls are indicated. Modeled after Figure 3 in Pengilley (1971) and based on data presented in Michael (1996, 1997), Ovaska and Caldbeck (1997a ,b), and Stewart and Rand (1991, 1992).


Advertisement
Aggressive
Courtship
E. coqui
E. antillensis
E. cochranae
kHz
5
4
3
2
1
0
0
1
Seconds


Advertisement call
First note or a relatively low frequency note
Second note or relatively high frequency note
Repeated rapidly; downward sweep in frequency
Short notes repeated rapidly; pulsed
Repeated once
Short notes repeated rapidly
Courtship call (leading female to nest site)
Spacing call (trills interspersed with advertisement calls)
Short threat (during intensive bouts of calling)
Retreat/ nest defence call (in response to intruder in retreat site)
E. antillensis
E. coqui
E. cochranae
E. antillensis
E. antillensis
E. coqui
E. cochranae
E. antillensis? (in late courtship at nest site)

Acoustic communication and aggressive calls of the neotropical frogs *Eleutherodactylus cochranae* and *E. schwartzi*

A proposal for SSAR Grants-in-Herpetology, 1997

Funding category: Travel

Kristiina Ovaska, Ph.D., M.Sc.
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I will comply with all applicable permit regulations, and adhere to all appropriate animal care guidelines in the course of conducting the project.

BACKGROUND AND OBJECTIVES

Frogs have served as successful model organisms for understanding acoustic communication and its role in evolutionary processes, including speciation, sexual selection, and the evolution of mating strategies. The relative simplicity of these communication systems, when compared to those of other vertebrate groups such as birds and primates, facilitates the elucidation of patterns from acoustic data. Also, frogs often are easily amenable to experimental studies of call function using playback experiments.

Eleutherodactylus coqui, a common Puerto Rican frog of the family Leptodactylidae, has played a prominent role as a model system for studies of acoustic communication and call function (Narins and Capranica 1976, 1980; Drewry and Rand 1983, Stewart and Rand 1991, 1992). However, there are over 500 species in the genus *Eleutherodactylus* in Central and South America and the islands of West Indies, with major centers of endemism occurring on the larger islands (Hedges 1989), and the acoustic communication systems of most of these are virtually unknown. Recent studies of several species in the British Virgin Islands (BVI) and Puerto Rico have expanded our knowledge of the vocal repertoires of the frogs and revealed interesting patterns (Michael 1996, 1997, Ovaska and Caldbeck 1997a & b). For example, both courtship and aggressive calls (which are repetitions of components of the advertisement calls) of the handful of species so far examined show striking similarities, although their advertisement calls are very different. Information on vocal repertoires and call function of more *Eleutherodactylus* species is required to examine the generality of this pattern and to elucidate the selective pressures that have shaped acoustic communication in this group of frogs.

In the British Virgin Islands, there are three species of *Eleutherodactylus*: *antillensis*, *cochranae*, and *schwartzi*. These species occur in various combinations on the different islands and can be locally very abundant. Like all *Eleutherodactylus* species, all have direct development that takes place on land. Since 1993, together with coworkers, I have studied the island distribution, habitat use and behaviour of *Eleutherodactylus* in the BVI. We have described the diversity of calls produced by male *E. antillensis*, including courtship and aggressive calls, and experimentally examined their functional significance (Ovaska and Caldbeck 1997a & b). We have also described the courtship calls of *E. cochranae* (Ovaska and Caldbeck 1997b), and *E. schwartzi* (unpubl. data). However, aggressive calls of *E. schwartzi* and *E. cochranae* (apart from

a retreat defense call of *E. cochranae* in captivity; Michael 1997) have not been documented. Here we propose to investigate experimentally the function of the presumed aggressive calls of these two species through playback experiments under natural conditions.

We propose to test the following hypotheses:

(1) "Click" notes that male *E. cochranae* occasionally add to the end of their single-note, whistle-like advertisement call, are agonistic calls, which function in the spacing of calling males. If so, then males should respond to the experimental playback of advertisement calls, and advertisement calls with clicks by increasing the number of clicks in their own calls.

(2) The aggressive calls of male *E. cochranae* are graded with an increasing number of clicks denoting increased threat. If so, then males should increase the number of clicks in their calls in response to the playback of the whistle, whistle followed by two clicks, and whistle followed by four clicks, in that order.

(3) The trill call, which differs from the two-note advertisement call of *E. schwartzi*, has an agonistic function and functions either in the defense of retreat or calling sites by males. If so, then males should respond to the playback of the advertisement call or the trill call by producing trill calls. A stronger response to the advertisement call would suggest a function in spacing among calling males.

METHODS

Playback tapes and experimental design. - Playback tapes will be created using SoundEdit and Canary software on a MacIntosh computer from the calls of two individual male *E. cochranae* and *E. schwartzi*, each. The calls of these "source" males were recorded in the BVI in October 1997. The playback tapes for *E. cochranae* will consist of a 2 min. period of silence, providing a baseline during which the calls of the test animal will be recorded, followed by either 2 min. of repeated whistles with no clicks (whistle stimulus), whistles with two clicks (2 click stimulus), or whistles with four clicks (4 click stimulus). The order of the presentation of the stimuli to the individual target frogs will be random, with approximately an equal number of frogs

receiving each stimulus first. There will be a 5 min. interval between the playback of the three stimuli to each frog to ensure that there is no carry-over effect from the presentation of the previous stimulus.

The tapes for *E. schwartzi* will consist of a 2 min. period of silence (baseline) followed by 2 min. of either repeated advertisement calls or trill calls. Again, the order of the presentations will be random, and there will be a 5 min. interval between the two stimuli to individual males.

Field methods. - A Sony Professional Walkman will be used to play the stimuli sequences to individual calling males of the two species after dark under field conditions. The speakers will be placed so as to result in a sound pressure level of about 75 dB SPL at the position of the target frog, so simulating an intrusion into its acoustic space . The distance between the speaker and the frog, perch height of the frog, and air temperature will be recorded for each trial. When possible, the snout-vent length and weight of the frog will also be recorded after the completion of the trial. The sample size will be 15-20 males of each species. The playbacks will be carried out on Sage Mountain, Tortola, BVI in October 1998.

Data recording and analysis. - During the experiments, an observer will record the number of different calls that the target males produce during the baseline and the stimulus periods (i.e. the number of single whistles, and whistles with varying numbers of clicks for *E. cochranae*; the number of two-note advertisement calls, and trill calls for *E. schwartzi*). Data analysis will consist of comparing the number of presumed aggressive calls (click calls of *E. cochranae*, and trill calls of *E. schwartzi*), among the baseline and the stimulus periods using the Friedman's test, a nonparametric test for repeated observations.

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COMPLETE PROJECT BUDGET

EXPENSE	FUNDING SOURCES	TOTAL COST
1. TRAVEL (1) 2 return airfares (for applicant and a field assistant) Victoria, BC - Tortola, BVI (2) Travel in the BVI to study site (car rental or taxi)	**SSAR: $500 - Requested** Guana Island Club: $600 - Requested Applicant's contribution: $900 Provided by Conservation Agency (RI)	$2,000 "in kind"
2. EQUIPMENT (1) Audio-equipment (tape recorder, speakers, stopwatch) (2) Head-lamps (3) Camping gear	Provided by applicant	"in kind"
3. SUPPLIES (1) Cassette tapes, batteries (2) Waterproof note books (3) Miscellaneous	Provided by applicant	$150
4. ACCOMMODATION /FOOD IN THE BVI	Provided free of charge by the Conservation Agency (RI) and Guana Island Club	"in kind"
TOTAL (cash)		**$2,150.00**

A NEW SPECIES OF MABUYA (SAURIA: SCINCIDAE) FROM THE BRITISH VIRGIN ISLANDS

James D. Lazell[1] and Gregory C. Mayer[2]

ABSTRACT - Mabuya macleani sp. nov., a pallid, drab, almost patternless skink is abundant on Carrot Rock, British Virgin Islands. Mabuya mabouya shows spectacular character divergence in pattern from the new species concordant with geographic approach to within less than 600 m. The presence of this species and another endemic lizard (Anolis ernestwilliamsi) on such a small (1.3 ha), poorly isolated, and young (< 3000 y) island is a striking case of rapid divergence of insular populations.

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[2] Department of Biological Sciences, University of Wisconsin-Parkside, Kenosha, WI 53141, U.S.A.

The coloration is highly interesting... several insular forms may be distinguishable when adequate series become available.

Karl P. Schmidt (1928)

The scincid lizards of the genus Mabuya are nearly tropicopolitan in distribution. We have collected or examined them in numbers from the Antilles, South America, tropical Asia, and Africa. Throughout this vast range, with the exception of one tiny islet, their populations are remarkably uniform in appearance. The exception is Carrot Rock, a very small (1.3 ha), steep-sided island off the southeast end of Peter Island in the British Virgin Islands (Fig. 1).

On 13 July 1985, while one of us (GCM) climbed the biggest tree on the island in search of anoles, the other (JDL) toiled in the dust in the little gully on the windward side of Carrot Rock in which the tree grew, looking for Sphaerodactylus geckos. A far larger, drab, pale lizard was turned out, and ran up his sleeve; it was rewarded with a position at the Museum of Comparative Zoology (MCZ), number 170884.

Although the initial specimen was distinctive, we at first referred to it as Mabuya mabouya sloanii (Mayer and Lazell, 1988), the common skink of the Virgins (MacLean, 1982; Lazell, 1988), pending collection of further specimens. Over the next several years JDL returned to Carrot Rock occasionally, and found an area where these peculiar pallid lizards were abundant, and succeeded in capturing five more individuals (of dozens seen).

These specimens, as well as comparison with Mabuya from throughout the islands of the Puerto Rican Bank, have abundantly confirmed the distinctiveness of this population, and also brought into sharp focus a most intriguing evolutionary phenomenon. We here describe this ~~distinctive~~ most distinctive New World Mabuya as:

Mabuya macleani sp. nov.

Mabuya mabouya sloanii.-- Mayer and Lazell, 1988:23 (in part).

Holotype.— MCZ 170884, collected on Carrot Rock, south of Peter Island, British Virgin Islands, 18°19'45"N 64°34'18'W, by J.D. Lazell, 13 July 1985 (Fig. 2D).

Paratypes.— All from the type locality: MCZ 182270-72, 17 July 1988; MCZ 176728 and Universtiy of Michigan Museum of Zoology (UMMZ) 197261, both 26 October 1991.

Diagnosis.— A pallid tan to brownish-gray New World Mabuya (Dunn, 1936: Greer, 1970) with one or two pairs of enlarged nuchals (their combined widths more than 75 percent of the width of the parietals); two frontoparietals; midbody scales in 32-34 rows; 16-18 subdigital lamellae under fourth toe of pes; limbs moderately long; dark dorsal markings fragmented or absent on head and separated from dark dorsolateral stripes on nape; nape stripes reduced, separated by all or most of two dorsal scales and not extending more than 21 dorsal scales posterior to

parietals; lateral dark stripes obsolescent. It is distinguished from the geographically nearest populations of M. m. sloanii by the much reduced dorsolateral dark stripe, the continuous stripe beginning behind the head in M. macleani (on the head in M. m. sloanii), and extending only to the level of the forelimbs (behind the forelimbs in M. m. sloanii).

Description of the type.- Rostral wider than high, bordered dorsoposteriorly by the nasals and paired supranasals, which are in narrow contact. The frontonasal is broader than long and in contact with the frontal. The paired prefrontals are separated medially by the contact of the frontonasal with the frontal. The frontal is about three quarters as long as its distance from the posterior parietal edge, and separated from the first supraocular by contact of the prefrontal with the second supraocular. There are four supraoculars, the second the largest. There are three supraciliaries, the second by far the longest. The two frontoparietals are in contact with the second, third, and fourth supraoculars, bordered posterolaterally by the parietals, and posteriorly by the interparietal, in which the parietal foramen is posteriorly situated. The large, paired parietals are in contact posterior to the interparietal, that on the right extending further posteriorly. There is one pair of transversely enlarged nuchals, but the second and third nuchals are enlarged on the left side.

The nasal is subrectangular with the large nostril posteriorly located, followed by the postnasal and two loreals;

the anterior one on the left is much larger than the posterior, but the two are subequal on the right. The anterior loreal is in contact with the prefrontal, but the posterior loreal is separated from the latter scale by the first supraciliary. The sixth supralabial on the left, and the fifth on the right, are about twice as long as the others and form a long subocular. There is a clear disk in the lower eyelid about as wide as the ear opening. The temporals are larger than the trunk scales. There are no auricular denticles. There are two pairs of chin shields in contact posterior to the mental.

Scales of body and limbs imbricating, subcycloid, regularly arranged in rows. Thirtyfour longitudinal rows at midbody, 57 transverse rows dorsally from parietals to anterior edge of hind limb, 61 ventrally from mental to vent. The vent is bordered anteriorly by eight subequal scales. Scales of soles and palms tubercular, transition from imbricate scales of limb to tubercular scales abrupt. Thirteen lamellae under fourth toe of manus, 17 under fourth toe of pes. Adpressed limbs do not meet.

In life, the type was extremely pallid beige-gray with a faint trace of a lateral stripe extending to just above the axilla. There are two dark dots on the frontonasal and a little dark gray flecking on the supraoculars. The plain lead-gray dark dorsolateral stripes end 13 (left) or 14 (right) dorsal scales posterior to the parietals.

Variation.— Some characteristics of Mabuya macleani are given in Table 1, and measurements in Table 2. The holotype is fairly

typical in its squamation, and the paratypes do not present a great deal of variability. Head scales of MCZ 182270 are shown in Fig. 3. This specimen shows two unusual conditions: the presence of an intercalary scale separating the first supraocular from contact with the frontal on the left side of the head, and the partial fusion of the fourth supraocular with the parietal, also on the left side. Contact of the supranasals is variable, being separated in one specimen, touching in four, and even fused medially into a single scale in another. The prefrontals are never in contact medially. The following summary of meristic variation gives for each character the range, followed by the mean and sample size in parentheses. For some bilateral characters the sample size has been reckoned by the number of sides rather than specimens, and this is noted after the sample size. Supraoculars: 4 (4.0, 12 sides); supraciliaries: 2-4 (3.0, 6 sides); supralabial subtending the eye (subocular): 5-6 (5.3, 11 sides); midbody scale rows: 32-34 (32.3, 6); transverse dorsal rows: 54-58 (56.0, 4); transverse ventral rows: 58-66 (61.2, 6); fourth toe of manus lamellae: 13 (13.0, 4); fourth toe of pes lamellae: 16-18 (17.3, 6).

All Mabuya macleani have a much reduced pattern of striping compared to the bold striping typical of Antillean Mabuya (Fig. 2), but the extent of reduction varies, and seems to be size related, with smaller specimens having less reduced markings. All specimens have paired blotches on the frontonasal, but they are scarcely evident on the largest specimen (MCZ 182270), in which, were it not for their presence in the other specimens,

they might be taken to be merely two of several scattered dark mottlings on the head, rather than reduced pattern elements. In all specimens the dorsolateral stripe is short and starts on the neck, beginning 3-5 (4.6, 12 sides) scales behind the parietals, and extending to the 15th to 21st (17.7, 12 sides) transverse dorsal scale row behind the parietals; the posterior end is thus at about the level of the forelimbs. There is also size related variation in the intensity of the the striping, the dorsolateral dark and light stripes being relatively darker and lighter, respectively, in the second smallest specimen (MCZ 182272) than in the larger ones. The most distinctive pattern variation is in the smallest specimen (UMMZ 197261), which, in addition to the frontonasal blotches and dorsolateral dark stripe (which is longest in this specimen, extending from the 5th to 21st scale row), also has two short stripes on the head, extending from the second supraoculars to the parietals.

There appears to be allometric growth of the limbs. The smallest individual, University of Michigan Museum of Zoology (UMMZ) 197261, 44.5 mm SVL, has proportionately by far the longest limbs, and MCZ 187220, 80.5 mm SVL, the largest, has the shortest. The other four are intermediate. The type, at 69.5 mm SVL, has slightly shorter limbs proportionately than MCZ 176726, 71 mm SVL, but the overall impression is that limb length fails to keep pace with body growth.

The sexes are quite similar. Based on broad head, thick tail base, and enlargement of the medial pair of scales bordering the vent, MCZ 182271 was judged to be a male, and dissection

confirmed that. Based on narrow head, abruptly tapering tail, and subequal scales bordering the vent, MCZ 187220, the largest available specimen, was judged to be a female, and dissection confirmed that. There would seem little purpose in damaging more specimens to determine sex (even for the type).

Comparisons.— Some localities from which specimens have been examined, including those that corroborate character divergence of M. macleani and M. mabouya, are shown in Fig. 4. To date, all Antillean skinks (except lineolata of Hispaniola) have been referred to the species Mabuya mabouya (Schwartz and Henderson, 1991), with the subspecies M. m. sloanii Daudin (1802), type locality St. Thomas, Virgin Islands, as the form throughout the Greater Antilles. M. m. sloanii in widespread, but nowhere abundant, in the British Virgin Islands (Lazell, 1983, 1991, 1995; Mayer and Lazell, 1988). This skink is deep copper to chocolate brown with prominent lateral stripes of near-black and very bold jet black dorsolateral stripes, beginning on the head, and extending continuously down the nape onto the anterior trunk, well past 20 dorsal scales posterior to the parietals (Figs. 2C and 5). The dark dorsolateral stripes are black and separated by silvery-white on the median portions of the two middorsal scale rows. In Puerto Rico, skinks are similarly dark with near-black lateral stripes extending onto the trunk, but the dark dorsolateral stripes are reduced to heavy blackish blotching on the head, fragmenting and dwindling to speckles on the nape (Fig. 2A). This pattern form was named M. nitida by Garman (1887) on

the basis of one specimen from Hispaniola and three from Puerto Rico. Stejneger (1904) described this form accurately based on one of two specimens numbered MCZ 6052 from San Juan, Puerto Rico. Schmidt (1928) also noted this pattern form, and restricted Garman's nitida to Puerto Rico. Four Puerto Rican specimens available to us, MCZ 6050, Garman's type of M. nitida, and MCZ 6052 (2 specimens), all from San Juan, and University of Puerto Rico at Rio Piedras (UPRRP) 5401, from Barrio Cotto, Isabela, (Garcia-Diaz, 1967), agree with Schmidt and Stejneger's description, as did the somewhat larger series available to Grant (1931). Based on these specimens and the literature, we cannot see why M. m. nitida is not recognized as a valid taxon today.

A specimen from Icacos, an island just east of Puerto Rico, MCZ 36624, is quite intermediate between m. nitida and M. m. sloanii of the smaller islands to the east (Fig. 2B). The overall picture is of striking variation in Mabuya mabouya showing spectacular character divergence concordant with geographic approach to Mabuya macleani (Fig. 1).

Dunn's (1936) description of Mabuya m. pergravis of the western Caribbean, "striping very indistinct; pale with dark dots above", may sound superficially similar to M. macleani, but the two forms are amply distinct. M. m. pergravis is much more slender, and has fewer midbody scale rows (28-30; Dunn, 1936; Dunn and Saxe, 1950). Striping is not indistinct in a single specimen from San Andres, and in those from Providencia the dark dots are numerous (unlike macleani, in which there are few or no dark dots dorsally).

In meristic and measurable characters, all New World Mabuya, and most from the rest of the world, are slightly, and usually only modally, differentiated. In this respect, M. macleani differs from M. mabouya somewhat in having smaller scales, reflected in higher midbody row counts: 32-34, as opposed to 30-32 in other Puerto Rico Bank Mabuya (n=20). It would take much larger sample sizes to even demonstrate statistical significance. There may be a real selection pressure for smaller scales in M. macleani. Carrot Rock's other endemic, Anolis ernestwilliamsi, has very small scales and is absolutely distinct from its closest relative in this character (Lazell, 1993). Interpreting the adaptive significance of scale size in lizards is, however, fraught with difficulties and apparent contradictions (Lazell, 1994, Dmi'el et al., 1997).

Etymology.— The species is named in honor of our late friend and colleague Dr. William P. MacLean, III, of the University of the Virgin Islands, who contributed so much to knowledge of the Virgin Island herpetofauna (MacLean, 1982), and who aided and assisted our work, and that of many others, on numerous occasions (Lazell and Mayer, 1992). He was one of the first, and still few, professional biologists ever to have set foot upon Carrot Rock, and recognize its biotic uniqueness.

DISCUSSION

Ecology.— Carrot Rock has undergone major ecological changes since it was first visited by JDL in 1980 (Lazell, 1983). Then,

most of the windward (eastern) and northern portion of the top of the islet was covered with a sprawling growth of sea grape, Coccoloba uvifera (Polygonaceae), which had to be either climbed over or crawled under. There were three thickets of sea grape on the edges of the scarp tall enough ~~for me~~ to stand in the shade of: one on the leeward coast, one on the northern windward coast, and the biggest in the gully -- locally called "ghut" -- where the first Mabuya macleani was apprehended.

Severe drought characterized the climate of the Virgin Islands duringthe eighties. It seemed that more precipitation fell in the form of dust -- said to have blown all the way from the Sahara -- than as water. JDL's field notes of 13 July 1985 record: "The Rock is in terrible shape! The sea grape looks 90% dead; places I could crawl under before are now just scattered dry sticks. Trying to dig out leaf litter was a nightmare of dust."

Despite the drought, Anolis remained common, the first Mabuya was secured, and Sphaerodactylus macrolepis (MCZ 170890) was also collected -- all in the one remaining sea grape thicket in the ghut -- in 1985. This brought Carrot Rock into compliance with the "rule of three" for Caribbean islands, as predicted (Lazell, 1983). On 17 July 1988 conditions were no better, but more Mabuya macleani were seen and collected than ever before. Over most of the boulder jumble surface of Carrot Rock, skinks have the advantage over would-be captors. In one small area near the top, however, there are few rocks, little vegetation, and a soil substrate. Here a group of us simultaneously sighted eight

skinks in a 10x20 m (200 m^2) plot (and caught three of the eight). Excluding the bare rock faces and wave-washed talus of the edges, we estimate the top of the islet habitable for skinks at ca 1.3 hectares. Using our crude estimate, the total population of Mabuya macleani might be something like 520 individuals. In any case, a density of 12 in 200 m^2 (400 per hectare) far exceeds that of skinks or other comparable ground lizards (e.g. Ameiva) anywhere in the Antilles.

On 27 October 1994, three Mabuya macleani were seen in about two hours on the Rock. JDL's field notes mention "the incredible drought," and the appearance of the islet as "dead gray still" and "really bleak." Hurricanes Luis and Marilyn struck the Virgin Islands in September 1995. Low-lying areas like Carrot Rock were inundated with sea water, but there was relatively little mitigating rainfall. In October 1995 ~~On this day~~ the Rock was visited with a group of enthusiastic lizard hunters, but in two hours ashore we saw but two skinks and not a single Anolis. Approximately half the sea grapes in the ghut thicket were dead. The large candelabra cactus, Pilosocereus royenii, that had crowned the top of the islet (and housed the largest, uncatchable Anolis) was "rotting pulp and stark skeleton."

Rainfall in the region began to increase in 1996. On 24 October 1996 a group of us checked the Rock briefly. We did not attempt to collect specimens, but we quickly located three Anolis gingerwilliamsi and two Mabuya macleani, one of the latter perched on a vine ca 3 cm above the ground (Schwartz and Henderson, 1991, note climbing in Mabuya mabouya). Again, from

JDL's field notes: "Seagrapes are regenerating well; the place generally looks much better than last year."

A brief vegetation survey of Carrot Rock, by Dr. Fred Kraus, done 26 October 1991, included, in addition to seagrape and candelabra cactus, Mammillaria nivosa, Melocactus intortus, and Opuntia dillenii (all Cactaceae), and the vines Capparis flexuosa (Capparidaceae), Stigmophyllon periplocifolium (Malpighiaceae), and Cavanalia maritima (Leguminosae). There are "various graminoids including the rare silky foxtail grass Pappophorum pappiferum."

Differentiation on small islands.— The distinctiveness of populations inhabiting small islands, and the apparently rapid evolutionary rates involved in achieving this differentiation, have long been known to students of the zoology of archipelagos (Mayr, 1941, 1963; Lazell, 1972). Mabuya macleani appears to be an example of this phenomenon. Two aspects of Carrot Rock's geographic situation, in particular, argue for rapid evolution (Fig. 6). First is its short distance, approximately 400 m, from Peter Island. Given this short distance, and the predominant direction of the currents from the northeast, there seems a considerable probability of waif dispersal of skinks from adjacent parts of Peter Island where typical M. m. sloanii does occur: MCZ 150273 or other islands to windward. Divergence of the Carrot Rock population, especially by genetic drift, would have to proceed at a higher rate between immigration events to offset the genetically homogenizing effects of those events.

The second aspect is the short time during which Carrot Rock has existed as a separate island. Lowered sea levels during the last glacial period united all of the islands of the Puerto Rican Bank into a single large island (Heatwole and MacKenzie, 1967). The age of separation of two islands on the bank can be inferred from the maximum depth of the water now separating them, and the time course of the Holocene sea level rise. We cannot say with certainty what the maximum depth of the channel between Carrot Rock and Peter Island is, because the channel is so shallow and strewn with rocks that only the smallest of boats attempt to pass through the strait, and then only at high tide, so that accurate soundings are not possible. The very inability to measure the depth reveals its shallowness, and it cannot be more than several meters. Based on the time course of Caribbean sea level rise (Fairbanks, 1989), a depth of 5 m would correspond to a separation of 3000 years; as the actual depth is almost certainly less than this, this is an upper limit on the age of Carrot Rock.

The causes of rapid divergence in island populations have long been a matter of contention (Williamson, 1981; Berry, 1986), with some arguing for the importance of stochastic factors (e.g. Mayr, 1954), while others have stressed the adaptive nature of island differentiation (e.g. Grant, 1968). Carrot Rock's closeness to Peter Island argues for a non-stochastic cause, since even a low rate of migration is sufficient to counteract divergence due to founder effect or drift (Crow and Kimura, 1970); gene flow is much less effective in counteracting selection (Lande, 1980). There is another, in our opinion much

stronger, argument for non-stochastic causes: the occurrence on Carrot Rock of its other endemic lizard, Anolis ernestwilliamsi, which, like Mabuya macleani, has a close relative, A. cristatellus, widespread on other islands on the Puerto Rican Bank (Lazell, 1983; the third species on the island, Sphaerodactylus macrolepis is not distinct). As Mayr (1963) has noted, production of evolutionary novelties or new species in small, isolated populations is a rare event; if the initiating genetic events are stochastic in nature, it is highly unlikely that, of all the many islands on the Bank inhabited by Mabuya (Fig. 4) and A. cristatellus (MacLean, 1982; Mayer, 1989), these events should occur in both taxa on the same island. We infer that there is something about Carrot Rock itself which is conducive to divergence, rather than that there have been two independent occurrences of a rare stochastic event. We can only suggest that it is the unusual environmental conditions of the island (see above under Ecology) that are the common factor in divergence of the two species, but could only speculate about the exact conditions influencing one or the other species. Although it is often argued that evolution proceeds faster in smaller populations, adaptive divergence in fact is faster and greater in larger populations (Weber and Diggins, 1990; Coyne et al. 1997), making the situation of two endemic lizards on Carrot Rock even more remarkable.

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FIGURES

Figure 1. Carrot Rock, British Virgin Islands, viewed from the north, 17 July 1988. Windward is to the left, leeward to the right. From a Kodachrome transparency by G.C. Mayer.

Figure 2. Dorsal patterns of skinks from the Puerto Rican Bank. A-C, geographically approaching Carrot Rock: A) MCZ 6050, type of Mabuya mabouya nitida, San Juan, Puerto Rico, ca 164 km WNW of Carrot Rock. B) MCZ 36624, intergrade, M. m. nitida x sloanii, Cayo Icacos, ca 102 km WNW of Carrot Rock. C) MCZ 182273, M. m. sloanii, Stoney Bay, Peter Island, British Virgin Islands, 600 m N. D) MCZ 170884, type of Mabuya macleani, Carrot Rock, British Virgin Islands. Bars below lizards indicate 1 cm in each case.

Figure 3. Aspects of head squamation in MCZ 182770, Mabuya macleani paratype. The first pair of enlarged nuchals are marked "n." Bar is 1 mm.

Figure 4. The eastern portion of the Greater Puerto Rico Bank showing some localities from which specimens have been examined. 1, San Juan, Puerto Rico. 2, Cayo Icacos. 3, Isla Culebra. 4. Tortola. 5, Anegada. 6, Peter Island. 7, Carrot Rock. Bar indicates 10 km. The dotted line is the edge of the Greater Puerto Rican Bank, ca 100 m below sea level.

Figure 5. Daudin's (1802) illustration of his Scincus sloanii, the widespread form of the Virgin Islands, showing pattern in side view. (Missing from this copy: long story.)

Figure 6. The south end of Peter Island and Carrot Rock, British Virgin Islands. Dot indicates collection site of Mabuya

mabouya sloanii, MCZ 182273, at Stoney Bay. Sand (dots), cobble and scree, and cliffed shorelines are indicated. Black diamonds indicate rocks that break at low water (from U.S. NOAA chart 25641, 1984). Contours are at ca 7.62 m or 25 ft. (from British Directorate of Overseas Surveys 346, Series E 837, 1959). Bar, lower right, indicates 200 m.

Table 1. Some characteristics of Mabuya macleani. "Scales" are number of rows around trunk at midbody. "Stripe" is the length of the dorsolateral dark stripe dorsal scales posterior to the parietals (left/right).

	SVL	Scales	Supra-nasals	Stripe	Nuchal Pairs	Adpressed limbs
MCZ 170884	69.5	34	Contact	15/16	1	Fail to meet
MCZ 176728	71.0	32	Contact	18/18	1	Toes barely touch
MCZ 182270	80.5	32	Contact	17/18	2	Fail to meet
MCZ 182271	76.0	32	Contact	18/15	1	Fail to meet
MCZ 182272	63.0	32	Separated	17/18	2	Meet
UMMZ 197261	44.5	32	Fused	21/21	1	Toes overlap

Table 2. Measurements (mm) of holotype and three paratypes of Mabuya macleani.

	MCZ 170884 Holotype	MCZ 182270 Paratype	MCZ 182271 Paratype	MCZ 182272 Paratype
Snout-vent length	69.5	80.5	76.0	63.0
Tail length	52+	67+	56+	75.5
Axilla-groin length	38.0	45.0	40.5	34.5
Snout length	5.4	5.7	5.7	5.0
Snout width	5.5	5.5	5.4	4.9
Head length	11.9	13.0	12.8	11.4
Head width	8.2	10.2	10.2	8.0
Upper arm length	5.5	6.5	6.0	5.0
Lower arm length	4.9	5.5	6.5	4.7
Palm length	1.9	2.8	2.6	2.9
Fourth finger length	4.5	4.5	4.5	4.0
Upper leg length	8.0	8.0	8.0	7.0
Lower leg length	6.6	7.5	7.3	6.6
Sole length	3.4	3.8	4.3	3.1
Fourth toe length	6.5	7.0	7.0	7.5

+ tail broken or regenerated

FIG. 1

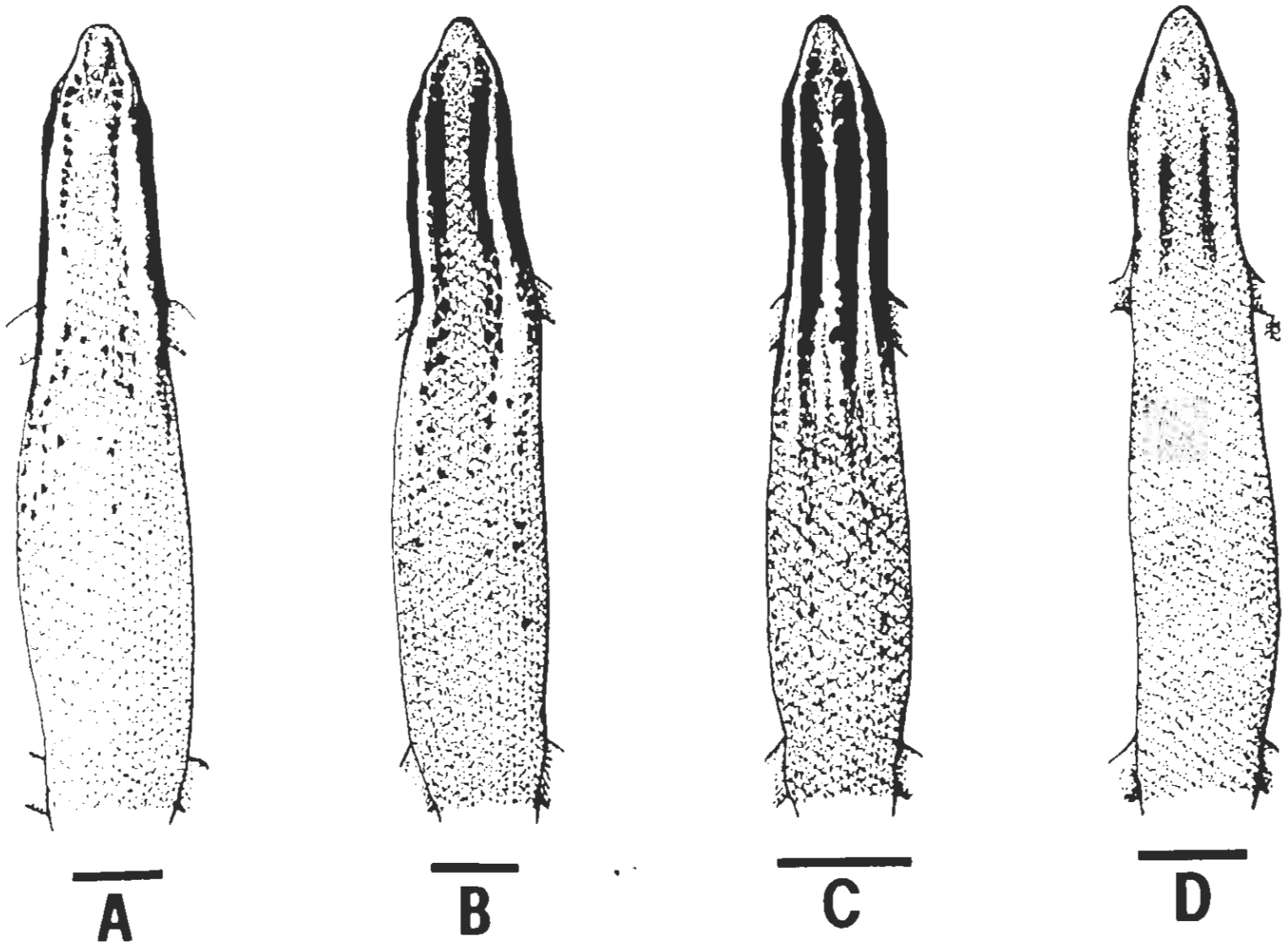

FIG. 2

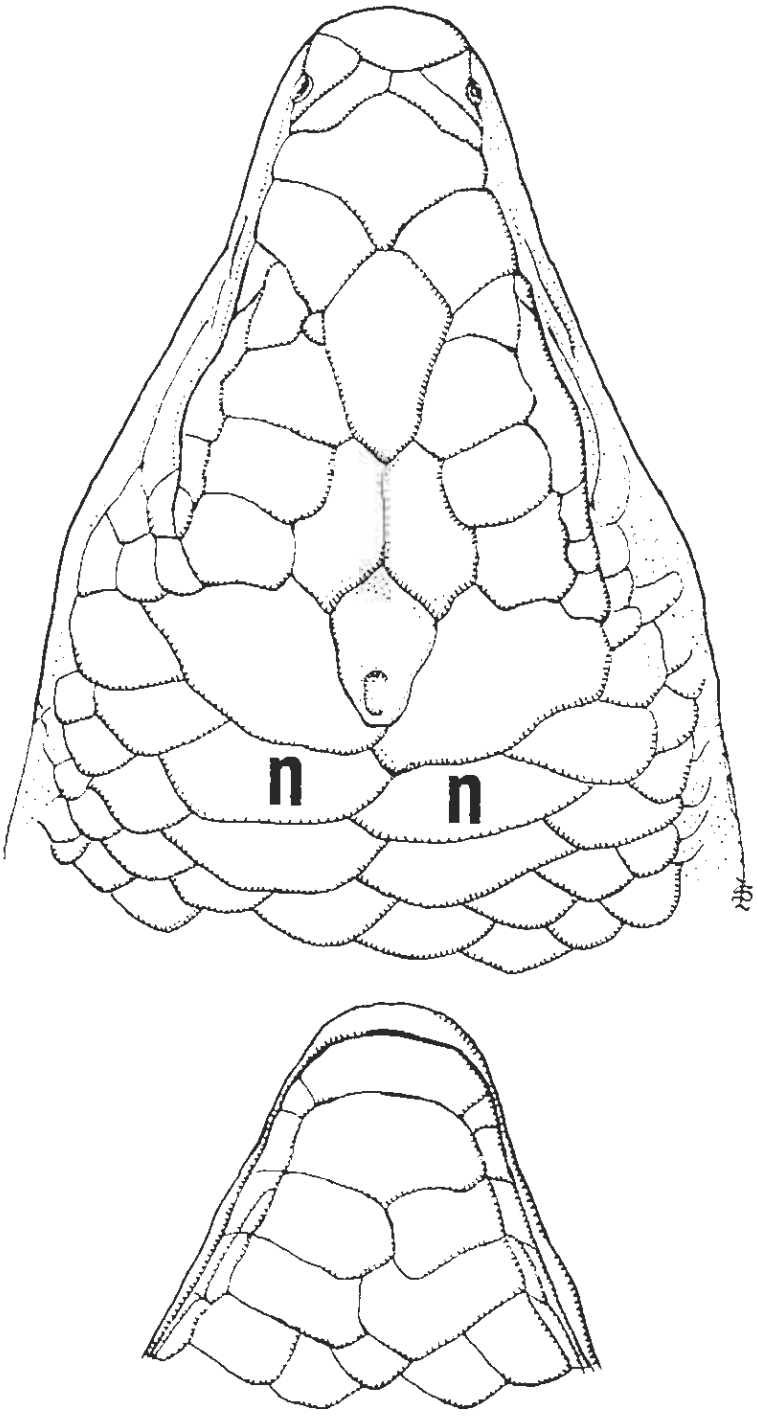

FIG. 3

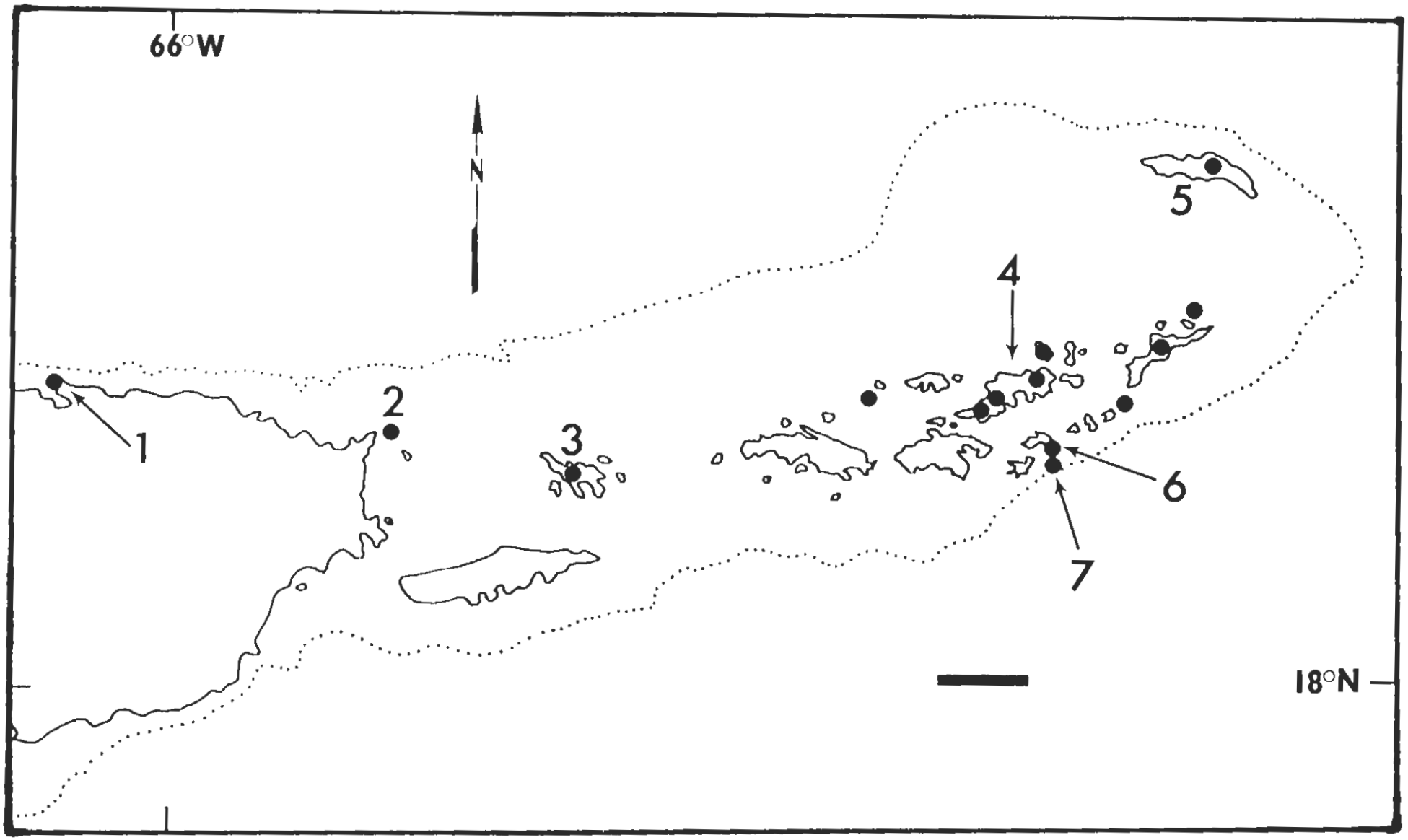

FIG. 4

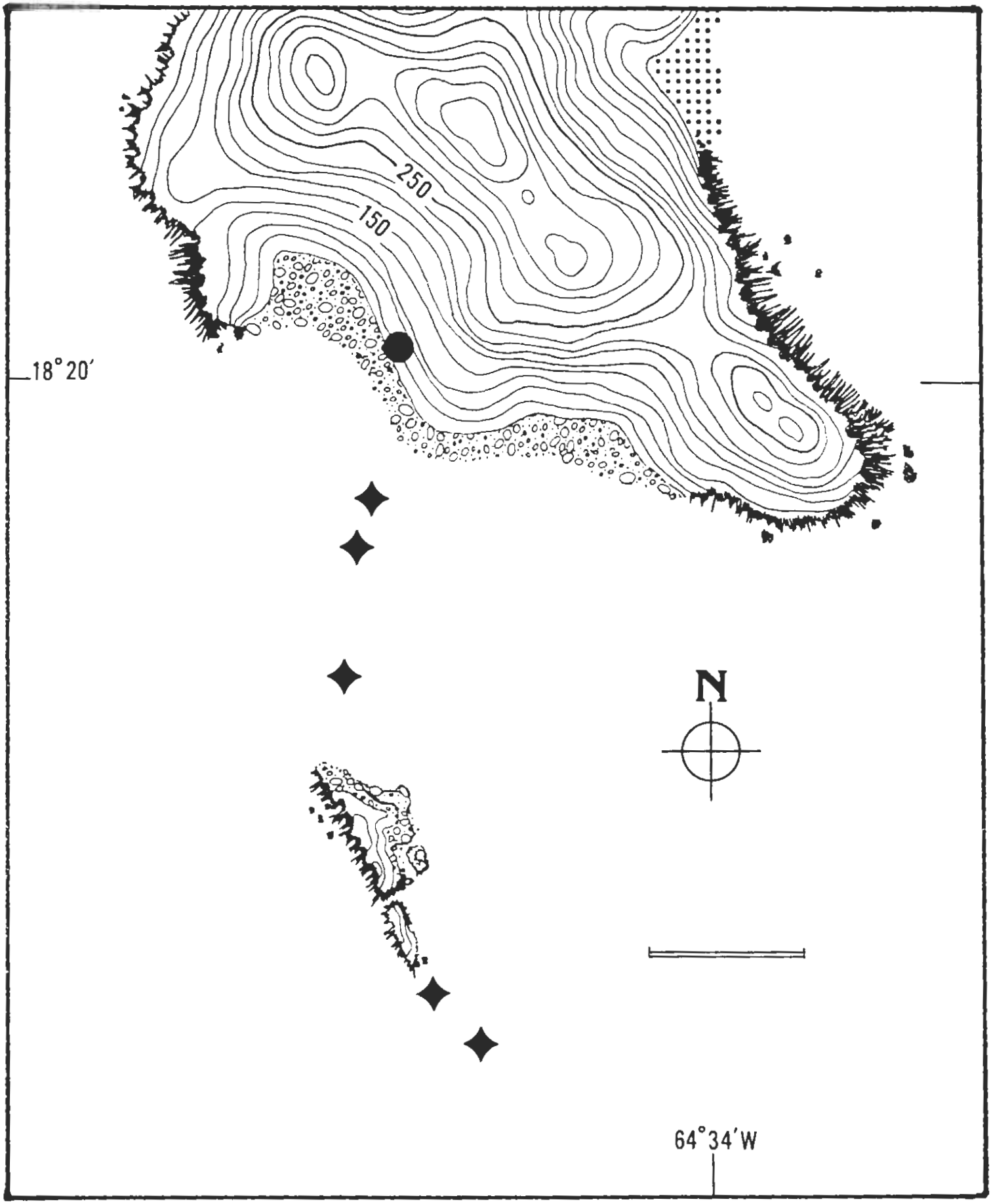

FIG. 6

Rick Hudson's report on C. pinguis follows:

REPORT ON WIISG VISIT TO ANEGADA ISLAND, 23-31 OCTOBER, 1997

On 23 October, Jeff Lemm (Research Fellow, San Diego Zoo/CRES) and I flew to Tortola, BVI, at the request of Mr. Joseph Smith-Abbott, Deputy Director and Science Coordinator at the BVI National Parks Trust (NPT). Our mission was to construct a small headstart facility on Anegada to house three 1997 Cyclura pinguis hatchlings that had been collected earlier in the month by Mr. Rondel Smith. Our other goals were to collect additional hatchlings for headstarting, provide iguana husbandry training to caretaker Rondel Smith, collect blood samples for genetic analysis, survey areas supporting iguana populations, visit the introduced population on Guana Island if possible, and meet with government personnel to discuss various conservation options for the recovery of the Anegada iguana. I am happy to report that we accomplished all of our goals with the exception of collecting additional hatchling iguanas.

HEADSTART FACILITY

Using materials provided by the BVI National Parks Trust, Jeff and I constructed a small (10 x 6 x 6 ft) headstart facility beside the new Administration building on Anegada. The facility is located in the partial shade of a tree, and enjoys the protection of the local police department. It is available for the local population to view and hopefully appreciate. We completed this facility in two days, and on our last day there, placed the iguanas in the enclosure. Though small, it is adequate for the three juveniles for probably the next three years, but will need to be expanded in order to house additional hatchlings in the coming years, a plan which BVI NPT supports.

HUSBANDRY TRAINING

Jeff and I spent a good deal of time with Rondel, coaching him on proper feeding techniques. He is feeding some native vegetation, but the bulk of the diet appears to be vegetables and that have been discarded by local restaurants. Unfortunately much of this is brown and wilted iceberg lettuce. We advised him not to feed such poor quality food, and to offer local, naturally consumed food items; later we suggested to the Trust that they set up an account to allow Rondel to procure higher quality greens and vegetables. We also gave two cases of commercial iguana pellets to Rondel and encouraged him to begin feeding it immediately in addition to greens.

COLLECTION OF BLOOD SAMPLES FOR GENETICS

We collected blood samples from six iguanas, thus vastly expanding the sample base for C. pinguis. Presently, everything that is known about pinguis genetics is based on one sample. The samples are in storage buffer in the refrigerator at the Trust office on Tortola, and will be shipped to Scott Davis once the WIISG CITES blanket permit has been granted. We were able to collect samples from a wild adult male at Bones Bight (Numi's former study site), another male in captivity at Rondel's, the three juveniles in the headstart facility, plus an additional hatchling on Guana Island.

HABITAT SURVEY

Though our time in the field was extremely limited, we did manage to get out to Bones Bight on two occasions. We flushed several adult and sub-adult iguanas in this area, able to hear them but rarely see them. We found tail drags and scat samples in this habitat, and luckily were able to capture an adult male. Due to an uncommonly wet season, the vegetation was green and lush, and iguana browse plants seemed to be in abundance. This should not, however, be interpreted as the normal situation, and disturbingly, the male that we captured appeared weak and anemic (oral

cavity pale; eyes flushed pink instead of the typical blood red). A possible nesting site on a small island in Manhead pond was identified.

CONVERSATIONS WITH LOCAL ANEGADIANS

We found the Anegadians to be, for the most part, environmentally and politically aware (although generally mistrusting of the government), and genuinely concerned for the survival of their iguana. In numerous conversations with locals we were surprised to learn that most local residents were well aware of the plight of the iguana, and overwhelmingly blamed the "out-of-control" feral cat population as the causative factor. In fact, several residents matter-of-factly asked us "When are you going to do something about all these cats?" It is my opinion that a program to eradicate cats would not meet with serious opposition.

On the other hand, most locals we spoke with had different views on the goat problem, and were not convinced that goats were actually to blame. Some felt like goats had "always" been there but that the dramatic rise in cat numbers was a more recent trend. Some residents firmly believe that the iguana decline can be strongly correlated with the explosion of cats in the early 1970s. There are also numerous cattle grazing throughout the area, including Bones Bight.

AREAS FOR FUTURE RESEARCH

A primary need is to learn where female C. pinguis lay their eggs on Anegada. This is important not only so this area can be slated for protection, but so that hatchling iguanas can be collected for headstarting. This should be undertaken only after we are confident that husbandry protocols are satisfactory so as to insure a high rate of survival, as well as the production of healthy headstarted offspring for release. Additional survey work should be concentrated on the east end of the island which has not been formally censused; it appears that few roads penetrate into this area.

MEETINGS WITH BVI MINISTRY OFFICIALS

Upon our return to Tortola we were accompanied by our host Mr. Joseph Smith-Abbott during meetings with two BVI Ministry officials. The first was Mr. Louis Potter, Chief Physical Planning Officer (CPPO) with the Town and Country Planning Department - Office of the Chief Minister, VI. Mr. Potter seemed very proactive with respect to the iguana situation on Anegada, and indicated he felt there had been enough talk and now was the time for action. I outlined the actions we had taken to assist the Jamaican iguana recovery program in situ, and suggested that we approach the C. pinguis problem in a similar manner. Expanding the headstart operation, increased field research, and the urgent need for predator control were the main topics of discussion. Mr. Potter did inquire about the need for bringing hatchling iguanas from the introduced Guana Island population to Anegada for headstarting. I told him that though this may seem like a good idea for political reasons, there was simply no good biological justification for such an undertaking and that resources could be better used elsewhere.

Our second meeting was with Ms. Sheila Brown, Permanent Secretary for the Ministry of Natural Resources and Labour, BVI. Ms. Brown was exceptionally cordial and like Mr. Potter, seemed genuinely interested in the iguana problem on Anegada. She likewise seemed to share his sentiment "enough talk, time for action." We discussed our accomplishments and observations on Anegada, our impressions based on discussions with the locals, and what we felt needed to be done. The feral cat problem was foremost on our list of immediate conservation initiatives, and we discussed possible funding sources. Again, I outlined our approach with the Jamaican iguana program, and suggested that, given time and resources, we could bring the same sort of proactive and aggressive conservation measures to the Anegada situation. Ms. Brown is from Jamaica and intended to be in Kingston in November so I suggested that she visit the Hope Zoo to inspect the headstart program there firsthand.

We were extremely encouraged by our visits with these officials and Joseph Smith-Abbott seemed likewise. Both Mr. Potter and Ms. Brown appear to be real action-oriented people, and if we can count on them as allies in this endeavor, then I am enthusiastic that we will succeed. To emphasize the success of these meetings, later that day we were presented with a five page MOU between the BVI National Parks Trust and the West Indian Iguana Specialist Group. Allison is currently reviewing that document and the content will be forthcoming.

VISIT TO GUANA ISLAND

Upon returning to Tortola from Anegada, we were excited to learn that Skip Lazell and Numi and Glenn Mitchell were still on Guana Island and that we would be able to join them there on our (and their) last day in the BVI. We had a nice visit with them, got a tour of this incredibly beautiful resort island, and caught a juvenile iguana. Though we were there during the heat of the day and did not see many iguanas, there was evidence that they were abundant there. And, although Numi and Skip disagree as to the estimated numbers of iguanas now inhabiting Guana Island, both feel that the population is growing and thriving.

Although we were only on in the BVI for a week, we were able to accomplish a great deal, and came away with a greater appreciation for the problems facing this iguana. I hope that this was the beginning of a long and productive working relationship with the BVI NPT, and strongly believe that if we focus our efforts, and continue to receive the support of the local people, then we have a fighting chance of saving this iguana on Anegada. It will however, take considerable fund-raising efforts to solve the immediate and pressing problems of predator control; the land tenure and National Park issues are, in my view, secondary at this time.

As a final note, all of the travel expenses incurred during this trip were funded through the sale of West Indian iguana posters.

Respectfully submitted,

Rick Hudson

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89

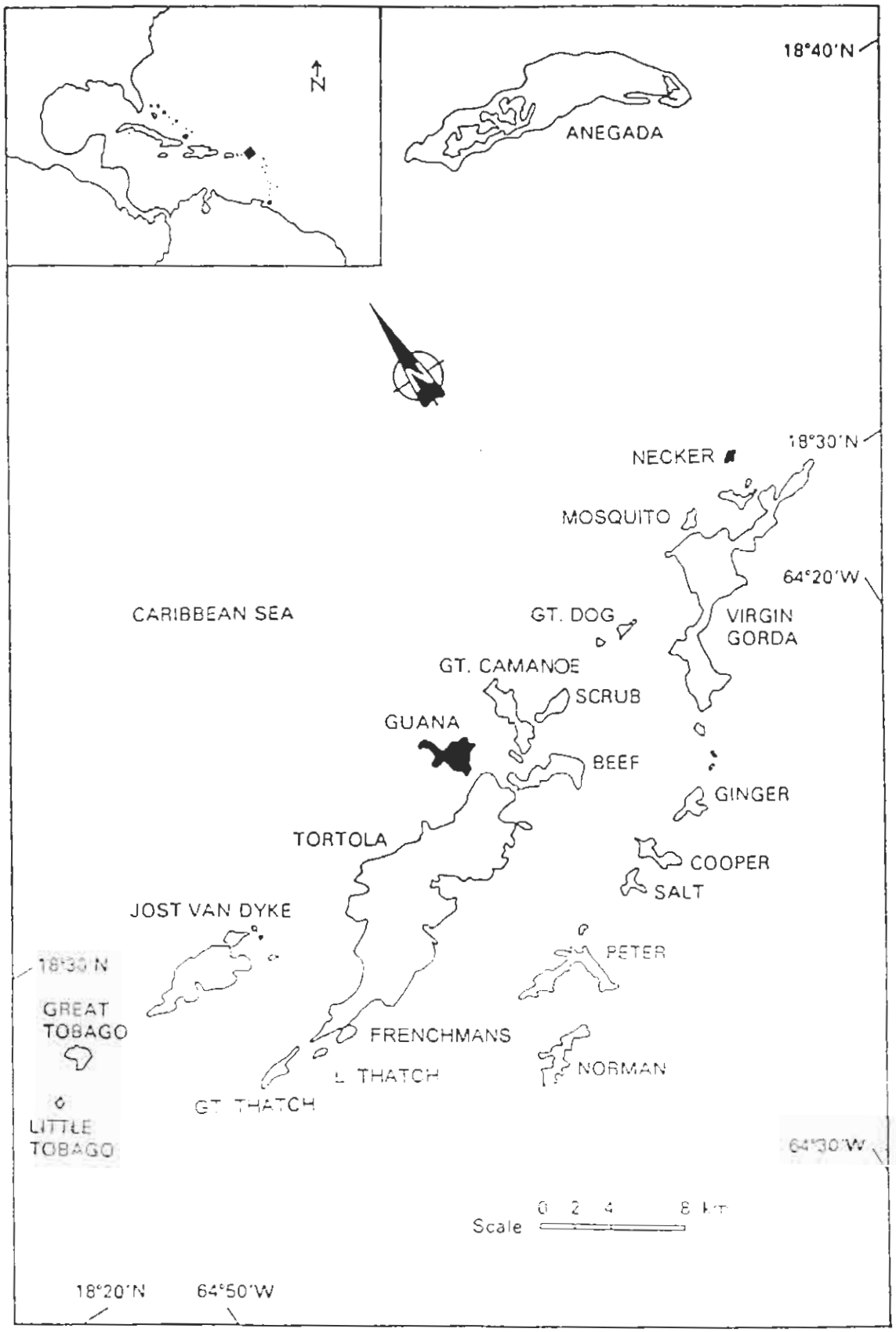
The Stout Iguana of the British Virgin Islands

James Lazell

Which is the largest, the most anatomically distinctive, the rarest and most critically endangered of all West Indian iguanas? Perhaps none of those questions has a clear, unequivocal answer—there is always the possibility of dissent—but my vote has to go to the stout or "Anegada" iguana, *"Cyclura" pinguis*, today confined to only three islands. These are ponderous beasts, said to attain weights of more than 60 pounds and lengths over six feet. Its species name *pinguis* means stout.

Apart from mass, the stout iguana has several remarkable anatomical features. First and most obviously, it lacks caudal verticils—rings of enlarged scales set off from the ordinary scales on the tail. The name *Cyclura* means ring tail. These caudal verticils are the only anatomical character provided in keys or field guides for recognizing the genus *Cyclura*, said to occupy the entire Greater Antilles, of which the British Virgin Islands (BVI) are the extreme eastern extension. The species *Iguana iguana* and *I. delicatissima*, native to the Lesser Antilles, similarly lack caudal verticils. As is well known, herpetologists are wonderfully imaginative people. Still it is surprising to read in Schwartz and Henderson (1991) of scale counts to the "first caudal verticil," or "in the fifth caudal verticil." As in all iguanas, there is variation in tail scale size, but if one can discern verticils of distinctive scales on the tail of *pinguis*, one can surely perceive them equally well on *Iguana iguana* and *I. delicatissima*. Apart from the fact that *pinguis* has, overall, larger scales

Adult male stout iguana basking in a loblolly tree (*Pisonia subcordata*) on Guana Island. Stout iguanas are moderately arboreal at all stages of life. *Photograph: Gareth Rockliffe*



The British Virgin Islands, showing islands mentioned in the text. Guana and Necker Islands are shaded

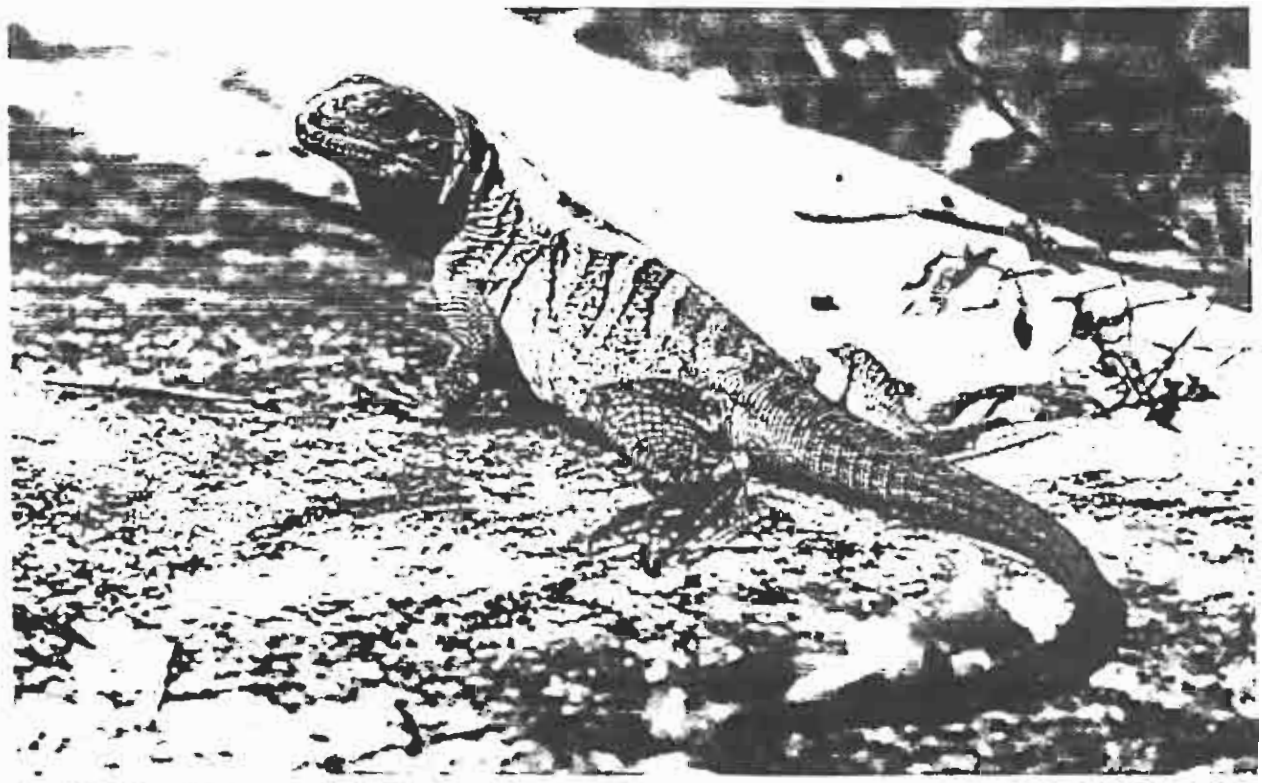
than other iguanas, the three eastern species are similar in caudal squamation.

Schwartz and Henderson's (1991) account also leaves out the fact that adult male stout iguanas typically develop very dark—even sooty blackish—heads and necks. Schwartz and Henderson also said "juveniles presumably like adults," but this is not at all the case. Hatchling stout iguanas are very pale in ground color but have bold dark transverse bands. The ground color varies from gray with greenish tints ("lichenate" is a good descriptor) to green. The greens vary from olive to bright blue-green or aquamarine, and are richest posteriorly and middorsally. While baby stout iguanas are never the brilliant "arsenic" green of most *Iguana iguana* and *I. delicatissima* babies, they are typically much greener than the western species.

There are two other striking similarities among these three species that set them off from their western relatives. Their lateral teeth are complexly cusped, with many more points (cusps) than are seen on the simpler, fleur-de-lis teeth of normal *Cyclura*. And the floor of the braincase, in all species a bone called the parabasisphenoid, is very broad in *iguana*, *delicatissima*, and *pinguis*, but very narrow in western *Cyclura*. The stout iguana, however, is unique in having the largest body scales and the lowest, least developed crest scales of any West Indian iguana.

Although I began biogeographic and evolutionary studies of West Indian iguanas more than 40 years ago, I did not meet a stout iguana until 1980. At that time I was commissioned to do a study of wildlife for the government of the BVI. There were already plans to develop a national park on Anegada, the low, flat, easternmost island in the group. Apart from bones and stones, stout iguanas were then known from nowhere else. Back then, stout iguanas were still common on Anegada. I saw enormous individuals, far larger than any other iguanas I have ever seen elsewhere. However, the situation was bleak.

Beginning about 1960, major development schemes—eliminating or amalgamating entire islands—were promulgated in the BVI. The most ambitious scheme was for Anegada, but it progressed only as far as the obliteration, by bulldozer, of Anegada's livestock paddocks. Traditionally, Anegadians relied heavily on careful animal hus-



A juvenile stout iguana. The white marking is latex paint, used for marking in our population studies on Guana Island. *Photograph: Gareth Rockliffe*

92

bandry on their dry island. Livestock—goats, sheep, cattle, swine, and burros—were kept within a vast system of stone fences. They were moved around, and even let out in small, well-tended herds, to browse and forage. The destruction of the stone walls freed the livestock, and was simply too great a catastrophe for the people to overcome and repair. Feral livestock, especially goats and burros, were in turn too much for the iguanas. Insidiously, the population dwindled.

Once the stout iguana enjoyed a vast range. It was the native species of Puerto Rico and all the U.S. Virgin Islands except St. Croix. Stout iguana bones are a common and nearly ubiquitous component of the middens, refuse heaps, left by Native Americans who began populating these islands at least three thousand years ago. Early European settlers, especially from Spain and France, also consumed these big, relatively slow lizards. By the twentieth century, Anegada may have harbored the sole survivors. Major Chapman Grant, however, visited Guana Island (also in the BVI) in 1930 and said there were iguanas there. If so, they did not survive long.

By 1984 it was clear to me that the situation on Anegada was desperate. Although hatches of baby iguanas occurred annually, there were many fewer iguanas than even four years earlier in 1980. Most of the survivors were old males. Adult females were scarce and getting scarcer. I believe they virtually commit physiological suicide in the process (no doubt involuntary) of trying to get enough food energy to yolk up egg clutches. Males, of course, do not expend much energy on reproduction. Also, males are much larger and hold vastly larger territories. Females, and youngsters past their hatchling carnivorous stage, simply cannot compete with goats. Although the great national park plans still existed, and many Anegadians wanted the park to become a reality, land title issues seemed impossible to resolve. I decided to attempt bringing stout iguanas back to Guana.

Louis Bigelow of Massachusetts bought Guana Island in 1954. The first things he did were to extirpate the goats and ban wood cutting for charcoal. He reduced the number of burros to two, and controlled their movements. He did not get rid of the sheep—the only other feral domestic

Adult female stout iguana, Guana Island, marked with white paint. Photograph: Gareth Rockliffe.

livestock present—but he did control them. The vegetation began to recover. Bigelow also fenced a large sheep exclosure around the area where he began construction of the Guana Island Club buildings. Although sheep grazing outside the exclosure remained a problem, sheep are not as destructive as goats, and I believed conditions had improved to the point where iguanas could survive. Beginning in 1984, I brought eight stout iguanas, four males and four females, over from Anegada. The population has exploded. We now have bumper crops of hatchlings annually, with ongoing recruitment into the subadult and adult ranks. Adult females outnumber adult males by about three to one. Guana Island's snakes seem more common and seem to grow much bigger now. Each year, at hatching time, our population of red-tailed hawks seems to at least double, from the normally resident pair to four or five birds. Fecundity plus natural selection add up to iguana prosperity, and prosperity for their predators too.

In 1995 I took some youngsters over to Necker Island (also in the BVI). Necker has no feral livestock, not even rats. It will be at least 1999 before Necker iguanas reach potential breeding age, but the new residents seem to be doing very well. I am full of hope. There are at least three more privately owned islands in the BVI that may be suitable for stout iguana restocking: Great Dog, Mosquito, and Little Thatch. One BVI National Park, Fallen Jerusalem (a small island named for its wonderous stone topography) has been cleared of goats and other livestock. It no doubt needs some revegetation, but it could soon support stout iguanas.

For the foreseeable future, the best hope for the stout iguana's long term survival is to reestablish the species on as many small, predator- and competitor-free islands as possible within its former range. We must bear in mind that its former range was the entire Puerto Rico bank, certainly not just Anegada, or even the BVI. *Iguana iguana* has now been introduced to many of these islands. Private landowners typically like iguanas and want them on their properties. Land owners are little concerned with the subtleties of species differentiation, and will demonstrably import *Iguana iguana* from the U.S. Virgin islands, even to the BVI. Thus, Sandy Cay, in the BVI, is now infested with *Iguana iguana* introduced from St. John.

Adult male stout iguana basking in a loblolly tree on Guana Island. *Photograph: Gareth Rockliffe*

I see no hope of reestablishing stout iguanas on an island now populated by exotic green iguanas. We must act rapidly to reclaim as much stout iguana habitat as possible before potential sites are lost. Young stout iguanas from the Guana Island population are expendable, and can be excellent stock for restorations.

Of course, the fondest hope for the longterm conservation of the stout iguana is the Anegada national park. Even now, while some land title disputes remain, some have been settled and livestock exclosure areas—even if small—could be initiated. The BVI National Parks Trust and the IUCN Iguana Specialist Group have built a head-start pen on Anegada, and obtained a few of the increasingly rare local hatchlings to populate it. Meantime, Dr. Numi Goodyear Mitchell, of The Conservation Agency, has begun erecting more sheep exclosures on Guana Island. Of course, we continue to try to extirpate the last of the feral sheep.

94

Right now, Guana Island seems to hold the most secure population of stout iguanas. Their continued success there, however, depends on active management. For those concerned with inbreeding depression in small populations, Guana's sheep could provide a cautionary tale. Guana is steep and rugged. The big ravines—called ghuts—on the windward side were never cleared and support deep, dark forests which are perhaps the best remaining old growth in the Antillean lowlands today. The formerly cut-over areas have come back in dense second-growth jungles. We have waged war on the sheep. Repeatedly, we have hoped—or dreamed—we had finally got the last ones. Repeatedly, twinning twice a year, they have rebounded. Most West Indian sheep are blissfully stupid creatures, slow and seemingly lacking the senses to even perceive a large truck or bus at ten feet. The remaining sheep on Guana, coming through the gauntlets of many population bottlenecks, are fleet and agile. Not only have they apparently developed extrasensory perception, but they seem to have strategic planning capabilities greater than those of us who hunt them. If they exemplify inbreeding, then that is a wonderful thing.

Ironically, it would have been easier to eliminate the sheep if there were still goats. Goats eat many dense understory shrubs that sheep do not, and so clear out the woodland floor, increasing visibility. My strong advice to anyone planning iguana management and restoration is to get rid of all the feral ungulates on an island while still clearing out the goats. Once the goats are gone, any other remaining species will not only become greater competitors with iguanas, but will become much harder to control.

The stout iguanas of Guana Island are generally extremely popular with visitors. The owners of Guana (who purchased the island in 1975 from Louis Bigelow), Dr. and Mrs. Henry Jarecki, have declared their Island a wildlife sanctuary. In addition to stout iguanas, successful restoration projects include tortoises, flamingos, and white-crowned pigeons—all species nearly or completely extirpated previously from the BVI. Island staff, especially Mr. Lynford Cooper, have taken a great interest, even developed a fondness, for the iguanas that just back in 1980 almost everyone seemed to hate and fear. Guana Island today is a destination resort for a small number of tourists. While most enjoy seeing iguanas, some are actually frightened of them. The biggest Guana individual I have weighed was a mere 23 pounds, but I have seen lots of others that were bigger than he was (and he has grown a lot since I weighed him in 1986). There is one legendary fellow known as "Monster" who, it is said, could swallow a 23-pounder like one of those swallows a grape. Maybe I will catch him next year.

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SAURIA

ANOLIS CRISTATELLUS WILEYAE (Virgin Islands Crested Anole). **FRUGIVORY.** Anoles have long been known to eat fruit (Lazell 1972. Bull. Mus. Comp. Zool. 143:22–74) but the frequency and enthusiasm with which they do so have not often been documented. Here we report several instances of frugivory observed in the British Virgin Islands. On 5 October 1996 we watched an adult male crested anole consuming the sweet, magenta fruits of *Melocactus intortus* (Cactaceae) on Guana Island. Anoles caught during the fruiting season often defecate red or purple masses containing seeds. Previous studies of stomach contents conducted at this site have shown that fruits are not uncommon in anole stomachs (G. Perry, unpubl.; material deposited in the Texas Memorial Museum, Austin); however, this was our first observation of intentional ingestion at this site. On 11 October 1996 we observed a pair of crested anoles feeding in a patch of *Trichostigma octandra* (Phytolaccaceae) profusely in fruit with crimson berries. The fruits were about 50 cm above the ground in clusters. Access seemed to be a problem; although the anoles easily could have ridden these small, semi-vining herbs down, they did not. The female anole climbed down a small vine to consume as many berries as she could reach. The male (now Museum of Comparative Zoology 182075) attacked the berries from the edge of a large boulder. It ate all the berries it could reach, even to the extent of lunging out, disengaging its forefeet, and sprawling forward, retaining a grip on the rock only with its rear feet. When captured, this individual defecated *Trichostigma* seeds and skins in a red matrix. On dissection, the entire gut was packed with fruit.

We are indebted to Dr. George Proctor, Puerto Rico Department of Natural Resources, and Dr. Fred Kraus, Hawaii Division of Forestry and Wildlife, for identifying the plants.

Submitted by **JAMES LAZELL**, The Conservation Agency, 6 Swinburne St., Jamestown, Rhode Island 02835, USA, and **GAD PERRY**, Department of Zoology, Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210, USA.

ANOLIS STRATULUS (Saddled Anole). **NECTIVORY.** Nectar feeding has been recorded in anoles (Liner 1996. Herpetol. Rev. 27:78), but we believe it is far more commonplace and widespread than published records indicate. On 12 October 1996 we observed an adult male *Anolis stratulus* climbing on top of a shrub, *Pedilanthus tithymaloides* (Euphorbiaceae), on Guana Island, British Virgin Islands. The anole approached the shrub's flowers and proceeded to lick off drops of nectar that form on the tops of the flowers. This feeding behavior continued for over 10 min. The flowers are coral-red and the clear nectar is sweet to the taste.

We are indebted to Dr. Richard Howard, Gray Herbarium, Harvard, for confirmation of the plant's identity.

Submitted by **GAD PERRY**, Department of Zoology, Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210, USA, and **JAMES LAZELL**, The Conservation Agency, 6 Swinburne St., Jamestown, Rhode Island 02835, USA.

SAIL TAIL MALES: A HYPOTHESIS THAT EXPLAINS EVERYTHING

by

James Lazell, 28.x.97

I have observed no small male Anolis cristatellus wileyae with tail crests. Small means less than 55 mm SVL. However, all really large individuals -- over 68 mm SVL -- have big crests -- sail tails. Males between 56 and 68 mm SVL show variable degrees of cresting from none to big.

I hypothesize that these anoles put all their growth resources into simple size gain (as measured by SVL) until they approach maximum, and then growth goes into tail crest differentially. That is, SVL gain slows dramatically after ca 64 mm SVL, but tail crest grows rapidly after that size: classic allometry.

Thus, we see crestless males holding territories and winning over sail tails because younger individuals often displace old individuals. At Sage Mountain, for example, most adult males holding territories are small and crestless; the few really big males I have seen there were sail tails. I suspect high predation and rapid turnover at Sage.

We could test this hypothesis during the three month water loss run next year. Or, if that is too short a time, we could permanently mark crestless males and remeasure them in subsequent years. If I am right, having a sail tail is only beneficial late in life, possibly only after one has won a good territory.

Submitted to Cryptozoology.

ROOSEVELT GIANT ANOLE: LOST LIZARD OF THE ANTILLES?

JAMES LAZELL

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ABSTRACT: Reports of unusual lizards seen by professional biologists in 1995 and 1996 from Guana and Tortola, British Virgin Islands, recall the crested giant *Anolis roosevelti*, last certainly seen alive on Culebra, east of Puerto Rico in 1932. Specimens in the museums of Copenhagen and Stockholm, collected prior to 1863, voucher the existence of *Anolis roosevelti* (at least then) on Vieques and Tortola; a literature record exists for St. John, U.S. Virgin Islands. A possible evolutionary history for *Anolis roosevelti* and renewed effort to locate the species alive are suggested.

INTRODUCTION

On 22 October 1995, arachnologist James Ortiz, of the Orange County, California, Natural History Museum, returned from collecting spiders in the Muskmellon Bay area of Guana Island, British Virgin Islands, to report observations of a very large lizard. Ortiz was reporting to me and several other vertebrate zoologists at our Guana Island headquarters, about a kilometer from his observation site. We immediately set out, with Ortiz, to return to the spot. As is usual in the cases of reptiles not captured when first seen, we could find no trace of Ortiz's huge lizard.

For a period of years, I have worked annually on Guana Island, and its neighbors in the British Virgin Islands (BVI), on various aspects of the biology of the abundant crested anole lizard, *Anolis cristatellus wileyae*, and its relatives. Crested anoles on Guana Island attain a snout-vent length (SVL) of about 70 mm (less than three inches). Their tails are much longer than SVL, when undamaged, so a big individual might attain a total length of about eight inches (herpetologists rarely measure these lizards' tails because they break off readily and usually regenerate at least partially). Ortiz, pointing out big male crested anoles conspicuously perched all along our route, insisted that the lizard he had seen was at least "three times" bigger than the largest of these.

Two other species of lizards occur on Guana that attain large size. The ground lizard, *Ameiva exsul*, and the stout iguana, *Iguana pinguis* (Lazell, 1991). Both are common. Ortiz, a veteran of several months collecting in the BVI, knew both species well, and was certain the lizard he had seen was neither of them. The lizard he saw, he insisted, was of the shape and general appearance of a regular crested anole. It was perched on a tree branch. It had a spectacular sail-like tail

crest, just like a big male crested anole. However, it was a foot-and-a-half long, its tail crest was over an inch high, and it was plain gray in color, Ortiz said.

A year later, 29 September 1996, entomologist Dr. Wenhua Lu, of The Conservation Agency, returned from a collecting trip to White Hall, an old estate ruin in now large second growth forest on the main ridge of western Tortola, BVI, with another report of a spectacular lizard. She knows crested anoles, and the other standard species of BVI lizards, very well, and is also a veteran of many months of field work in these islands. The lizard she reported was not enormous. Indeed, it was little bigger than a large male of the common crested anole. However, it was not, in Lu's opinion, an adult male. It lacked a tail crest and had the prominent light mid-dorsal stripe or band of a female or juvenile crested anole. Female crested anoles are about one half the linear dimensions of males. Lu said that her lizard was at least twice as long as a female crested anole. No crested anole that size would retain a mid-dorsal stripe and lack a tail crest, even though juvenile males do, and look like females.

Furthermore, Lu reported, this lizard was nearly black with a green cast, and -- most impressively to her -- it had huge digital pads: the expanded, leaf-like structures of the distal toes characteristic of the climbing anole lizards. Once again, she insisted, this lizard was an anole -- not some other generic sort of reptile.

What might Ortiz and Lu have seen? One may speculate that they observed, respectively, a male and a female of a giant crested anole: Something like ordinary *Anolis cristatellus*, but vastly larger. Could such a lizard exist?

HISTORY

In 1931, Major Chapman Grant, a prominent herpetologist, described and named *Anolis roosevelti* from one preserved specimen -- an adult male -- from the island of Culebra, just east of Puerto Rico and west of the Virgin Islands. The following year, he secured a second adult male, also from Culebra. These lizards were, for anoles, indeed huge: to 162 mm SVL and with great sail-tail crests. Grant's new species was clearly distinct from the Puerto Rican giant anole, *Anolis cuvieri*, which is neither so large nor so high-crested. *Anolis cuvieri* is green. Grant's *A. roosevelti*, when alive, was "brownish gray." Nothing was seen or heard of Grant's giant, which he named for Theodore Roosevelt Jr., then governor of Puerto Rico, for half a century. The two specimens, one at Harvard's Museum of Comparative Zoology (MCZ), and one at the Museum of Zoology, University of Michigan, have been examined repeatedly by interested herpetologists (like me), and eventually caught the eye of Dr. Gregory Mayer, now at the University of Wisconsin Parkside, in Kenosha, but then a graduate student at Harvard. Mayer also noted (as had I: Lazell, 1983) that there were records of "*Anolis cuvieri*" from the Virgin Islands.

All of the British and U.S. Virgin Islands -- except St. Croix -- are part of the greater Puerto Rico Bank, as is Culebra. All of these land areas -- numbering today over a hundred isles, cays, and lizard-inhabited rocks, were continuous land as recently as 12,000 years ago, when glacial ice caused much lower sea levels (Heatwole and MacKenzie, 1967; Lazell, 1995). Mayer immediately questioned the identity of those Virgin Island giants, and wrote to the curators of museums where the specimens might actually be, requesting loans. Mayer located, borrowed, and examined three specimens from Copenhagen and a fourth from Stockholm. They had come from the islands of Vieques and Tortola (Figure 1).

Mayer (1989) included a chapter in his doctoral dissertation on the new, expanded view of *Anolis roosevelti* that resulted. Mayer's report, while solidly in the public domain, is not well known, even to specialists. Some of the highlights are repeated here. There may have been eight *Anolis roosevelti* actually collected: Reinhardt and Lutken (1863) published on four individuals. Two from Vieques and one from Tortola were in the Copenhagen Museum, and are presumably the three specimens still there. The fourth was in the Danish Royal Museum and labelled as from "St. Jan" (St. John). This specimen has not been relocated. The Stockholm specimen is from Vieques. Mayer (1989) notes that the Philadelphia scientist Edward Drinker Cope listed a specimen from Vieques, but no one knows where it is now. It may be the Stockholm specimen; if so, only seven have ever been collected: three from Vieques, two from Culebra, one from Tortola, and one -- now missing -- from St. John.

Of the six (two Culebra, three Vieques, and one Tortola) seen by Mayer, four are males and two are females. Mayer noted that the females are much smaller than the males (standard in anoles) and lack a high tail crest. In both sexes there are 32-36 expanded scales in the digital pad (subdigital lamellae); there are about 20 in *Anolis cristatellus*. This increase in scales would certainly make the digital pads look much larger in *A. roosevelti* than in *A. cristatellus*, even if one compared two individuals of similar size (young and old, respectively). For me, the appearance of the large, leaf-like toe dilations Dr. Lu reported are the most compelling part of her description. Anoles are hatched with all their scales. Of course, the scales grow as the lizard grows, but -- puppy-like -- young individuals with their full complement of digital lamellae will have disproportionately large pads. A toe pad with 34 lamellae on a young, female (small) anole will look much

larger than a toe pad with 20 lamellae looks on an adult male the same size as the young female.

We know nothing about color change in life, but most anoles are capable of turning very dark on occasion. This might account for Lu's color description. Mayer does not note a light middorsal band in the two females he examined, but these may simply have faded from years in preservative. A light middorsal band is standard in both species of Virgin Islands crested anoles, *A. cristatellus* and *A. ernestwilliamsi*, as well as many or most other species in the genus.

DISCUSSION

It is interesting to speculate on the evolutionary history of the Roosevelt giant anole. First, on anatomical grounds, I believe we can reject the hypothesis that *Anolis roosevelti* is derived from Puerto Rican *A. cuvieri*. Apart form large size, the two have little in common, as fully annotated by Mayer (1989). Instead, *A. roosevelti* really does seem more like a giant crested anole, perhaps evolved directly from *A. cristatellus* of the Virgin Islands. There is ample precedent for insular speciation in these islands (Lazell 1983 and 1996). If this is what actually happened, then *Anolis roosevelti* spread westward to Vieques and Culebra at low stand sea level, during a glacial maximum.

The early stages of this very scenario seem to be unfolding in the BVI today. A direct derivative of *Anolis cristatellus* is *A. ernestwilliamsi*, a large form attaining at least 84 mm SVL (specimen, Yale Peabody Museum R.07270, collected 27 October 1994), inhabiting tiny Carrot Rock, south of Peter Island, BVI. This recently evolved species, probably no more than four thousand years old (based on sea level rise estimates), has at least occasionally colonized adjacent

Peter Island (MacLean 1982; Lazell 1996), where it apparently resists interbreeding with *A. cristatellus*. Apart from body size, the two species differ strikingly in their scale size (*A. ernestwilliamsi* has smaller scales) and in digital pads: *A. ernestwilliamsi* has much larger expanded toes with many more gripping scales: lamellae. This distinction mirrors that separating *Anolis roosevelti* from *A. cristatellus*. Is, therefore, *Anolis ernestwilliamsi* following the same evolutionary trajectory that *A. roosevelti* pioneered? Insular gigantism is a frequent, if not common, phenomenon in reptiles (Amos 1980, Ineich and Zug 1996). Giant anoles occur in the speciose anole lizard faunas of Hispaniola, Cuba, and Jamaica -- as well as Puerto Rico and the Virgin Islands, and several Lesser Antilles. The various giants, like *A. roosevelti* and *A. cuvieri*, often are not directly related to each other, but are typically closely related to sympatric small species. If we could locate living *Anolis roosevelti*, biochemical evaluations might reveal its ancestry and even pinpoint its time of origin (Hillis and Moritz 1996).

Giant anoles often inhabit big trees and tend to stay high up. There are few big trees left, at least in continuous areas of forest or woodland, anywhere in the Virgin Islands. Guana Island provides some, as does interior Tortola, and there is at least one real forest on Beef Island, now threatened by development. The island of Culebra today is probably at least as well forested as it was in 1932. The U.S. Navy has for most of this century held large tracts of Vieques; the condition of forest there is not known to me or correspondents who study wildlife in these islands. To quote Dr. Mayer (1989, p. 105): "Demonstration that the early reports of giant anoles on Vieques, Tortola, and St. John refer to *roosevelti* considerably expands the search area...." Mayer continues, "... the 60 years between the collection of Reinhardt and Lutken's and Grant's specimens suggests that the species is not easily found, and that relatively brief searches have failed should not

be surprising." It would seem that there are real possibilities for rediscovery of living *Anolis roosevelti*. An effort to find them would likely require someone with excellent vision, a practised eye, and considerable arboreal agility. So far, luck has not been good enough.

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Figures

1. Islands of the eastern Puerto Rico Bank showing those from which *Anolis roosevelti* was known: 1. Culebra. 2. Vieques. 3, St. John. 4. Tortola. Guana Island is 5. PR is extreme eastern Puerto Rico. Bar is 10 km. Dotted line is the edge of the Greater Puerto Rico Bank, sea level at glacial maximum, about 12 thousand years ago.

2. Three species of eastern Puerto Rico Bank crested anoles, from large to small: *Anolis roosevelti* (type specimen, MCZ 63138), *A. ernestwilliamsi*, (MCZ 158396), and *A. cristatellus wileyae* (MCZ 179271). All are adult males.

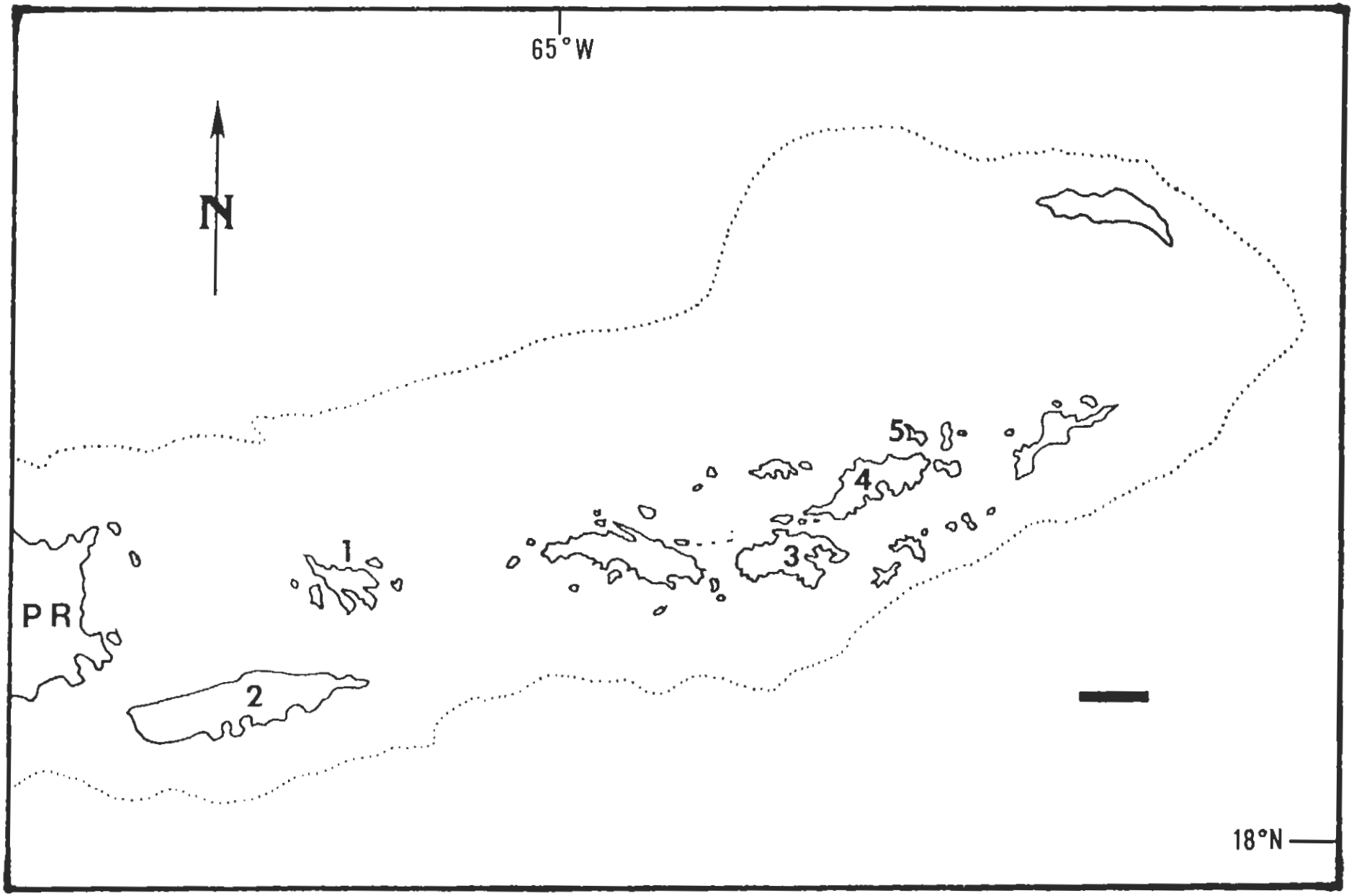

FIG. 1

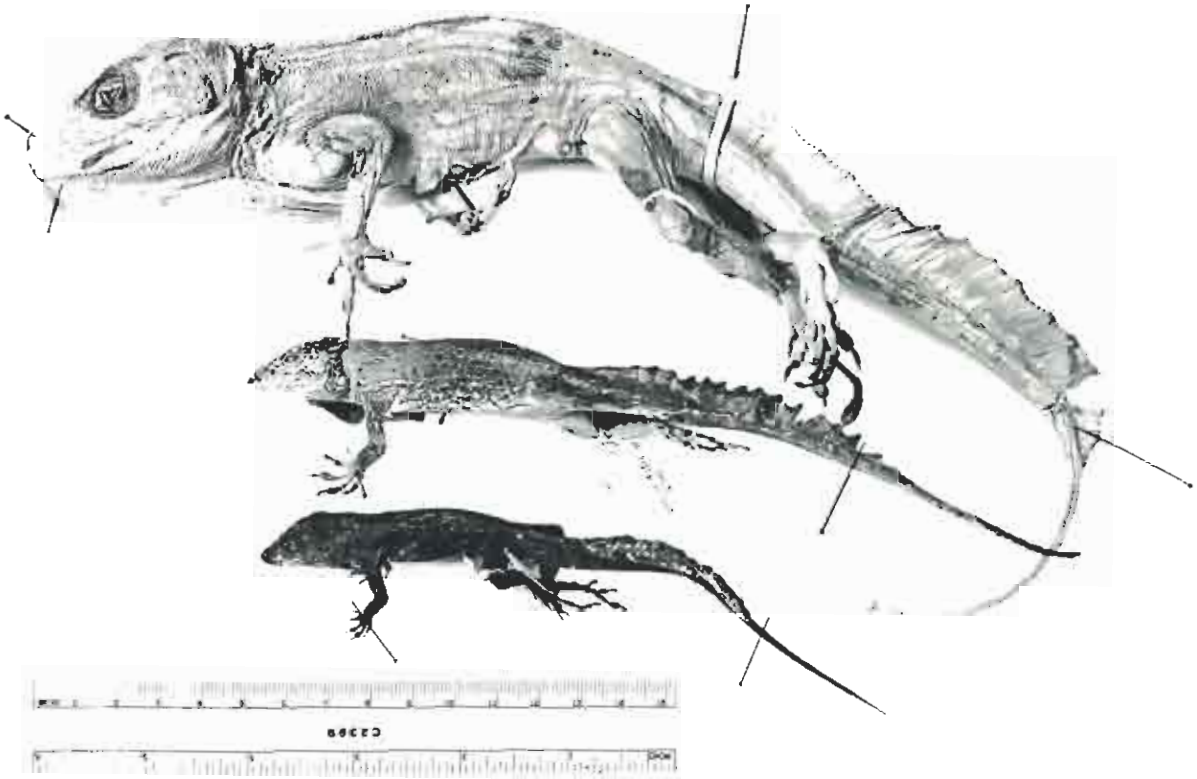

FIG. 2

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Dear Skip,

I want to thank you for the opportunity to conduct research this past October on Guana Island. It was the most conducive environment for field work that I have ever encountered. Both the accomendations and food were excellent and you made me feel immediately welcome and comfortable. Other aspects, such as your broad biological knowledge of the area was of great benefit to my education. The extensive trail system also enabled me to work as efficiently as possible on Guana in scouting out areas for my beetles. My only regret of the visit was not taking advantage of the beach and warm water for swimming until my last day.

I came to Guana to study my organisms of interest, the spider beetles (Coleoptera: Anobiidae: Ptininae). In particular, I wanted to come and find *Lachnoniptus lindae*, a new genus I had recently described based on specimens from Guana, St. John, and a single specimen I had collected on Tortola. This beetle is small (3 mm in length), brown, wooly, globular-shaped and flightless. Nothing is known about any of its habits.

The evolutionary history of spider beetles is obscure because of the morphological similarity of adults. My goal was to collect live specimens and bring them back to Columbus, Ohio for study. By culturing, I hoped to collect larvae and pupae. With immatures, I can then hypothesize the evolutionary relationships among *Lachnoniptus* and other ptinine taxa. The resulting "family tree" can then be used as a powerful predictive tool to hypothesize traits about the evolution of behavior, lifestyle or any other aspect of interest. This includes the evolution of flightlessness, feeding habits, and myrmecophily. I also wanted to determine what sort of habitats are home to this beetle.

To find these creatures, I initially concentrated my efforts on the saddle of Quail-Dove Ghut. This is where Michael Ivie (Montana State University) had previously collected the species. Surprisingly, after setting and leaving large numbers of traps in the vicinity for five days, I never collected a single specimen. Traps set along three other trails also failed to yield any specimens. It wasn't until my fourth day in the field that I finally found specimens of *Lachnoniptus lindae* along Monkey Point trail. Fortunately, I managed to collect 26

individuals (which more than doubled the number of specimens in research collections). There is no doubt that this species is difficult to collect; the traps Mike Ivie set for about one year yielded only about 1 specimen per month. Similarly, most other species of spider beetles are only very rarely collected, making it difficult to study them.

Lachnoniptus lindae are currently being reared in the insect quarantine facility at Ohio State University. Adults are being offered a variety of potential foods, such as a ground dog food-oatmeal-yeast mixture and cat dung. Dung is most likely the natural food source for these beetles and they can probably use this resource from a wide variety of animals, such as mammals, birds, and reptiles. I definitely now have larvae, as evidenced by exuded larval frass from dung.

In closing, I would like to again extend my sincere appreciation to you for enabling me to conduct research on the island. You are in charge of an exceptional research program which represents a fantastic opportunity for scientists. I hope that science month continues indefinitely and I thank you for enabling me to work on the island and for the financial support which helped make this trip possible. My goal of collecting live *Lachnoniptus* for study was reached. The rearing is progressing well, about 20 beetles are still alive, and I will soon be preserving immature stages for morphological study. I hope I am able to return in the future and continue to study spider beetles and other insects on the island. *Lachnoniptus* and at least one other species of spider beetle (*Ptinus*) I collected on Guana present future opportunity for study.

I will be certain to send you any publications resulting from this research. All the best in your own research, both on and off Guana.

Yours sincerely,

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A NEW GENUS AND SPECIES OF SPIDER BEETLE FROM THE VIRGIN ISLANDS: *Lachnoniptus lindae* (COLEOPTERA: ANOBIIDAE: PTININAE)

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ABSTRACT

Lachnoniptus lindae, a **new genus** and **new species** from the Virgin Islands, is described. It appears most similar to *Trigonogenius*, and characters differentiating the two genera are given. The habitat and probable biology are discussed.

Key Words: Ptininae, Ptinidae, spider beetles, Virgin Islands, West Indies

The ptinine fauna of the Virgin Islands presently includes one recorded species, *Pitnus antillanus* Bellés (Bellés 1992). In the more inclusive West Indies, another species of *Pitnus* Gorham, four species of *Ptinus* Linnaeus, three *Gibbium* Scopoli, and one *Fabrasia* Martinez and Viana (=*Cubaptinus* Zayas, Philips 1997) have been recorded (Boieldieu 1856, Gorham 1898, Pic 1906, Lepesme 1947, Wolcott 1948, Bellés and Halstead 1985, Zayas 1988, and Bellés 1992). Recent investigations on the beetle fauna of the Virgin Islands have resulted in the discovery of two undescribed ptinine species. One of these belongs in the genus *Ptinus*, but the unique morphology and phylogenetic position of the other requires the creation of a new genus. I take this opportunity to make a name available for the latter.

Lachnoniptus Philips **New Genus**

Type Species. *Lachnoniptus lindae* **New Species.**

Diagnosis. This genus is easily recognized by the transverse pronotum and the very convex globose shape of the elytra. The dense pubescence dorsally results in a very woolly, fluffy appearance. Also, the apical antennomere is slightly but distinctly wider than the penultimate one.

Trigonogenius is the only genus that approaches this elytral and pronotal shape, but *Trigonogenius* has dense, appressed setae on the elytra, unlike the fluffy elytral setae of *Lachnoniptus*. Further, *Trigonogenius* does not have the laterally enlarged and distally rounded apical antennomere of *Lachnoniptus*. In contrast, *Trigonogenius* is characterized by the apical and penultimate antennomeres subequal in diameter and the apex acuminate. Other differences include the following: *Lachnoniptus* with a mesosternal process 2/3

the width of the mesocoxa (1/3 the width for *Trigonogenius*); the absence of the mesosternal-mesepisternal suture (present in *Trigonogenius*); metepisternum not visible due to fusion with metasternum (distinctly visible in *Trigonogenius*); metacoxae approximately round *(rectangular* in Trigonogenius); the metacoxae laterally contacting the first ventrite (laterally adjacent to the metepisternum in *Trigonogenius*); the fourth ventrite compared to third about equal in length (a ratio of about 1.15:1) (greatly reduced in *Trigonogenius* (a ratio of about 3:1)); and the anterior margin of the first ventrite narrowly pointed laterally (sharply pointed in *Trigonogenius*). There are two more subtle characters that differentiate these two genera. The scutellum is narrowly rounded in *Lachnoniptus* but is broadly rounded in *Trigonogenius*. In some specimens of *Lachnoniptus* there is a faint row of transverse setal tufts on the pronotum. Pronotal tufts are always absent in *Trigonogenius*. While *Lachnoniptus* is known from the West Indies, *Trigonogenius* is found in the western part of North and South America.

Description. Body robust and globular, densely covered with erect fluffy setae that obscure cuticlar surface.

Head. Very robust, not visible from above, partially hidden within the pronotum up to the posterior dorsal margin of the eye, eye nearly semicircular, slightly rounded on dorsal side; longitudinal groove on the frons between antennal insertions, clypeus equilaterally triangular, labrum narrow, no wider than proximal edges of antennal insertions, anterior margin approximately truncate, anterio-lateral edges broadly rounded; antennae 11 segmented, second segment attached on side of scape near apex, apical antennomere distinctly widest at anterior 1/3, tapering to rounded tip; mentum slightly longer than wide, triangular, not truncate but narrowly rounded at anterior margin, with a small round depression medially at basal 1/3, a patch

of 4-8 moderately long setae anterio-medially; hypopharygeal setal rows closely spaced and nearly overlapping; maxillary and labial palpi with apical segment tapered to a point; galea and lacinia with stout spines, spines obscured with fine setae.

Thorax. Pronotum globose and convex, transverse, 1.35 times wider than long, widest at middle; scutellum small, hidden, slightly tranversely ovoid, distinctly below level of elytra; procoxae cylindrical, projecting, prosternal process with apex expanded and rounded, extending ventrally about as far as coxae, at narrowest width about 1/3 the width of coxa; mesosternum smoothly concave, slightly narrower posteriorly, process about 2/5 width of mesocoxa; mesepimeron visible but narrow, mesosternal-mesepisternal suture absent; metasternum about half the length of the mesosternum, sharply, obtusely emarginate at posterior margin; metacoxae transversely triangular, laterally in contact with first ventrite.

Elytra. Globose and convex, fused, nearly as wide as long, length 1.10 times width; large strial punctures easily discernible and in longitudinal rows, puncture edges broadly rounded, intervals convex, surface usually hidden beneath dense pubescence.

Ventrites. All sternal sutures clearly defined, second ventrite widest at middle and at lateral edge, third ventrite distinctly narrowest at middle, third ventrite only slightly longer than fourth, about 1.1-1.2 times length of fourth.

Legs. Femora gradually increasing in size towards apex, pro and mesotibiae about 2/3 as long as metatibiae, all tarsomeres about equal in length, except first metatarsomere about 1/3 longer than second.

Etymology. Derived from the Boieldieu genus *Niptus* combined with the greek *lachno*. The name translates as "woolly-haired" *Niptus*.

Discussion. Putative synapomorphies for *Lachnoniptus* are as follows: 1) the first ventrite narrowly pointed laterally; 2) the ultimate antennomere enlarged; 3) the scutellum vertical and narrowly rounded posteriorly; and 4) the fourth ventrite approximately equal in length to the third. The first character state appears to be uniquely derived while the second and third have similar states or convergences in other ptinine taxa. The fourth character state is hypothesized to be a reveral to the pleisiomorphic state. While most ptinines have the fourth ventrite reduced to various degrees relative to the third, *Lachnoniptus* and the Gibbiinae (sensu Bellés 1985) have the fourth and third ventrites approximately equal, similar to the non-ptinine Bostrichoidea.

Lachnoniptus lindae **New Species**

Figures 1-6

Diagnosis. This species is easily recognized by the variegated pattern of brown and tan pubescense on the elytra. It can also be recognized by the laterally (but not posteriorly) carinate antennal fossae that are separated by a ridge as broad as the second antennomere length. Pronotal tufts are usually absent or, at most, very loose and indistinct.

Description. Length: 2.25-3.04 mm (n = 23). Body very robust and globular, covered with dense fine short brown and tan pubescense, on pronotum and elytra relatively longer and more erect than the rest of the body, also much longer scattered erect or suberect setae arising above short setae that usually have the tips curved towards the posterior.

Head. Covered with appressed very dense tan colored setae, slightly darker towards vertex and on the fronto-clypeal area, longer, slender,

suberect brown setae scattered on front of head; antennal fossae separated by a ridge as broad as second antennomere, laterally with carinate borders that become obsolete posterior to antennal insertions; relatively deep narrow longitudinal groove between fossae, deepest at a point about equal to posterior margin of fossae; eyes moderate in size, maximum length about as long as second antennomere, usually eight ommatidia at minimum width, 9-10 ommatidia at maximum.

Thorax. Pronotum covered with dense brown pubescence except pale orange or tan colored in a longitudinal median band at middle on anterior 3/5, expanding on posterior 2/5 to form a triangular patch adjacent to base about 3 times as wide as scutellum; this same color of setae laterally at posterior edge expanding slightly from a point near coxae up to dorsal-lateral border and forming an elongate triangle on each side, another less distinct lateral band near anterior margin; shallowly, moderately rugose-reticulate surface visible beneath setae; erect, elongate curved setae occasionally forming very loose, indistinct tufts on dorsal surface, two inner tufts at posterior 1/3 on either side of midline, two outer tufts at middle but laterad inner tufts; scutellum covered with pale tan pubescence.

Elytra. Dense tan and brown pubescence in a mottled or variegated pattern, slightly darker brown color surrounding scutellum and along first elytral interval at basal 1/5; moderately large, well-separated, somewhat square-shaped strial punctures slightly visible beneath pubescence, edges smoothly rounded, middle punctures separated longitudinally by about 3 times their length, puncture rows separated by about 4 times puncture width; long erect setae rising above dense pubescence, about 1.5 times as long as one elytral interval at middle, decreasing in length laterally and posteriorly; dense pubescence slightly more orange adjacent to apical margin.

Ventral surface. With dense yellowish-tan pubescence, slightly darker patches near margins of second through fourth ventrites, and evenly scattered

suberect dark brown setae; posterior margin of mesepisternum with orange pubescence; first and second sutures between ventrites becoming more obscure laterally; ventrite ratios (first to fifth): 20: 21: 15: 13: 30.

Legs. Covered with dense recumbent tan pubescence and longer darker scattered appressed setae; trochanters and apices of femora and tibia orange-tan, longer, coarser setae at tibial apex and ventral margin distinctly orange; margins at apical 2/5 of pro- and mesotibiae and apical 1/3 of metatibiae covered with longer, coarser more erect setae.

Sexual dimorphism. None.

TYPES. Holotype: VIRGIN ISLANDS: Guana Island, Quail Dove Ghut, 600 ft., 12.VII-09.X.1994, flight intercept #13, M. A. & L. L. Ivie colr [600, 18° 28.49' N, 64° 34.21'W] (NMNH); Paratypes, same data as holotype (10), same data except 12-24.VII.1994, S. A. Bucklin colr (1), 25.I-25.II.1993, Lio Wei Peng colr (1), 25.II.-25.III.1993, Lio Wei Peng colr, flight intercept trap #5 [400', 18° 28.64' N, 64° 34.20'W] (5), Monkey Point Trail, 6-10.X.1997, T. K. Philips, dung pitfall (26), St John, Estate Carolina, NW Coral Bay, 250 ft., 09.V.1994, litter among rocks, Muchmore (1), St John, Lameshur Bay, V.I.E.R.S., 10.III.1984, leaf litter, W. B. Muchmore (1), St John, Maho Bay, 12.III.1984, in hollow tree, W. B. Muchmore colr (1), Guana Island, VII-X.1993, "beetle-trap", collected by C. Bartlett & J. Cryan (1), Tortola, Windy Hill, 25-28.XII.1993, 350', thorn-scrub for., T. K. Philips, colr., dung pitfall (1) (Paratypes in the collections of the author, the Virgin Islands Beetle Project Collection [Montana State University, Bozeman, Montana], Xavier Bellés, Muséum National d'Histoire Naturelle de Paris [MHNP]).

Distribution. This species is known from three of the northern Virgin Islands (Guana Island, St John, and Tortola). It seems likely that it will be found on other Virgin Islands and Puerto Rico, of the Puerto Rican Bank, which

were connected as a single land mass during periods of low eustatic water levels during the Pleistocene (Heatwole and MacKenzie 1966).

Etymology. Named after my wife Linda, in recognition of her support and encouragement of my career.

DISCUSSION

Lachnoniptus lindae is one of the more highly derived ptinines as characterized by fused elytra, winglessness, and a very globular body form. The majority of species in this group utilize dung or other accumulated organic material of animal or plant origin as a food source. As it has been collected with a dung trap, this species may be using dung from various animals as an adult and larval food.

All sites where this species was collected are tropical dry forest, characterized by rocky, thin red soils. Evapotransporation is considerably higher than rainfall for much of the year, especially during droughts, such as those occurring in 1993-1994. The absence of scarabaeine competition in these areas might be critical for successful reproduction of this ptinine, if it really is a dung feeder. More observations are needed to determine the biology of this beetle.

ACKNOWLEDGMENTS

My sincere gratitude to James Lazell and The Conservation Agency for supporting research on Guana Island, and to Molly and Wilfred Gerofsky for their support of field work on Tortola, British Virgin Islands. My appreciation to Michael Ivie for supplying additional specimens of this species and for his review of the manuscript. Thanks to Joseph McHugh and one

anonymous individual for their careful reviews. Additionally, my thanks to Miguel Archangelsky for his help with the Spanish version of the abstract and to John Mitchell for the scanning electron microscope pictures.

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FIGURE CAPTIONS

Figs. 1-4. External morphology of *Lachnoniptus lindae*: 1) dorsal habitus; 2)lateral view; 3) ventrites (most of the setae abraded); 4) elytral setae. Scale line = 1.0 mm for figs. 1-2, 100 um for 3-4.

Figs. 5-6. Head of *Lachnoniptus lindae*: 5) frontal view; 6) lateral view of eye. Scale line = 100 um.

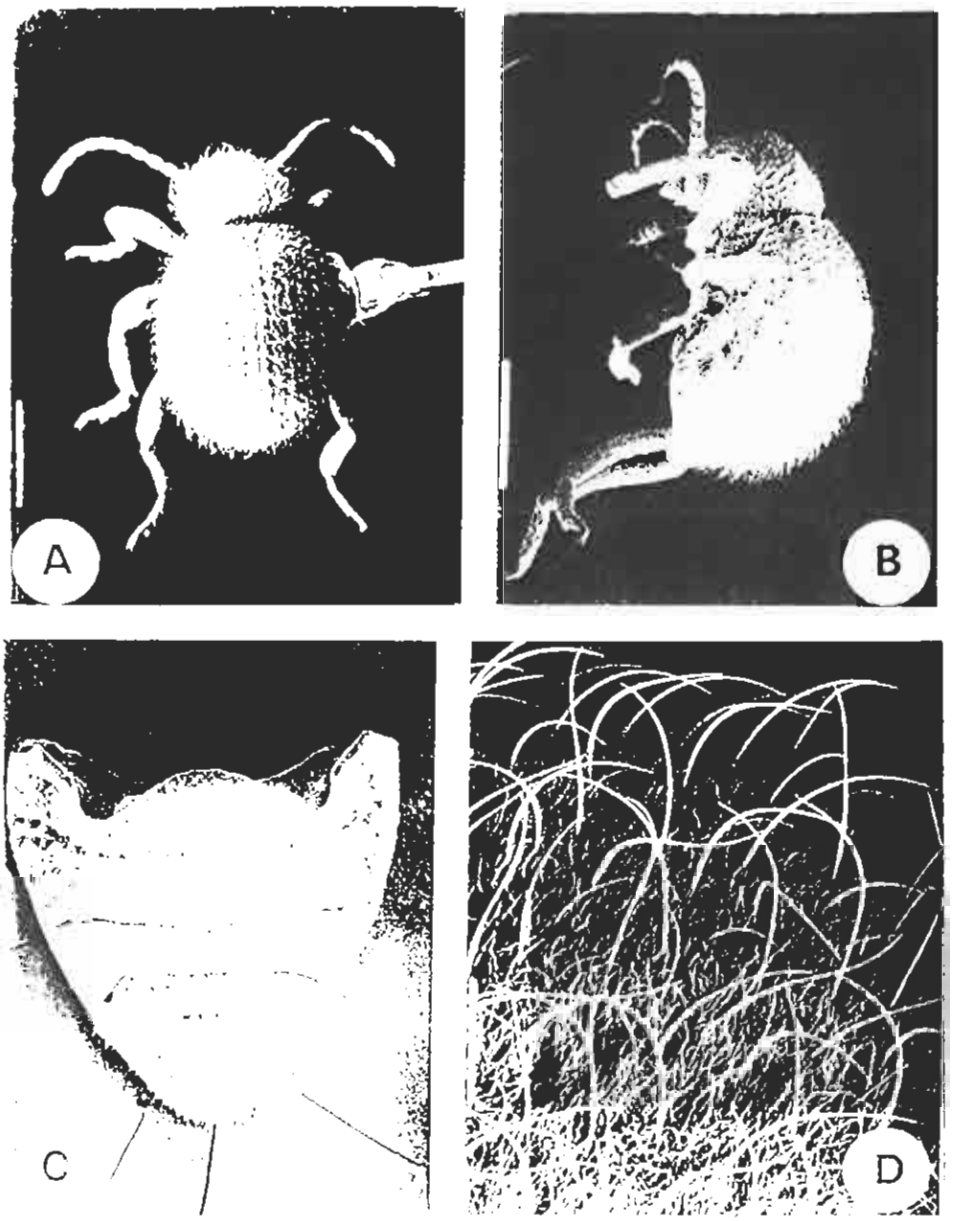

FIGURE 4.1

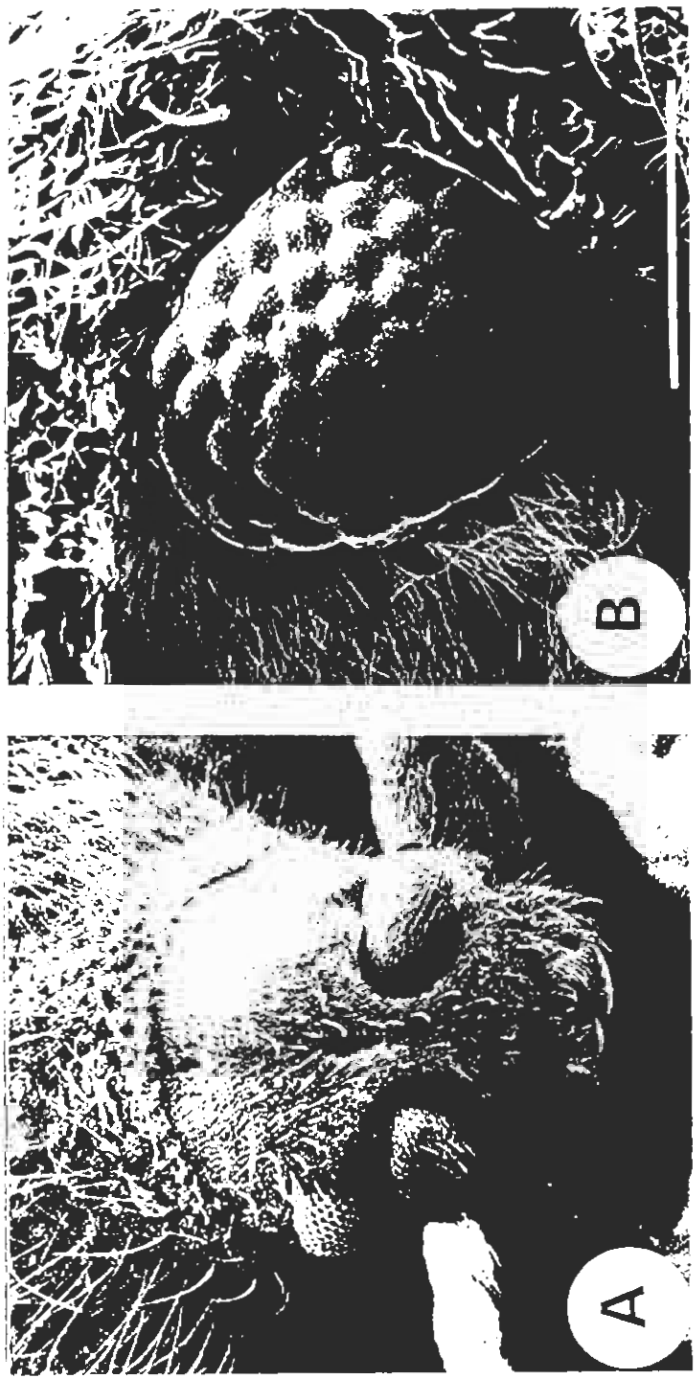

FIGURE 4.9

From: Coleoptera de Antilles 1947
Bostrychoidea by F Lepesme

127

2. **Ptinus Dufaui** Pic, Échange, XXII, 1906, p. 21
Type : Guadeloupe; coll. Pic.
Fig. 259. Long. 2-2,3 mm. Subparallèle, assez large, brun rouge, les pattes et les antennes plus claires, la face ventrale plus sombre, garni de courts poils dorés

ou grisâtres en partie subcouchés, en partie dressés, ces poils répartis assez irrégulièrement. Tête courte, densément pubescente en avant. Yeux gros, fortement convexes, noirs. Antennes plus courtes que le corps, les articles III à X subégaux, II à peine plus longs que larges, XI deux fois aussi long que X. Prothorax un peu plus long que sa largeur maxima, celle-ci au milieu, rétréci en avant et en arrière, étranglé et avec un sillon transverse net devant la base, un peu élargi de nouveau ensuite; grossièrement et densément ponctué, faiblement pubescent. Écusson subcirculaire; densement couvert d'une fine pubescence grisâtre. Élytres un peu moins de deux fois aussi longs que larges pris ensemble, subparallèles ou du moins très faiblement élargis de la base au tiers postérieur, légèrement déprimés transversalement au quart antérieur, les épaules arrondies; ponctués-striés, les points assez forts, très serrés sur chaque ligne, les stries un peu confuses à la base près de la suture, les interstries étroits. Pattes assez courtes, les tibias très grêles; tarses courts, l'article I deux fois environ aussi long que large, II nettement plus court, III et IV subtransverses, V comme II, mais très grêle, les ongles très fortement divergents.

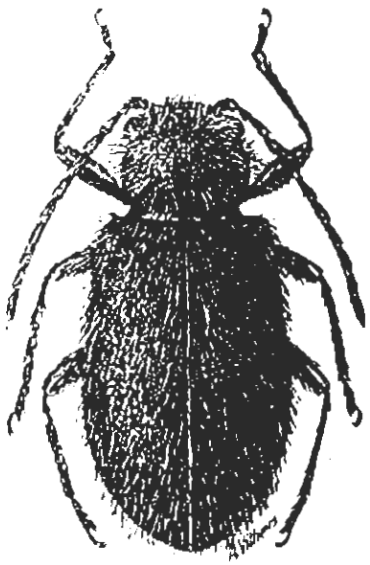

Fig. 259. *Ptinus Dufaui* Pic.

Guadeloupe : Trois-Rivières.

This species of spider beetle was also collected on Guana by Keith Philips- a new record for the Virgin Islands.

UNIVERSITY OF MARYLAND AT COLLEGE PARK
COLLEGE OF LIFE SCIENCES • DEPARTMENT OF ENTOMOLOGY

November 11, 1997

Dr. James D. Lazell
The Conservation Agency
6 Swinburne Street
Conanicut Island, RI
02835

Dear Skip:

Thank you very much for facilitating all aspects of our new conservation genetics project in the BVI. As you know, our research focuses on inherent differences in dispersal capability among several insect taxa (termites and planthoppers with moderate dispersal capability, and leafhoppers which are very mobile) and how such differences in mobility influence gene flow and the genetic structure of populations throughout the BVI. This work will provide a scientific basis for the management of less numerous taxa on Guana and other islands throughout the BVI. From this year's sampling, we have three replicates of within and between island comparisons (Tortola vs Guana, Virgin Gorda vs Great Camanoe, and Anegada vs Necker). During our sampling we also targeted, but did not have time to sample thoroughly, two flightless insect taxa (crickets and book lice). This winter, we plan to analyze our samples by using genetic markers (mitochondrial and nuclear DNA) to examine the relationship between dispersal capability, island size, and inter-island distance on the amount genetic variation within and the genetic differentiation among populations.

After another sampling season in the BVI we will have sufficient data to compete for NSF support of a broader-scale project. Because you are projecting that bed-night availability on Guana will be limited during Scientist Month 1998, we would like to submit an early request for space consideration. Obtaining insects from additional islands and augmenting samples from some of the 1997 sites will be critical to building on this year's efforts in order to generate a robust series of papers in respected journals and a competitive NSF proposal.

To our knowledge, no previous study has tested the consequences of dispersal strategy on the genetic structure of populations in truly insular habitats. Thus, we feel that this research has broad scientific appeal both in the context of population biology as well as in the sphere of conservation genetics. This study has the potential to become a recognized contribution to the management of endangered island populations. For this reason, we hope that you place our project high enough on the Scientist Month 1998 priority list that we can accomplish our sampling objectives next year. We shall keep you informed of our results and interpretations from 1997 as our sequencing data becomes available for analysis. Next year Dave Hawthorne will be prepared to give a presentation which features our results at either the Guana Island Symposium or the College Colloquium.

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Skip, we each deeply appreciate all that you have done for us, and we look forward to continued collaboration as this project develops. Again, thanks so much and we hope that your re-entry into the temperate north has proved smoother than has ours.

Sincerely,

Barbara L. Thorne, Associate Professor

Robert F. Denno, Professor

David J. Hawthorne, Assistant Professor

Subj: Guana island moth ms
Date: 98-03-16 10:07:58 EST
From: scottm@bishop.bishop.hawaii.org (Scott Miller)
To: vbecker@rudah.com.br (Vitor Osmar Becker)
CC: scottm@bishop.bishop.hawaii.org, JCINJTOWN@aol.com (Skip Lazell)

Vitor: I owe you updates on various things, but this one will deal with our long-lost Guana island large moths paper. This was one of the projects that I intended to finish before I departed from Honolulu. In fact, I had all the files sitting on my table ready to finish, but as I departed in a panic, that is where they stayed. With 11 years of accumulated unfinished projects to finish and a household to move, there was just too much to do in a few months. Before I actually left the museum job, the heavy budget pressures meant that I had to devote my time to projects that paid the museum's bills.

Anyway, I am sorry for the delays, but I think the larger moths manuscript is close enough to completion that I can finish the editing here, then do a final check on some literature when I am visiting Smithsonian or Bishop later this year. Can you please send your most recent version of the manuscript as an email attachment so that I can make sure I have the most recent version here?

Of course, there is still no word from Covell on his identifications!

I think I have mentioned this before, but there is a nice WWW site dealing with moths from the French Antilles at www.jouy.inra.fr/papillon/indexeng.htm. I will check our manuscript against the names they are using also.

Regarding the Pyraloid and Micro manuscripts, I think I can finish up the pyraloid manuscript fairly quickly when I move to Smithsonian in 2000. Since Gene Munroe has become pretty much inactive, we'll have to solve the identification problems ourselves, but I could fairly easily do this with the resrouces of the Smithsonian. Then we can keep working away at the micros as time allows.

Are you having Razowsky review the Guana tortricids? Could you please ask him to send me a set of his reprints when he returns home (send to my Nairobi address)?

==========NEW ADDRESS==========

Scott E. Miller, Leader, Biodiversity and Conservation Programme
International Centre of Insect Physiology and Ecology (ICIPE)
Box 30772, Nairobi, KENYA

Tel: +254-2-861680 [switchboard] Fax: +254-2-860110
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African projects (new!):

Build a better mosquito trap and the world . . .

Jamestowner readies new product for outdoor lovers

By Donna K. Drago

The upcoming release of the Counterflow 2000, new technology by a company with Jamestown roots, may some day put mosquitoes and other biting pests out of business.

American Biophysics, the developer of the free-standing biting insect trap, got its start in small offices on Southwest Avenue and has grown into a 6,000 square foot research and manufacturing facility on South County Trail in East Greenwich. The release this spring of the bug killer's prototype should put the small company in the public eye.

Islander Bruce Wigton, president of American Biophysics, said that his company's new device is "on the cutting edge" of technology in the field of insect trapping instruments, adding that "we are in the lead in this kind of work."

High tech mosquito trap — the Counterflow 2000.

According to Wigton, the Counterflow 2000 uses attractants that mimic those put out by the human body. The device emits an undetectable amount of carbon dioxide in conjunction with water vapor and heat that attracts the mosquitoes. The insects are then sucked into an updraft vent that leads to a net bag within the unit. The method of death is dehydration, Wigton said, adding that since no chemicals are used in the process, "the mosquitoes can be used to feed your fish."

It took several years to determine the best type of attractant for the prototype, said Wigton, who, along with staff electrophysiologist Alan Grant, demonstrated how mosquitoes respond to carbon dioxide.

Under a microscope, Grant stuck electronic probes into the neural receptors in a live mosquito's antennae. Once properly hooked up to equipment similar to an electrocardiograph machine, Grant blew his breath in the vicinity of the mosquito, who let out an agitated series of clicks and blips on the screen.

Through the use of the carbon dioxide mix, only mosquitoes and other biting flies are attracted to the unit, which saves other flying insects for the birds and keeps the food chain intact, Wigton said.

Though the unit is available in prototype form now, Wigton said that its official unveiling will be at the National Hardware Show in Chicago this August. Once it has made its debut, Wigton expects that he will sign an agreement with a large manufacturer that will mass produce the unit, which looks like a cross between a movie theater popcorn maker and a gas grill.

Wigton said that he has sold 37 of the prototypes for $1,000 each, "cash in advance." Once mass produced, each unit will cost "about $350" and he expects to sell "at least 50,000 next year."

American Biophysics has been in the business of insect collection since 1991, and released a line of products in 1994 for the professional entomologist and organizations like the Center for Disease Control that are in the business of collecting and studying virus carrying insects.

The Counterflow 2000 will be the first mass produced product for the company, and Wigton said his product, which is economical, safe and highly effective, will compete with the Bug Zapper, which he said "is completely ineffective" against biting insects. The Counterflow 2000 is so effective that it has been successfully tested in tropical places like Thailand, Kenya and the Caribbean, where, Wigton said, they are in the process of "ridding an island of its entire population of sand flies."

American Biophysics is staffed by five full-time employees, three who live in Jamestown. Office Manager Kasia Jankowski lives on East Shore Road, and Dave Wright, head of manufacturing, lives on Carr Lane. Wigton lives on Pennsylvania Avenue with his wife Sandy and five children: Rebekah, 12, Rachel, 10, twins Nathan and Jeremy, 8, and Jacob, 6.

Jamestowners will be able to see the Counterflow 2000 when it debuts at Jamestown Hardware this month.

12-2-97

Hi Skip,

Thanks for the copy of the Guana Video - you looked great! You probably think I have vanished from the world , but I have only been busy with many projects. I am working on a revision of my Joshua Tree National Park papers and on my So. Calif. Spider Project. I have also worked on the synonomys in the Guana Spider Literature and am almost ready to publish a short paper.

I took up Rock Climbing this year and have scaled some very formidable peaks . My teachers were some big wall climbers from Yosemite. I'm ready for the crags on Guana Is.

I think I can return to Guana Is. this October. I Would like to explore the spider populations on some of the surrounding islands and compare them to Guana populations. I've really missed seeing you and the gang . Hope to return this year . Keep me informed.

Sincerely,

PS - I may be working on a Costa Rica Project this August and may need some input from you on designing a research facility there.

answ: 13.xii.97

The Conservation Agency

Exploration, Education, and Research

President
James D. Lazell, Ph.D.
401 423 2652

6 Swinburne Street
Conanicut Island
R.I. 02835 U.S.A.

29.xii.97

Todd L. Zimmerman
Research and Collections, LACM
900 Exposition Blvd.
Los Angeles, CA 90007

Dear Todd:

It all sounds terrific. I have long been interested in decapods, and hoped to find someone to take them on. Indeed, both Gecarcinus are on Guana, and common (not as common as Coenobita). I put vouchers for many of the species on Guana and other BVIs in USNM. Somewhere in the chaos of my office is a folder on "land crabs." I will find it....

Meantime, I am sending a batch of reading material. Also, despite my enthusiasm and yours, we have a Big Problem: Guana is a luxury destination resort most of the year, so living there except during the two Scientists Months - July (marine) and October (terrestrial) -- is very difficult to arrange (unless you can afford ca $600.00 a day!). Not only that, but Guana is very much a family affair: Dr. Henry Jarecki, the owner, his wife Gloria, their niece Lianna -- who is finishing up her Ph.D. on salt pond ecology and teaches at the local Community College, the Jarecki's three sons and their families.... A lot of people would have to know and like you. Not to mention Richard and Linda, the managers. It is a close little community.

However, your plan is not unprecedented. Dr. Liao, a Chinese ornithologist, has been in residence for long periods, even during high tourist season. Also, there are other places to live, like just across the bay on Beef Island or Tortola. You could commute to Guana easily, daily, and probably free.

Yes, you could probably arrange to rent a whaler often; yes, we have tanks and compressor. As you will note, there is a huge amount of info on our termites. We have experimental plots working to track the effects of sheep.

I have a meeting with the Jareckis on 11 January, and will bring up your proposal then. Meantime, Roy Snelling, entomologist, there at LACM, can tell you lots more about Guana.

For sure, you should plan to come next year -- either in July or October -- or even both. There may be some problems for October, because we have a big project scheduled that will take up a lot of our slots. I trust Leslie got her specimens OK. Give her my best, and tell her to start making plans. Is marine month -- July -- better for you two?

More later.

All the best,

James Lazell, Ph.D.

Encls: Publication list (needs updating)
Petrovic letter
Plant list
Natural Necker

30 April 1998:

This guy wrote a fascinating proposal back in December. This is my answer. Never heard another word....

Skip

The Conservation Agency

Exploration, Education, and Research

President
James D. Lazell, Ph.D
401 128 2652

2.xii.97

6 Shearwater Street
Cruzan Island
B.V.I. 03895 U.S.A.

orig mailed 12/4/97

Clive Petrovic
H.L. Stoutt Community College
Paraquita Bay
Tortola, British Virgin Islands

Dear Clive:

I have mailed Chace & Hobbs as printed matter. Apart from obtaining specimens, there will be problems. The Tortola form is close to, if not quite, sinuatifrons as that species is currently conceived. However, allocation of that name is unclear.

C & H do not tell us if a type specimen exists or on what grounds authors fix this name on the PR form. Milne-Edwards was at Mus. Nat. Hist. Paris, and it is unlikely he had PR specimens (VI is more likely). First, you have to search for a type. If it is quite clear that none exists (perhaps ME never designated one -- you have to get his original description), then you can fix the name and designate a neotype. It is most improbable that PR, St. Croix, and Tortola populations are the same, so you first hope ME said something that will tell you which he had (if there is a type specimen, then allocation should be easy).

Let's assume that either the type or the original description allows the interpretation (of authors) that ME described the PR form. Then you locate good, fresh specimens from a protected drainage (if possible). You also borrow and examine all the PR material you can. All this becomes your basis of comparison. If there is no type specimen, you will have to designate a neotype (and preferably donate it to Paris). Then you sort out the Tortola and St. Croix forms. You might have two new ones.

Ah, but the problem of granulata: what is it? Going by the description, it seems not to be armata of Cuba, as C & H suggest. The denticulate margin suggests sinuatifrons, or something close. You will have to examine the pathetic remains (C & H do not say where) and decide. If there is really no way to tell, then granulata is a nomen nudum and can provisionally be placed in the synonomy of whatever you cannot tell it from -- perhaps armata as C & H suggest (but which I doubt). Fortunately, Rathbun's material is probably at USNM.

My suspicion is that ME's sinuatifrons is from St. Croix. If so, then portoricensis Rathbun 1905 becomes available for the PR form, presumably with a type specimen.

Then the Tortola form needs a name. It was Fenner Chace, after examining my Tortola specimens (safely at USNM), who said they were different from the PR form.

Are there truly no populations on St. Thomas or St. John? If they are there, are they intermediate between Tortola form and PR form? Or, like Tortola....

Re: Bullet trees, Dr. George Proctor is at 11 Caleta de las Monjas, San Juan, PR 00901. Better send him a blow-up of the topo sheet.

It's going to be quite a little project! Good luck....

All the best.

Skip

Note: This has been exhibited as an expanded poster at Yale Peabody Museum. Slip

RESEARCH ON THE SHALLOW-WATER AMPHIPODA AND ASSOCIATED INVERTEBRATES AT GUANA ISLAND, BVI, OCTOBER, 1997.

Eric A. Lazo-Wasem
Division of Invertebrate Zoology
Peabody Museum of Natural History
Yale University
New Haven, Connecticut

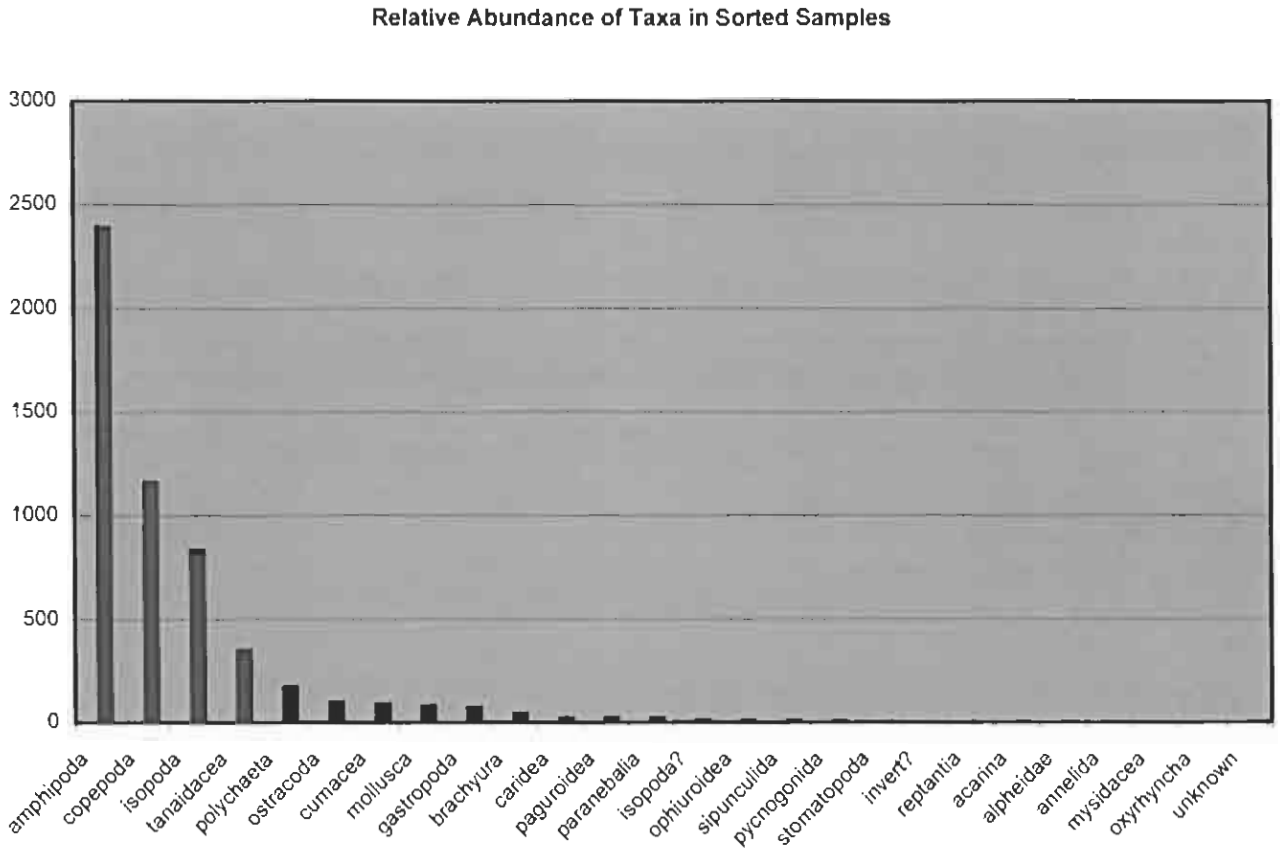
During the 1997 October field season at Guana Island, I was accompanied by a marine worm (polychaete) specialist from the Los Angeles County Museum of Natural History, Ms. Leslie Harris. Our goal was to 1) re-examine many of the localities I had sampled during the 1996 season; 2) collect from the more remote places on the island

not reached by ELW in 1996; and 3) use techniques to target the collection of marine bristle worms; these methods are different than those employed by ELW to target amphipod crustaceans. Unfortunately, the weather of October 1997 was very unsettled, with a major storm moving into the area bringing high winds, driving rain and a heavy surf. The weather greatly curtailed our ability to collect from all but the most protected beaches. Continuous high surf made collecting along the rocky coastline relatively dangerous, and often impossible. As a result, we concentrated our collecting activity at White Bay Beach and North Beach. Attempts to collect at Monkey Point, Long Man's Point, and even the relatively protected Crab Cove proved futile. To broaden the coverage of our collecting therefore, we sampled the mangrove faunal community adjacent to the Beef Island Bridge, and one of us (ELW) collected in Roadtown Harbor, Tortola.

RESULTS

To date, twenty two samples comprising nearly 5400 individual specimens have been sorted from the collections made during 1995 (F.C. Sibley), 1996 (Lazo-Wasem), and 1997 (Lazo-Wasem and Harris). By far, gammaridean amphipods were the most abundant taxa, comprising nearly 50% of the total collection. Caprellidean amphipods (skeleton shrimps), expected to be found in reasonable numbers, have not yet been collected. In addition to the amphipods, three other crustacean orders, the copepods, isopods, and tanaids were present in large numbers. These orders along with the

amphipods accounted for nearly 75% of the total specimens. All other taxa were present in relatively small amounts. Although making up a relatively small proportion of the specimens, the number of cumaceans collected (81) is significant, as these are relatively uncommon in samples of the type made at Guana Island.



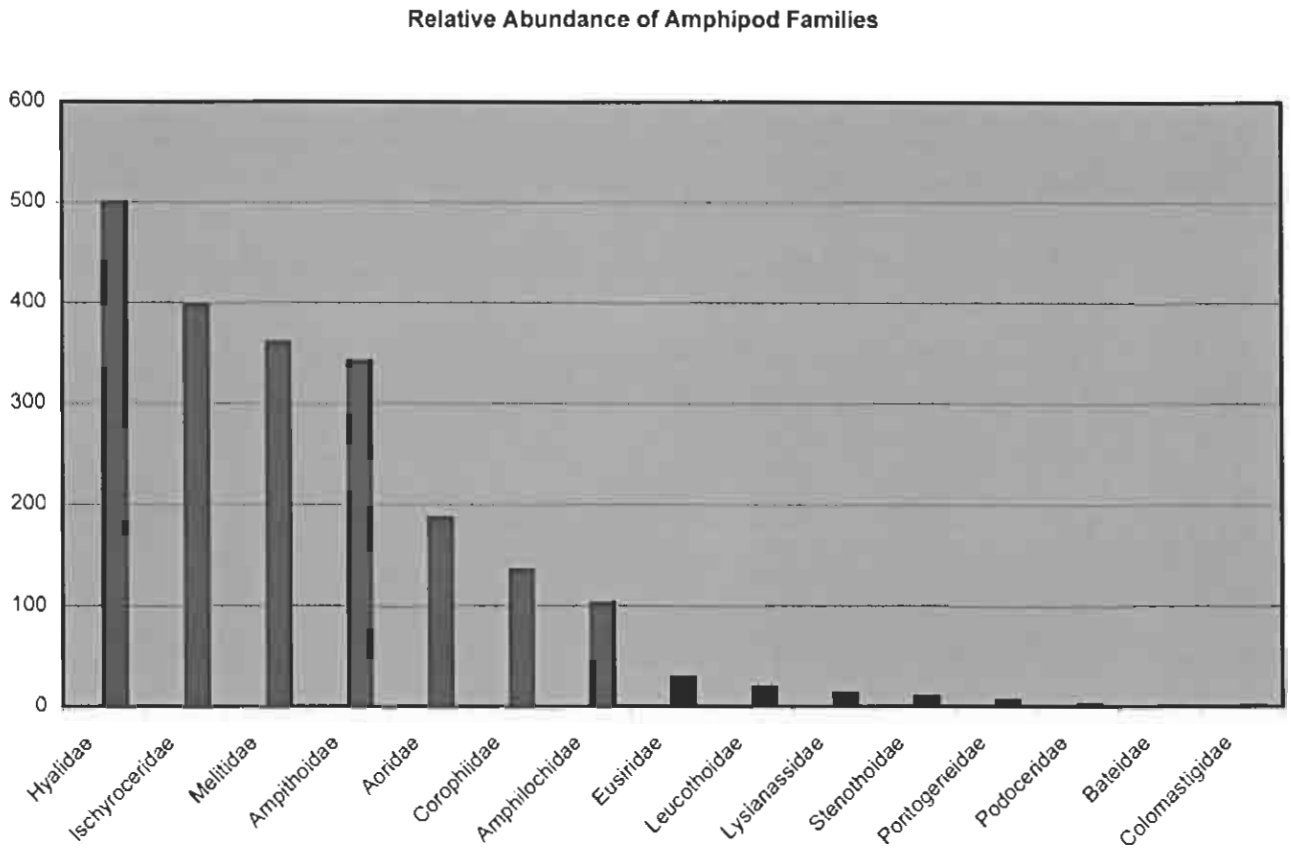
Nearly twenty four hundred amphipods were sorted from the samples, representing fourteen different gammaridean families. At present, thirty one differernt taxa have been recognized, although mainly at the genus or family level. Only a few

specimens, e.g. *Audulla* cf. *chelifera*, *Erichthonius rubricornis*, and *Dulichiella appendiculata* have been tentatively assigned to a particular species. In the case of the latter two, both have distinctive morphologies, broad geographic ranges, and therefore are easy to identify.

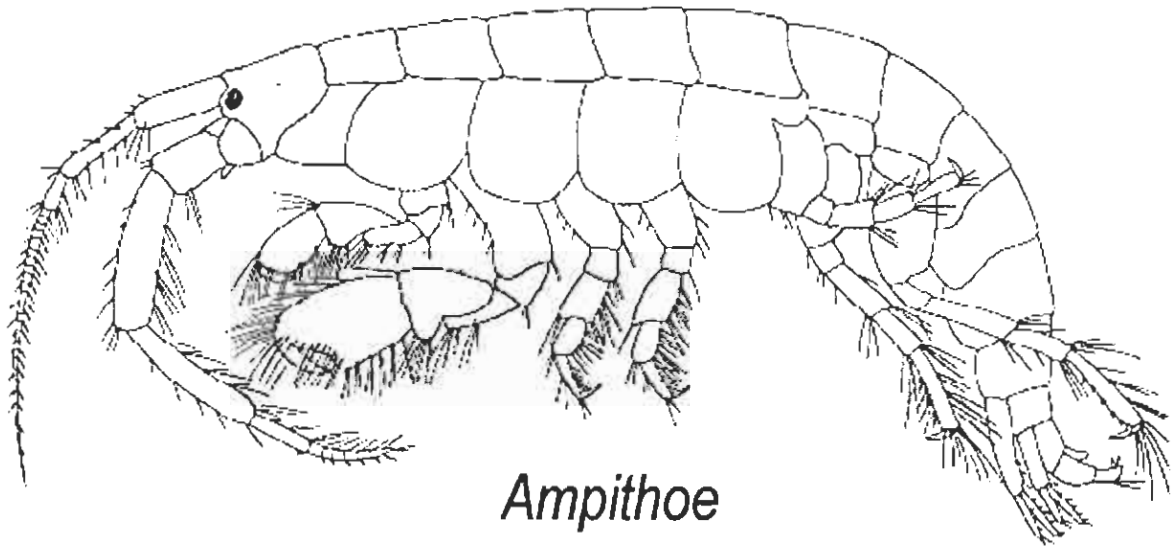
AMPHIPOD TAXA FOUND AT GUANA ISLAND AND VICINITY

Family	Genera
Amphilochidae	
Ampithoidae	*Ampithoe, Cymadusa*
Aoridae	*Lembos*
Bateidae	*Batea*
Corophiidae	*Audulla, Erichthonius, Gammaropsis*
Colomastigidae	*Colomastix?*
Eusiridae	
Hyalidae	*Hyale, Parhyale?*
Ischyroceridae	*Ischyrocerus*
Leucothoidae	*Leucothoe*
Lysianassidae	
Melitidae	*Dulichiella, Elasmopus, Maera, Melita*
Pontogeneidae	
Stenothoidae	

Several families that dominate the samples undoubtedly comprise several species, and probably genera. The family Hyalidae, the most abundant of the amphipod samples, is certainly represented by *Hyale*, but *Parhyale* is expected too as it is widespread throughout the tropics. The correct species assignment for *Hyale* will be extremely difficult, as the genus has more than one hundred species and is in need of revision.



The ampithoids (family Ampithoidae) are quite common (N=350) and is represented by the genus *Ampithoe* and *Cymadusa*. The genus *Ampithoe* is the largest common amphipod to be seen at Guana Island. Specimens of this genus can reach 15 mm and can often be found along with relatively large hyalids clinging to the green algae on rocks and man-made structures such as the Boat Dock at White Bay, and the pilings of the pier at North Beach.

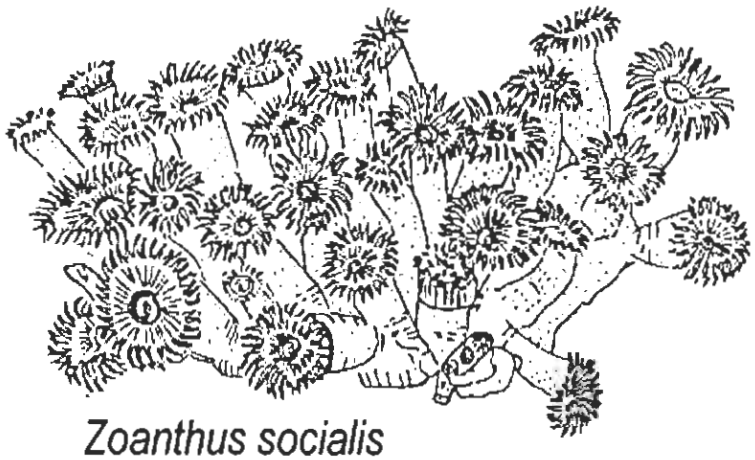


Ampithoe

Although relatively uncommon compared with the hyalids and amphithoids, several taxa, usually hard to obtain, were found in significant numbers. Of these, the amphilochids (family Amphilochidae) are very important, as more specimens of this family were found at Guana than was found in samples collected from Bermuda, St. Kitts and Nevis (British West Indies), and Belize combined even though similar collecting methods were employed. The amphilochids are currently being studied by Mr. Adam Baldinger, Museum of Comparative Zoology, Harvard University.

One area specifically targeted for collecting was the East end of White Bay Beach. This site was the only locality where specimens of a crustacean of particular interest, i.e. *Paranebalia* cf. *longipes*, was collected in 1996. *Paranebalia* are small, nestling crustaceans; when present, they often represent a significant proportion of the algal holdfast community. Unfortunately, algae clumps were very rare at the end of White Bay Beach; this is in direct contradiction to what had been observed by EALW during the 1996 season. In 1996, tufts of algae covered the surface of rocks in the

shallow subtidal region. In 1997 however, virtually all surfaces previously covered by algae were blanketed by a sea mat, tentatively identified as *Zoanthus socialis.* This colonial relative of sea anemones and corals is easily recognized when snorkelling by its green appearance and 1 cm diameter tentacle bearing polyps. In colonizing this region of White Bay, the dense mats of *Z. socialis* has apparently crowded out the dense covering of algae present the year before.

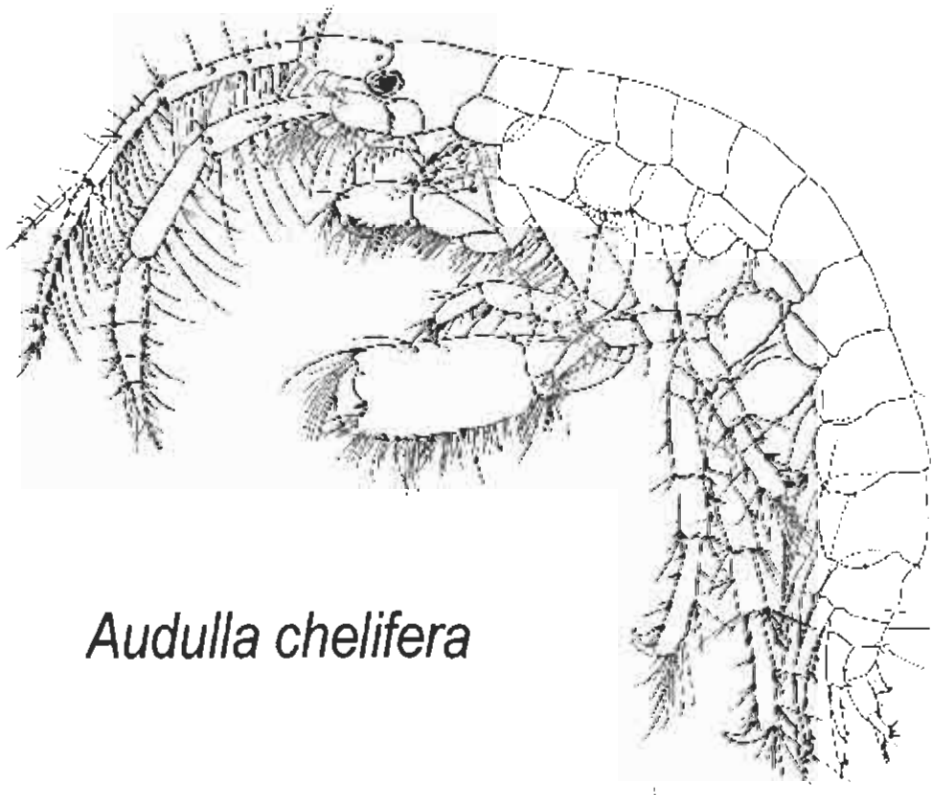


Zoanthus socialis

SPECIFIC TAXONOMIC PROBLEMS

Two microcrustaceans (an amphipod and nebaliacean) collected from Guana Island have been the focus of detailed taxonomic analysis during the past year. The discovery of the gammaridean amphipod *Audulla chelifera* Chevreux at Guana Island represents only the second Caribbean record of this species; the only previous Caribbean record was from from Carrie Bow Key, Belize (Thomas and Barnard 1987). Furthermore, an abundance of specimens of this species from Guana Island has allowed a detailed morphological comparison with *Audulla lina* (Kunkel), a species

originally described from Bermuda and now considered to be junior synonym of *A. chelifera*. This study was done as a collaborative effort with Ms. Hanna Norfleet, Department of Biology, Yale University. Although very little Bermuda material of *Audulla* is available (all known specimens are deposited at the Yale Peabody Museum), our comparison suggests that the form known from the Caribbean (Carrie Bow Key and Guana Island) is distinct from that found in Bermuda. It is of interest to note that the relative abundance of *A. chelifera* is very high in the Guana Island samples; Barnard and Thomas (1987) have commented on the rarity of this species elsewhere in the Caribbean Sea.



Another microcrustacean of interest is the nebaliacean genus *Paranebalia*.

Paranebalia longipes (Willemoes-Suhm) was originally described from Bermuda, and has occasionally been reported from the Bahamas and the Caribbean. The few specimens of this crustacean collected at White Bay Beach on Guana Island during 1996 allowed Mr. Thomas Sawicki and Dr. Michael Gable, Eastern Connecticut State University, to preliminarily analyze the morphological differences between the Caribbean *Paranebalia* and *P. longipes* of Bermuda. Several characters were found to vary between specimens from these localities; these characters may warrant separation of the two at the species level. A thorough analysis of many specimens should help to resolve this taxonomic question. Unfortunately, I had hoped to collect a large series of *Paranebalia* during the 1997 trip, but because of the poor weather and our inability to locate large amounts of subtidal algae, only a few additional specimens were obtained. Until more specimens are available the distinctiveness of the Caribbean *Paranebalia* can not be assessed.

REMARKS AND CONCLUSIONS

Although this study is only in the preliminary stages, a general comparison can be made with other studies that have dealt with Caribbean amphipods. Dr. Michael Gable (Eastern Connecticut State University) is currently studying a large collection of Caribbean amphipods collected by P. Wagenaar Hummelinck over a long period beginning in the late 1930's and continuing into the 1970's. Most of this material was collected from the southern Caribbean, although some samples were from Puerto Rico.

For the most part, the families and genera found on Guana match those reported in the Hummelinck material, although in that collection no *Audulla chelifera* have been found, whereas it is quite common in our samples.

Considerable differences between faunal composition are seen when comparing the faunal makeup of Guana with that found during a recent outfall monitoring survey in St. Thomas, U.S.V.I. Several families e.g. Phoxocephalidae, Synopiidae, Oedicerotidae , Ampeliscidae, found at the outfall site have not been collected in Guana. Conversely, several of the more common genera at Guana e.g. such as *Ampithoe* and *Hyale* were not reported. The absence of the latter is not surprising, as hyalids are often associated with near shore habitats. The absence of *Ampithoe* from the St. Thomas samples is puzzling, as it should be common in offshore samples. The differences between the two faunas points to the need to sample from a great variety of habitat types and depth ranges, to adequately get a picture of overall taxonomic diversity.

Although the taxonomic diversity of amphipods in the Guana Island samples is relatively high, clearly [redacted] there are many rare forms that are still only rarely encountered. Last year I reported on the presence of an unidentified lysianassid amphipod that occurred in a few samples, and predicted that further sampling would yield enough specimens to make a positive identification. Even though many more samples were studied during the past year, only a few additional specimens have turned up. This could be due to the weather system and heavy surf, which might have driven these partially pelagic forms offshore to deeper water. Further collecting at

Guana and elsewhere in the B.V.I. may eventually yield a significant amount of additional lysianassids.

LITERATURE CITED

Thomas, J.D. and J.L. Barnard. 1987. The Indo-Pacific *Audulla chelifera* reported from the Caribbean Sea (Crustacea: Amphipoda). Proceedings of the Biological Society of Washington 100(2):364-370.

GUANA

In the following checklist, all numbers following names are Proctor collection numbers. The first (and only complete) set of this material is deposited in the herbarium of the Department of Natural & Environmental Resources, San Juan, Puerto Rico (SJ). Partial duplicate sets have been sent to the U.S. National Herbarium, Washington, D.C. (US); the Institute of Jamaica, Kingston, Jamaica (IJ); and the New York Botanical Garden, Bronx, New York (NY).

A limited amount of field work has been carried out on several islands nearby to Guana. Although information for these islands is far from complete, these records have been appended to the present list where relevant, using the following symbols:

GC	Great Camanoe
GD	George Dog
LC	Little Camanoe
S	Scrub

Presence of a species on St. John is also indicated. Names of native and naturalized plants are **bold face**.

PTERIDOPHYTA

POLYPODIACEAE (sens, lat.) – Nephrolepis falcata (Cav.) C.Chr. cv. 'Furcans' (sight, cult.) The "Fishtail fern.

N. multiflora (Roxb.) Jarrett ex Morton 42015 Rock crevices, summit of Guana Peak. (St. John)

Pteris vittata L. 42634 Crevices of old walls, Guana Island Club. (St. John)

GYMNOSPERMAE

No indigenous or naturalized Gymnosperms are known from Guana Island.

Araucaria heterophylla and Cycas revoluta are cultivated near Grenada House.

ANGIOSPERMAE – DICOTYLEDONAE

ACANTHACEAE – **Asystasia gangetica** (L.) T.Anders. 43402 Introduced from the Old World tropics; naturalized. (St. John)

Blechum pyramidatum (Lam.) Urban 43480 (St. John)

Crossandra infundibuliformis (L.) Nees 43892 Cultivated; native of Africa; alleged to be an afrodisiac.

Justicia periplocifolia Jacq. 47247 (GD) (St. John)

Oplonia microphylla (Lam.) Stearn 42014, 43703, 44898 (GD) St. John

O. spinosa (Jacq.) Raf. 43870, Monkey Point (GC) (St. John)

Ruellia tuberosa L. 43430 (GD) (St. John)

AIZOACEAE – Aptenia cordiofolia N.E. Brown (sight record; cultivated; D. Jarecki photograph). Native of South Africa.

Sesuvium portulacastrum (L.) L. 43437 (S) (St. John)

Trianthema portulacastrum L. 42526 (GC) (St. John)

AMARANTHACEAE – **Achyranthes aspera** L. 42645 (St. John)

Alternanthera crucis (Moq.) Boldingh 42598 Seen only at S. end of Muskmelon Bay Beach. (St. John)

A. pungens Kunth 42558

Amaranthus crassipes Schlecht. 43479 (St. John)

A. viridis L. 43478 (St. John)

Celosia nitida Vahl 43414 (GD) (St. John)

Iresine angustifolia Euphrasén 42617, 43407 (GD) (St. John)

ANACARDIACEAE – **Comocladia dodonaea** (L.) Urban 47245, 48403 (St. John)

Mangifera indica L. (sight) Introduced and long-established. (St. John)

Spondias mombin 44896. Quail-dove Ghut only. (St. John)

ANNONACEAE – **Annona glabra** L. 43682 (St. John)

A. muricata L. 43683 (St. John)

A. squamosa L. 43407 (St. John)

APOCYNACEAE – Catharanthus roseus (L.) (G.Don) 43889 (cult. & escaped) (St. John) The Guana plants represent the pure white form called "var. alhus".

Nerium oleander L. (Sight, cult.) (St. John)

Pentalinon luteum (L.) Hansen & Wunderlin (formerly known as Urechites lutea) 42593 (St. John)

Plumeria alba L. 42563 (GC, GD. LC, S) (St. John)

P. rubra L. 48828, cult. (GC, cult.)

Prestonia agglutinata (Jacq.) Woodson 42586 (St. John)

Rauvolfia viridis Willd. Ex R. & S. 42003, 48824 (GC, GD, LC) (St. John)

Tabernaemontana divaricata (L.) R.Br. (Sight, cult.)

ASCLEPIADACEAE – **Asclepias curassavica** L. 42525 (St. John)

Cryptostegia grandiflora R.Br. 43857-a (cult & naturalized) (St. John)

Matelea maritima (Jacq.) Woodson 46551 (St. John)

Metastelma grisbachianum Schltr. In Urban 43871, Monkey Point (GD) (St. John)

BIGNONIACEAE – **Crescentia cujete** L. 42522 (LC) (St. John)

Macfadyena unguis-cati (L.) A.Gentry 42001, 43470 (GC, GD) (St. John)

Tabebuia heterophylla (DC.) Britton 42581 (GC, GD, LC) (St. John)

T. lepidota (Kunth) Britton 48816 Accordiing to A. Gentry (1992), this species occurs in the Bahamas, Cuba, the Haitian island of Tortue, and is represented by a single record from Anegada. The citations by Howard (1989) from Anguilla, St. Martin, and Barbuda were not accepted by Gentry for this species.

Tecoma stans (L.) A.Juss. ex Kunth 43861 (cult. & naturalized) (St. John)

BORAGINACEAE – **Argusia gnaphalodes** (L.) Heine 43400, North Beach. (LC) (St. John)

Bourreria succulenta Jacq. 42024 (GC, GD) (St. John)

Cordia alliodora (R. & P.) Oken 47235, Quail-dove Ghut only. (St. John)

C. **collacocca** L. 43449, 43712 (St. John)

C. laevigata. Lam. 47233, Quail-dove Ghut only. (St. John)

C. obliqua Willd. 47229, naturalized.

C. **rickenseckeri** Millsp. 42601, 44897 (St. John)

C. sebestena L. 43908 (cult., Grenada House; D. Jarecki photo)

Heliotropium angiospermum Murray 42632 (St. John)

H. curassavicum L. 42631 In saline soils. (GD, S) (St. John)

H. indicum L. (sight; photo D. Jarecki) (St. John)

(H. ternatum Vahl GD, St. John) Not yet found on Guana.

Tournefortia microphylla Bertero ex Spreng. 43872, Monkey Point; 47236, Grand Ghut (GD, S) (St. John)

BURSERACEAE – **Bursera simaruba** (L.) Sarg., 42006 (GC, GD, LC) (St. John)

CACTACEAE – **Hylocereus trigonus**, (Haw.) Saff. 43462 (St. John)

Mamillaria nivosa Link ex Pfeiff 43849, E. side of Monkey Point. (GD,S) (St. John)

Melocactus intortus (Mill.) Urban 43456 (GC,GD,LC,S) (St. John)

Opuntia dillenii (Ker-Gawl) Haw. 44879 (GC,GD, LC,S) (St. John)

O dillenii X repens 47250, on rocky slopes near Guana Head. (GD,LC)

O. repens Bello 43418 (GC, GD, LC, S) (St. John)

O. rubescens Salm-Dyck ex DC, (sight, cult. only) (St. John)

Pilosocereus royenii (L.) Byles & Rowley 42592 (GC, GD, LC,S) (St. John)

Selenicereus aff. **grandiflorus** (L.) Britton & Rose 43420 (sterile only), on rocky hillside near Guana Island Club. This plant is not very similar to any of the diverse forms of S. grandiflorus occurring in Jamaica, the type locality of the species. Further taxonomic study of these plants is necessary. The Guana population was presumably introduced long ago and has become naturalized. (St. John)

CAPPARACEAE – **Capparis baducca** L. 43464 (St. John)

C. cynophallophora L. 43408 (GC,GD,S) (St. John)

C. flexuosa (L.) L. 42619 (GC, GD) (St. John)

C. indica (L.) 43463, 43667 (St. John)

Cleome viscosa L. 42550, 43886 (GC) (St. John)

Morisonia americana L. 42572, 48812 (sight, cult.) (St. John)

CARICACEAE – Carica papaya L. (sight, cult.) (St. John)

CASUARINACEAE – Casuarina equisetifolia L. (sight, planted, one tree only)

CELASTRACEAE – **Crossopetalum rhacoma** Crantz 42606 (GC) (St. John)

Elaeodendron xylocarpum (Vent.) P.DC. 42564 (GC, LC, S) Note:: This species is listed under the name Cassine xylocarpa Vent. in "Flora of St. John" (1996, p. 166). My reason for not accepting Cassine for our plant is as follows: N. Robson in a

taconomic study of African Celastraceae (1965), restricted the genus Cassine to two South African species. Subsequent authors have varied widely in their treatment of this taxon. In the present checklist I follow Airy Shaw's usage (1988), in which Cassine is a genus of 40 species occurring in South Africa, Madagascar, tropical Asia, and Pacific islands, while Elaeodendron is recognized as a taxon of 16-17 species of wide distribution, including the neotropics.

Maytenus laevigata (Vahl) Griseb. ex Eggers 42005, 42664, 43465, 43704 (St. John)

Schaefferia frutescens Jacq. 42568, 43395, 43442 (GC, S) (St. John)

COMBRETACEAE – **Conocarpus erectus** L. 43867 (St. John)

Laguncularia racemosa (L.) Gaertn. 42630 (St. John)

Quisqualis indica L. 43857, cult. (St. John)

Terminalia catappa L. 48823 (St. John)

COMPOSITAE (Asteraceae of "Flora of St. John")

– **Bidens alba** (L.) DC. var. radiata (Sch.Bip.) Ballard 43713 (St. John)

B. cynapiifolia Kunth 42541 (St. John)

Chromlaena corymbosa (Aubl.) King & H. Rob. 43399 (GD) (St. John) Note: this and the following species have customarily been included in a broadly-construed genus Eupatorium. The present treatment follows the usage in "Flora of St. John".

C. **sinuata** (Lam.) King & H. Rob. 42574, ridge E. of Muskmelon Bay; 42591, northernmost hill. (St. John).

Conyza canadensis (L.) Cronq. 42642, in field near White Bay. The closely-related C. bonariensis (L.) Cronq. is cited from St. John.

Cyanthillium cinereum (L.) H. Rob. 43425 (St. John) Note: this species has been know as Vernonia cinerea (L.) Less. in most recent floras.

Emilia fosbergii Nicolson 43460 (St. John)

Launeae intybacea (Jacq.) Beauverd 43847, rocky seashore near Pinquin Ghut. (St. John)

(Lepidaploa glabra (Willd.) H. Rob., formerly known as Veronia albicaulis Willd. ex Pers., is recorded from Great Camanoe and St. John).

Melanthera aspera (Jacq.) L.C. Rich is recorded from George Dog but not from St. John)

(Pectis linifolia L. is recorded from Great Camanaoe and St. John)

Pluchea carolinensis (Jacq.) G. Don 43453 (St. John)

Synedrella nodiflora (L.) Gaertn. 43882 (St. John)

Tridax procumbens L. 42542 (St. John)

(Wedelia fruticosa Jacq. is recorded from George Dog and St. John)

CONVOLVULACEAE - **Convolvulus nodiflorus** Desr. 42621 (St. John)

Cuscuta americana L. 42021 (GD) (St. John) Note: this species is placed in a separate family, Cuscutaceae, in "Flora of St. John". I prefer to follow Howard's treatment in vol. 6 of "Flora of the Lesser Antilles" (1989).

Ipomoea eggersii (House) Austin 42604, on wooded hillside NE. of the Guana Island Club. (GC, GD) (St. John)

I. pes-caprae (L.) R. Br. 42638, 43873 (St. John)

I. triloba L. 43484 (St. John)

I. violacea L. 42608 (St. John)

(Jacquemontia cumanesis (Kunth) Ktze. (Found on George Dog and St. John)

J. havanensis (Jacq.) Urban 42607 (St. John)

J. pentanthos (Jacq.) G, Don 42651 (GC, GD, LC) (St. John)

J. solanifolia (L.) Hall.f. 42537, in thickets behind North Beach. (St. John)

Merremia quinquefolia (L.) Hall.f. 42633 (St. John)

Stictocardia tiliifolia (Desr.) Hall.f. 43448 (St. John)

CRASSULACEAE - Bryophyllum pinnatum (Lam.) Oken (sight, becoming naturalized) This species was reported to have been eradicated as potentially a noxious weed. (St. John)

Kalanchoë tubiflora (Harvey) Hamet 43423, naturalized on hillside NE. of the Guana Island Club.

CRUCIFERAE (Brassicaceae of "Flora of St. John")

- **Cakile lanceloata** (Willd.) O.E. Schulz 42650 (St. John)

CUCURBITACEAE - **Cayaponia americana** (Lam.) Cogn. 43424 (St. John)

Momordica charantia L. (sight, naturalized) (St. John)

ERYTHROXYLACEAE - **Erythroxylum brevipes** DC. 43472 (GC, GD, LC) (St. John)

EUPHORBIACEAE - **Acalypha chamaedrifolia** (Lam.) Muell.Arg. 42556 (LC)

Adelia ricinella L. 42658, 43389, 43390 (St. John)

Argythamnia candicans Sw. 42510 (St. John)

A. fasciculata (Vahl. ex A. Juss.) Muell.Arg. 43711. Grand Ghut; 43869, Monkey Point (St. John)

Chamaesyce articulata (Aubl.) Britton 43868. Monkey Point. (GD) (St. John)

C. hirta (L.) Millsp. 42539 (St. John)

C. hypericifolia (L.) Millsp. 42506 (St. John)

C. hyssopifolia (L.) Small (St. John)

C. mesembrianthemifolia (Jacq.) Dugand 42612 (LC) (St. John)

C. opthalmica (Pers.) Burch 42505 (St. John)

C. prostrata (Ait.) Small 42557 (St. John)

Croton astroites Ait. 42535 (GC,GD) (St. John)

C. betulinus Vahl 42540 (GC) (St. John)

C. fishlockii Britton This species was introduced to Guana Island in 1992 from Great Camanoe. It is otherwise known only from Anegada, Virgin Gorda, Tortola, and St. John and in all these places is quite rare.

C. flavens L. var. **rigidus** Muell.Arg. 42521 (GC, GD, LC) (St. John)

C. lobatus L. 43436 (St. John)

Dalechampia scandens L. 43485 (GC) (St. John)

Euphorbia heterophylla L. 42555 (St. John)

E. lactea Haw. (sight, cult.)

E. milii Ch. des Moulins (sight, cult.)

E. neriifolis L. 43419 (cult.)

E. petiolaria Sims 43398, common near summit of Guana Peak. (St. John)

E. tirucalli L. 42588 (cult.)

Gymanthes lucida Sw. 42594 (GC) (St. John)

Hippomane mancinella L. 43438, Bigelow Beach. Also seen a N. end of North Beach. (LC) (St. John)

Jatropha multifida L. 43875 (cult.)

Pedilanthus tithymaloides (L.) Poit. subsp. **angustifolius** (Poit.) Dressler 43845, Pinguin Ghut. (St. John)

P. tithymaloides subsp. parasiticus (Kl. & Gcke.) Dressler 43906 (cult.)

Phyllanthus amarus Schum. 43429 (St. John)

Ricinus cummunis L. (sight; eradicated as a noxious weed) (St. John)

Savia sessiliflora (Sw.) Willd. 43466, 43710, 48809 (GC) (St. John)

Securinega acidoton (L.) Fawc. & Rendle 43440, slopes behind Bigelow Beach.

Tragia volubilis (L.) 42523 (GC,GD,LC) (St. John)

FLACOURTIACEAE – **Samyda dodecandra** Jacq. 42000, 43679 (GC) (St. John)

GOODENIACEAE – **Scaevola plumieri** (L.) Vahl 42610, North Beach. (St. John)

S. sericea Vahl 48360, 48827 (cult.at Guana Island Club)

GUTTIFERAE (Clusiaceae in "Flora of St. John")

– **Clusia rosea** Jacq. (sight, summit area, Guana Peak; also cult. near Grenada House) (St. John)

LABIATAE (Lamiaceae in "Flora of St. John")

– **Leonotis nepetifolia** (L.) Ait. 43434 (St. John)

Plectranthus amboinicus (Lam.) Spreng. 43427, naturalized near Guana Island Club but not seen flowering at any time.

Salvia serotina L. 42512, in sandy soil near White Bay. (St. John)

LAURACEAE – **Ocotea coriacea** (Sw.) Britton 43684, 44906, base of hill SE. of White Bay. (St. John)

LEGUMINOSAE (Fabaceae of "Flora of St. John") Here divided in three subfamilies.

Caesalpiniodideae –

Bauhinia monandra Kurz 43897, 48834 (becoming naturalized)

Caesalpinia bonduc (L.) Roxb. 43447, S. end of White Bay. (St. John)

C. pulcherrima (L.) Sw. 43859 (Naturalized) (St. John)

Chamaecrista glandulosa (L.) Sw. var. **swartzii** (Wikstr.) Irwin & Barneby 42551, 43855 (St. John)

Maematoxylon campeehianum L. 47330 (naturalized)

Hymenaea courbaril L. (sight, Quail-dove Ghut) (St. John)

Parkinsonia aculeata L. 48829 (cult.) (St. John)

Senna bicapsularis (L.) Roxb. 42654 (St. John)

S. occidentalis (L.) Link 43692 (St. John)

Tamarindus indica L. 42516, 48825 (very large planted trees next to agricultural area, becoming naturalized) (St. John)

Faboideae – **Abrus precatorius** L. 43446 (GC) (St. John)

Alysicarpus vaginalis (L.) DC. 42635 (St. John)

Canavalia rosea (Sw.) DC. 42616 (GD) (St. John)

Centrosema virginianum (L.) Benth. 43393, 48359 (GD) (St. John)

Crotalaria incana L. 43405 (St. John)

C. lotofolia L. 43852, 48362 (St. John)

Desmodium glabrum (Mill.) DC. 46520 (St.John)

D. incanum DC. 42589 (St. John)

D. procumbens (Mill.) Hitchc. 42589 (LC) (St. John)

D. triflorum (L.) DC. 46552 (St. John)

Erythrina variegata (L.) DC. vari. orientalis (L.) Merrill 48839 (cult.)

Galactia dubia DC. 42573, 43406 (St. John)

G. eggersii Urban 42529 Endemic to St. John, St. Thomas, Tortola, and Guana

G. striata (Jacq.) Urban 42538, 48387 (St. John)

Gliricidia sepium (Jacq.) Kunth ex Walp. 42644 (planted, becoming naturalized) (St. John)

Indiogofera suffruticosa Mill. 42649 (St. John)

Pictetia aculeata (Vahl) Urban 42013, 43474 (GC) (St. John)

Piscidia carthagenensis Jacq. 43392, 48815 (GC,GD) (St. John)

Poitea florida (Vahl) Lavin (formerly Sahinea florida) 43685, 44907, base of hill SE. of White Bay; 43705, Grand Ghut; 48818, N. slope of Pyramid Hill. (St. John)

Rhynchosia minimia (L.) DC. 42647 (St. John)

R. reticulata (Sw.) DC. 42011 (GD) (St. John)

Stylosanthes hamata (L.) Taub. 42646 (LC) (St. John)

Tephrosia cinerea (L.) Pers. 43853, Monkey Point. (GD) (St. John)

T. noctiflora Bojer ex Baker 46674, 48363, along road below Grenada House.

Teramus labialis (L.f.) Spreng. 48386 (St. John)

Mimosoideae – **Acacia macracantha** M. & B. ex Willd. 42641 (LC) (St. John)

A. muricata (L.) Willd. 42653, 43469,. NW ridge of Guana Peak. (St. John)

A retusa (Jacq.) Howard 42656, 48810 (GC) (St. John)

Desmanthus virgatus (L.) Willd. 42648 (GD) (St. John) Very small or stunted examples of this species have been called D. depressus M.&B. ex Willd; such plants on Guana Island are represented by no. 42640.

Leucaena leucocephala (Lam.) de Wit 43457 (St. John)

Pithecellobium unguis-cati (L.) Benth. 42585 (GD) (St. John)

Samanea saman (Jacq.) Merrill 43691 (planted, becoming naturalized) (St. John)

LOGANIACAEA – **Spigelia anthelmia** L. 43860 (St. John)

LORANTHACEAE – **Dendropemon caribaeus** Krug & Urban 42012, 42562 (GC) (St. John)

LYTMRACEAE – **Ginoria rohrii** (Vahl) Koehne 43473, Palm Ghut. (St. John)

MALPIGMIACEAE – **Bunchosia glandulosa** (Cav.) DC. 42023, 42562, 44912 (St. John)

Meteropterys purpurea (L.) Kunth 43397, 43467 (GC, GD) (St.John)

MOLLUGINACEAE – **Mollugo nudicaulis** Lam. 42517, along track at base of Quail-dove Ghut, appearing only after rains. (St. John) In many publications, Mollugo is included in the Aizoaceae.

MORACEAE – Artocarpus altilis (Parkinson) Fosberg (sight, cult.) "Breadfruit" (Reported to be cultivated on St. John)

Ficus citrufolia Mill. 42613, 43707 (St. John)

MYOPORACEAE – **Bontia daphnoides** L. 42027, thickets behind North Beach. (St. John)

MYRTACEAE – **Eugenia axillaris** (Sw.) Willd. 42524, 47231 (St. John)

E. biflora (L.) DC. 42004, 42019, 43686, 47246, 48819 (St. John)

E. cordata (Sw.) DC. 42527, 42561, 48820, (GC) (St. John)

E. ligustrina (Sw.) Willd. 42657, 43702, upper slopes of Guana Peak. (St. John)

E. monticola (Sw.) DC. 42018, 47231, 48384, 48885 (St. John)

E. procera (Sw.) Poir. 42662, 43687 (St. John)

E. underwoodii Britton 43401, Grand Ghut. A rare shrub otherwise known from but few collections in Puerto Rico.

Myrcianthes fragrans (Sw.) McVaugh 42016, W. side of ridge saddle just S. of summit, Guana Peak; perhaps the tallest tree on Guana Island, with smooth orange bark. (St. John)

Myrciaria floribunda (West ex Willd.) Berg 47243 (St. John)

Psidium gua java L. 43893 (cult.) (St. John)

NYCTAGINACEAE – **Boerhavia coccinea** Mill. 43885 (St. John)

B. diffusa Mill. 45459, 43884 (St. John)

B. erecta L. 43458 (St. John)

Bougainvillea spectabilis Willd. 43903, planted & seminaturalized. (Reported to be cultivated on St. John)

Guapira fragrans (Dum.-Cours.) Little 42007, 43445, 43468 (GD) (St. John)

Neea buxifolia (Hook.f.) Heimerl 46569, near summit of Guana Peak. (St. John)

Pisonia subcordata Sw. 43411, 43490, 44910 (GC, GD, LC) (St. John)

OLACACEAE – **Schoepfia schreberi** J.F. Gmel. 42528, 43680 (St. John)

OLEACEAE – **Choinanthus compacta** Sw. 47245, upper slopes of Guana Peak. (St. John)

Forestiera eggersiana Krug & Urban 42530, 42531, 43435 (GC, GD) (St. John)

Jasminum grandiflorum L. 43894 L. 43894 (cult.)

J. sambac (L.) Sol. in Ait. 43895 (cult., Grenada House)

OXALIDALIDACEAE – **Oxalis corniculata** L. 43864 (St. John)

PAPAVERACEAE – **Argemone mexicana** L. 43403 (St. John)

PASSIFLORACEAE – **Passiflora edulis** Sims 46521 (becoming naturalized) (St. John)

P. foetida L. 43454 (St. John)

P. suberosa L. 42509, 42514 (GC) (St. John)

PHYTOLACCACEAE – **Petiveria alliacea** L. 43450 (St. John)

Rivina humilis L. 42663 (GD) (St. John)

Trichostigma octandrum (L.) H. Walter 43688, base of hill SE. of White Bay. (St. John)

PIPERACEAE – **Peperomia humils** A. Dietr. 42010, 42659, NW. ridge of Guana Peak. (St. John)

P. magnoliifolia (Jacq.) A. Dietr. 42660, near summit, Guana Peak. (St. John)

PLUMBAGINACEAE – Plumbago auriculata Lam. 43896 (cult.)

P. scandens L. 43444, ravine behind Bieglow Beach. (St.John)

POLYGONACEAE – **Antigonon leptopus** Hook. & Arn. 43421 (naturalized) (St. John)

Coccolaba uvifera (L.) L. 43396 (naturalized) (St. John)

PORTULACACEAE – **Portulaca oleracea** L. 43862 (St. John)

P. pilosa L. 48817, near NW. point

(P. teretifolia Kunth GD)

(Talinum fruticosum (L.) Juss. GD, St. John)

Malpighia emarginata DC. (sight, cult.) (St. John)

M. woodburyana Vivaldi 47241, Grand Ghut. (S) (St. John)

Stigmaphyllon emarginatum (Cav.) A.Juss. 42588 (GC, GD, LC) (St. John)

MALVACAEA – **Abutilon umbellatum** (L.) Sweet 43902, 44909 (St. John)

Bastardia viscosa (L.) Kunth 43426 (var. viscosa) (St. John)

Bastardiopsis eggersii (Baker f.) Fuertes & Fryxell (formerly known as Sida eggersii)

43706, 44428, Grand Ghut (23 trees counted; subsequently others have been found elsewhere on the island). This rare species is endemic to Culebra, Tortola, Jost Van Dyck, Guana, and Ginger Islands. It is reported to be cultivated on St. John.

Hibiscus rosa-sinensis L. (cultivars) (sight, cult.)

M. schizopetalus (Masters) Hook.f. (sight, cult.; phot D. Jarecki)

Malvastrum americanum (L.) Torr. 43877, 48404 (St. John)

M. corchorifolium (Desc.) Britton ex Small 42627 (St. John)

M. coromandelianum (L.) Garcke 42579 (St. John)

Sida acuta Burm.f. 44908 (St.John)

S. ciliaris L. 42554 (St. John)

S. glabra Mill. 43901 (St. John)

(S. glomerata Cav. has been found on Great Camanoe and George Dog) (St. John)

S. repens Domber ex Cav. 42620 (St. John)

Sidastrum multiflorum (Jacq.) Fryxell 42570 (GC, GD, LC) (St.John)

Thespesia populnea (L.) Sol. ex Correa 43851, beach area E. of Monkey Point. (St. John)

MELIACEAE – Azadirachta indica A. Juss 48401, 48832 (planted near Guana Island Club) "Neem" (reported to be cultivated on St. John)

Swietenia mahagoni (L.) Jacq. 45388, planted and well established at lower end or road to Guana Island Club. (St. John)

PUNICACEAE – Punica granatum L. "Pomegranate" 48836 (cult. & escaping)

RHAMNACEAE – **Colubrina arborescens** (Mill.) Sarg. 42624 (LC) (St. John)

C. elliptica (Sw.) Briz. & Stern 42578, 47239 (St. John)

Gouania lupuloides (L.) Urban 42584 (St. John)

Krugiodendron Ferreum (Vahl) Urban 42587 (GC) (St. John)

Reynosia guama Urban 43709, Grand Ghut. (GC) (St. John)

RHIZOPHORACEAE – **Rhizophora mangle** L. (sight; photo D. Jarecki) Lagoon, rare. (St. John);

RUBIACEAE – **Chiococca alba** (L.) Hitchc. 43708, 43866, Grand Ghut. This material is anomalous in having 4-parted flowers. Normally in this species the flowers are 5-parted. (St. John)

Erithalis fruticosa L. 43475 (St. John)

Exostema caribaeum (Jacq.) Schult. 41999 (GC, GD) (St. John)

Guettarda odorata (Jacq.) Lam. 43401, 43698 (St. John)

G. scabra (L.) Vent. 47237, Grand Ghut. (St. John)

Psychotria brownei Spreng 47234, 48833 (St. John)

P. microdon (DC.) Urban 41999, NW ridge of Guana Peak. (GC) (St. John)

Randia aculeata L. 43391 (GC, GD, LC) (St. John)

Rondeletia pilosa Sw. 42017, 42603 (St. John)

Scolosanthus versicolor Vahl 42560, hillside NE. of Guana Island Club; 43697, Palm Ghut. (GC) (St. John)

Spermacoce assurgens Ruiz & Pav. 42511, 42636, 43888 (St. John)

RUTACEAE – **Amyris elemifera** L. 42009, 42532, 43888 (GC) (St. John)

Citrus aurantifolia (Christm.) Swingle 43690 (naturalized) (St. John)

Zanthoxylum martinicense (Lam.) DC. (sight, Quail-dove Ghut) (St. John)

SAPINDACEAE – **Cardiospermum halicacabum** L. var. **microcarpum** (Kunth) Blume 42520

Melicoccus bi jugatus Juss. 43695 (planted old tree) (LC) (St. John)

Serjania polyphylla (L.) Radlk. 42622 (GC) (St. John)

SAPOTACEAE – Manilkara zapota (L.) van Royen 48826 (cult.) (Reported to be cultivated on St. John)

Sideroxylon foetidissimum Jacq. 47238, Grand Ghut; 48364 (St. John)

S. obovatum Lam. 42597, 43433, 44911 (GC) (St. John)

SCROPHULARIACEAE – **Bacopa monnieri** (L.) Pennell 42634, along SW. border of lagoon. (St. John)

Capraria biflora L. 42625 (St. John)

Russelia equisetiformis Schlect. & Cham. 43907 (cult., photo D. Jarecki) (GC)

SOLANACEAE – **Capsicum frutescens** L. 47232 (GD) (St. John)

Cestrum laurifolium L'Her. 42655 (St. John)

C. nocturnum L. 48835 (cult.)

Physalis angulata L. 43486, 43487 (St. John)

Soanum americanum Mill. 43455 (St. John)

S. polygamum Vahl. 41997, 42533, 43443 (GC) (St. John)

S. racemosum Jacq. 42008, 42515, 44405, (GC, GD, LC) (St. John)

S. torvum Sw. 43681 (St. John)

STERCULIACEAE – **Ayenia insulaecola** Cristóbal 43428, 43471, 44880 (GD, LC) (St. John)

Helicteres jamaicensis 64576q. 42569 (St. John)

Melochia nodiflora Sw. 43476 (St. John)

M. tomentosa L. 42626 (GC, GD, LC) (St. John)

Waltheria indica L. 42577 (St. John)

SURIANACEAE – **Suriana maritima** L. 42611, North Beach. (St. John)

THEOPHRASTACEAE – **Jacquinia arborea** Vahl 42596, 42609 (GD, LC) (St. John)

A. berterii Spreng. 41998, 42026, 46524 (GC) (St. John)

TILIACEAE – **Corchorus aestuans** L. 43482 (St. John)

C. hirsutus L. 42648 (GC, GD, LC) (St. John)

C. siliquosus L. 43483 (St. John)

TURNERACEAE – **Turnera ulmifolia** L. 46568 (St. John)

ULMACEAE – **Celtis iguanaea** (Jacq.) Sarg. 47240, Grand Ghut. (St. John)

Trema micranthum (L.) Blume 43488, S. end of plain E. of White Bay. (St. John)

URTICACEAE – **Pilea microphylla** (L.) Liebm. 43898 (garden weed, rare) (St. John)

P. microphylla var. **succelenta** Griseb. 43850, E. side, Monkey Point.

P. microphylla var. **trianthemoides** (Sw.) Griseb. 43874 (cult. & naturalized, Grenada House & vicinity).

P. tenerrima Miq. 42615, N. end of North Beach, sheltered among stones near the sea. (St. John)

VERBENACEAE – **Citharexylum fruticosum** L. 42582, 47249, (GD, LC) (St. John)

Clerodendrum aculeatum (L.) Schtdl. 46263 (LC) (St. John)

Lantana involucrata L. 42605 (LC) (St. John)

L. urticifolia Mill. 42583, 44899, (GC, GD, LC) (St. John)

Lippia nodiflora (L.) Michx. 42639, on low moist ground NE. of White Bay.

Priva lappulacea (L.) Pers. 42628 (St. John)

Stachytarpheta jamaicensis (L.) Vahl 43481 (St. John)

VITACEAE – **Cissus trifoliata** (L.) L. 43693 (LC) (St. John)

C. verticillata (L.) Nicolson & Jarvis 42614, 43694 (form with red & orange flowers; 43876 (form with greenish-cream flowers) (GC) (St. John)

ZYGOPHYLLACEAE – **Guaiacum officinale** L. 43858 (perhaps planted; five other possibly wild trees also seen) (St. John)

Kallstroemia maxima (L.) Hook. & Arn. 43416 (St. John)

K. pubescens (G. Don) Dandy 43905 (St. John)

ANGIOSPERMAE – MONOCOTYLEDONAE

AGAVACEAE Circumscription of this family follows that of Howard in "Flora of the Lesser Antilles" (1979).

– Agave angustiofolia Haw. 43890 (cult.) Probably native of Mexico.

A. beauleriana Jacobi (sight, cult.)

A. missionum Trel. 43413, 43699 (GC, GD) (St. John) This species is endemic to the Virgin Islands (except St. Croix) and Puerto Rico.

Dracaena fragrans (L.) Ker-Gawl. (sight, cult.) Native of Africa.

Sansevieria trifasciata Prain (sight, cult. & naturalized) (St. John)

Yucca aloifolia L. (sight, cult.) Originally described from Jamaica; widely naturalized in the West Indies. (St. John)

Y. guatemalensis Baker (sight, cult.) In Guatemala, the flowers are commonly eaten in a type of omelet.

AMARYLLIDACEAE – Hymenocallis expansa (Herb.) Herb. 43891 (cult.) The similar H. caribaea (L.) Herb. occurs on Anegada and St. John. In H. caribaea, the perianth tube is 4-6.5 cm. long, shorter than the segments, while in H. expansa the perianth tube is 8-11 cm. long, with segments 9-15 cm. long.

Zephyranthes puertoricensis Traub (sight) Although native to the region, it is not known if this white-flowered "zephyr lily" was introduced to Guana Island, where it is very rare.

ARACEAE – No indigenous Araceae have been observed on Guana Island. Anthurium crenatum (L.) Kunth, A. grandifolium (Jacq.) Kunth, and Epipremnum aureum (Lindl. & Sndré) Bunting have been seen under cultivation.

BROMELIACEAE – **Bromelia pinguin** L. 43846, Pinguin Ghut. (St. John)

Hohenbergia antillana Mez in DC. 44881 (cult.) (S) The Guana Island plants were introduced many years ago from Scrub Island. The species is otherwise endemic to mainland Puerto Rico.

Pitcairnia angustifolia Ait. var. **guanaensis** Proctor var. nov. Flores luteolus a var. angustifolius differt. Differs from var. angustifolius in having pale yellow (instead of red) flowers. 47242 (SJ), holotypus, collected 27 Oct. 1991. This variety appears to be endemic to Guana Island. The usual red-flowered variety occurs on George Dog and St. John, but has not been found on Guana Island.

Tillandsia fasciculata Sw. 42652, near summit of Guana Peak. (St. John)

T. utriculata L. 42602, widespread and common. (GC, GD, S) (St. John)

COMMELINACEAE – **Callisia fragrans** (Lindl.) Woodson 43417 (cult. & escaping) (GC) (St. John)

C. repens (Jacq.) L. 42533 (GC) St. John)

Commelina diffusa Burm.f. 43904

C. erecta L. 42552 (GC, GD, S) (St. John)

Tradescantia pallida (Rose) Hunt 43422 (cult. & becoming naturalized)

T. spathacea Sw. (sight, cult.) (St. John)

CYMODOCEACEAE – **Syringodium filiforme** Kütz. 44914 (St. John)

CYPERACEAE – **Cuperus confertus** Sw. 43878

C. nanus Willd. 42020, 42025, 42567 (LC) (St. John)

C. planifolius L.C. Rich 42565, 43439 (GD, LC) (St. John) The closely related C. brunneus Sw. has been found on Little Camanoe

C. rotundus L. 42629, 43865 (St. John)

C. unifolius Böcklr. 42513, 42566, 43700, 43848 Closely related to C. filiformis Sw. of the Greater Antilles but has much shorter spikelets.

Fimbristylis cymosa R. Br. 42519 (LC) (St. John)

(Scleria lithosperma (L.) Sw. has been collected on Great Camanoe and Scrub Islands) (St. John)

GRAMINEAE (Poaceae of "Flora of St. John")

- **Anthephora hermaphrodita** (L.) Ktze. (GC) (St. John)

Bothriochloa pertusa (L.) A. Camus 42544 (St. John)

Bouteloua americana (L.f.) Scribn. 42508 (LC) (St. John)

Brachiaria adspersa (Trin.) Parodi (Urochloa adspersa in "Flora of St. John") 42549, 43477, 43879, 43880 (St. John)

B. fasciculata (Sw.) S. T. Blake (Urochloa fasciculata in "Flora of St. John") 42543 (St. John)

Cenchrus echinatus L. 43410 (GC, LC) (St. John)

C. incertus M.A. Curtis 43409

Chloris barbata Sw. (often know as C. inflata Link) 42547 (GC, GD) (St. John)

Cynodon dactylon (L.) Pers. 43451 (St. John)

Dactyloctenium aegyptium (L.) Beauv. 42518 (St. John)

Digitaria bicornis (Lam.) R. & S. 43881 (GC)

D. ciliaris (Retz.) Koeler 42507 (St. John)

D. eggersii (Hack.) Henr. 47251, 48361, 48814, 48822 Originally described from St. Thomas, this rare species is otherwise known only from Virgin Gorda and the Sierra Bermeja in southwestern Puerto Rico.

D. insularis (L.) Mez ex Ekman 43404, 46522 (St. John)

Eleusine indica (L.) Gaertn. 42559, 43883 (St. John)

Eragrostis ciliaris (L.) R. Br. 42536 (GC) (St. John)

(Lasiacis divaricata (L.) Hitchc. Great Camanoe (St. John)

Oplismenus hirtellus (L.). Beauv. 42661, upper slopes of Guana Peak. (St. John)

Panicum maximum Jacq. (Urochloa maxima in "Flora of St. John") 42546 (St. John)

Pappophorum pappiferum (Lam.) Ktze. 42600, Muskmelon Bay Beach. Elsewhere in the Virgin Islands known only from Carrot Rock and a very old (1880-81) record from St. Thomas. It is also known from a single locality in western Puerto Rico, and from

Mona Island. Otherwise, this rare species has a broad range almost throughout the neotropics.

Paspalum laxum Lam. 43432 (GC, GD, LC) (St. John)

P, molle Poir. in Lam. 42545 (St. John)

P. pleostchyum Doell 42599, S. end of Muskmelon Bay Beach.

(P. plicatulum Michx., found on Little Camanoe)

P. setaceum Michx. var. **ciliatifolium** (Michx.) Vasey 43887, in sandy field near White Bay.

P. vaginatum Sw. 43412 (St. John)

(Setaria setosa (Sw.) Beauv. has been found on GC, GD, and LC; also St. John)

S. utowanaea (Scribn. ex Mills.) Pilg. 46523, along crest of ridge between Guana Island Club and Muskmelon Bay, in rocky woodland, rare. (GC, LC) (St. John)

Spartina patens (Ait.) Muhl. 43431, North Beach. (S) (St. John) This species apparently never flowers in the West Indies.

Sporobolus indicus (L.) R. Br. 48813, hill E. of Muskmelon Bay, in a gravelly clearing. (GC, LC) (St. John)

S. virginicus (L.) Kunth 43696, 43854 (LC) (St. John)

Tragus berteronianus Schult. 42595 (St. John)

HYDROCHARITACEAE – **Halophila decipiens** Ostenf. 44904, on sandy sea-bottom just S. of Monkey Point, depth c. 20m.

Thalassia testudinum Banks & Solander 44900, North Beach, in shallow sandy sea-bottom (St.John).

LILIACEAE (circumscription according to Howard, "Flora of the Lesser Antilles", 1979; however, the two included genera are obviusly not closely related)

– Aloe vera (L.) Burm.f. (sight, cult.) (St. John)

Asparagus densiflorus (Kunth) Jessop 43889 (cult.)

ORCHIDACEAE – **Epidendrum ciliare** L. (sight, near summit of Guana Peak; also cult. at Guana Island Club (St. John)

Psychilia macconnelliae Sauleda 42571 (GC) (St. John) Mostly restricted to the Virgin islands & Vieques but also reported from St. Kitts.

(Tetramicra canaliculata (Aubl.) Urban has been found on George Dog and several other Virgin Islands (St. John). It is also known from Florida, Hispaniola, Puerto Rico, and the Lesser Antilles.

Tolumnia prionochila (Kraenzl.) Braem. (formerly Oncidium prionochilum) 43678 (GC) (St. John) Endemic to the Virgin Islands and Culebra.

PALMAE (Arecaceae in "Flora of St. John")

– Several exotic species of palm have been introduced to Guana Island from time to time, including Chrysalidocarpus lutescens Wendl., Cocos nucifera L., and Veitchia merrillii (Beccari) H.E. Moore.

Coccothrinax alta (O.F. Cook) Beccari 41996 (St. John) This was erroneously reported as a species of Thrinax by Lazell (1983). C. alta is endemic to the Virgin Islands and Puerto Rico.

Sabal causiarum (O.F. Cook) Beccari 42022, in thickets behind North Beach; also occurs near the lower end of Grand Ghut and along the top of the sea-cliffs at the northernmost end of the island. It appears to be absolutely indigenous at all these sites. This species occurs elsewhere in the Virgin Islands only on Anegada; otherwise its range includes western Puerto Rico and scattered localities in southern Hispaniola.

PANDANACEAE – Several cultivated species, not identified.

RUPPIACEAE – **Ruppia maritima** L. 48402, in saline lagoon. (St. John)

SMILACACEAE – **Smilax coriacea** Spreng. 47244, on ridge leading to Palm Point, very rare. (St. John)

United States Department of Agriculure Forest Service PO Box 1377 Luquillo PR 00773-1377

Dr. James D. Lazelle
The Conservation Agency
6 Swainburne Street
Conanicut Island, RI 02835

Nove. 15, 1997

Dear Skip:

I want to thank you, The Conservation Agency, and its sponsors for making my October collecting trip to Guana Island possible. I made 112 collections during my stay, mostly from Guana Island, but a dozen were from Tortola. Among the collections are a number of valuable, rare species that have never been documented before in the Antilles, and some that are probably new taxa. One of the most exciting finds was from the forest just outside the entrance of the Sage Mtn. park on Tortola. This was the yellow mushroom that stained blue, which I had thought was a halucinogenic species of Psilocybe because of the staining reaction (photo enclosed). It appears to be close to *Lepiota sulphurocyanescens* Franco-Molano, only recently described from Central America. This group is especially interesting evolutionarily, and my colleauge at the University of Puerto Rico, Dr. Steve Rehner, is planning to obtain DNA sequences from it.

We obtained collections of two rare, beautiful, large species of *Volvariella* on Guana Island. A photo of the yellow one, collected in North Bay woods, is enclosed. These mushrooms fruit very rarely, so the collections are of great value. Some of these species are cultivated on wood for food in China, and are delicacies.

I was especially impressed at the diversity of Phallales (stink horn fungi) on Guana Island. I found four species on Guana and Tortola, *Clathrus* cf. *crispus* (the red buckyballs), *Gelopellis* sp. (a non-opening stinkhorn), *Mutinus* bambusinus (photo enclosed), and an unidentified species of *Lysurus* aff. *borealis* (photo enclosed). These have just been delivered to Dr. Orson K. Miler for determination of the species, and parts of the others have been sent to Dr. Joseph Spatafora for DNA sequencing. The specimen of *Gelopellis* is particularly valuable to Dr. Spatafora who is determining the evolutionary relationships among the stinkhorns, puffballs, and normal mushrooms.

The most impressive and valuable group of fungi collected from Guana island were those that form ectomycorrhizae, a beneficial symbiotic relationship, with roots of beach grape (*Coccoloba uvifera*) and *Pisonia* sp. Guana is unusual in having such well preserved dry forest habatat, and a very high density of large*Pisonia* trees. Before we started our project to obtain

a basidiomycete mycota for the Greater Antilles, the only islands for which we had reports of ectomycorrhizal fungi were Cuba and some of the Lesser Antilles. I have enclosed photos of the *Boletus* sp. from North Bay woods (the one that has like blue-staining yellow sponge-like structure below the cap instead of gills), and a species of *Russula*. I also collected a species of *Hebaloma*, *Scleroderma*, an *Amanita* in the vaginata group, and *Cantharellus cinnabarinus* that formed mycorrhizal symbioses with trees on Guana island. The latter species is a beautiful coral color (photos being developed), they have an odor of apricots, and a delightful flavor. These are the Chantrelles of French culinary fame.

In addition to the species mentioned above, two of the soft polypores were so interesting that Dr. Karen Nakasone and I would like to return to Guana Island in December for a day or so to recollect and culture them. One, found along the ridge trail near the peak, has beautiful yellow pores and has characteristics of two genera, *Ganoderma* and *Amauroderma*. It will take comparison of DNA sequences and mating tests to determine what this is. The other species was found to be decaying or parasitizing roots of trees that were injured by the recent hurricanes in North Bay Woods on Guana, and in the Botanic Garden in Tortola. I beleive I colellected this once before following Hurricane Hugo on St. John, but that specimen was in too poor a condition to identify. Parts of these polypore collections have gone to Prof. Leif Ryvarden in Norway, the world's expert on tropical polypores. Another part has gone to the Center for Forest Mycology Research in Madison WI, where a study is underway of species in this complex. Because these fungi are ephemeral and fruit very rarely, it is possible that they represent new species or varieties.

I have also enclosed prints of three other photogenic fungi from Guana and Tortola. I am still awaiting the developing of the field photos, so there are many more to come. The earth star and the lovely orange gelatinous mushroom (*Heimiomyces rheicolor*) were found near the Sage Mtn. park on Tortola. The orange one is restricted to and characteristic of moist forest in the Caribbean. The lovely pink to purple-red *Marasmius haematocephalus* was also from Tortola, but less photogenic specimens were also observed along the Guanaberry trail on Guana Island. These fungi hold leaf litter together with root-lke structions and are important fo retaining leaf litter on steep slopes during heavy rainstorms, therby protecting the soil surface from erosion. Preventing erosion is important to maintaining soil fertility, tree growth, and preventing siltation of the reefs. We would like to explore further the possibility of producing a small color guide to the more interesting and beautiful fungi on Guana and Tortola islands.

Thank you again for your assistance in making the October collecting trip possible, and for assisting in setting up a short return trip in December. I will be back in touch around Dec. 1-2, after I return from the Dominican Republic.

Sincerely,

D. Jean Lodge, Botanist (mycologist)
Center for Forest Mycology Research

P.S. - I've also enclosed the slides of the bat. The shots from the other camera will come later.

United States Department of Agriculture | Forest Service | Forest Products Laboratory | PO Box 1377 Luquillo, PR 00773 USA

24 April 1998

Dr. James Lazell
The Conservation Agency
6 Swainburne Street
Jamestown, RI 02835

FAX 401-423-2396

Dear Dr. Lazell:

The trip by Dr. Karen Nakasone and me to Guana Island in December was a success, and we were able to obtain cultures and additional collections of the target polypore species. Our colleauge in Norway discovered by looking at the scanning electron micrographs of the beautifully honeycomb-ornamented spores that it was a described species afterall, but of a rare tropical genus. It is known as *Humphreya coffeatum*, and ours are the first cultures ever of this species. The cultures are of great value for two reasons. First, it will allow Jean-Marc Moncalvo of Duke University to obtain ribosomal DNA sequences of it, and answer an evolutionary riddle about it's relationship with other genera in the family Ganodermataceae. Second, all members of the Ganodermataceae are sought after by programs screening for anti-cancer drugs, since *Ganoderma lucidum* has been found to have active compounds in this regard.

We photographed and cultured *Ganoderma resinaceum* in December. This is an interesting record because it is the European/N. African counterpart of our N. American species, *G. lucidum*. It is suspected that the Virgin Islands and the Lesser Antilles may receive spores and insects from storms originating in Africa, which may explain how this old-world species colonized Guana Island. In addition, we collected *Ganoderma nitidum*, a species described from N. America almost a century ago. From what I can deduce from the literature, this species was synonymized with another and forgotten, but our Norwegian expert, Prof. Leif Ryvarden, is apparently reinstating it. In addition to the polypore fungi mentioned above, Karen Nakasone also collected and cultured about 10 species in the Corticiaceae, but these have not yet been identified.

Thank you and the Conservation Agency for your assistance in making that trip possible.

Sincerely,

D. Jean Lodge

Subject: Thankyou Mr. Skip Lazell
Date: 97-11-06 09:47:44 EST
From: tamarin@caribsurf.com (Tamarin Charters)
To: jcinjtown@aol.com

File: Ind. Study Report #2 Revised.doc (12287 bytes)
DL time (14400 baud): < 1 minute
Hello Skip Lazell,
Thankyou very much for the tour of Guana Island. Gary and I found it most interesting. I especially liked the salt pond and it's wildlife. The lunch was wonderful, and your company very pleasant.

Attached is my report for my independent study. I enjoyed writing it f Guana Island. because I had a lot of good information to choose from.

When you get a chance, send me your list of The Conservation Agency writings please.

Hope you are having a nice fall. Take care, Beth Kiela

Captain Gary and Beth Kiela
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Objective #1 of my independent study is: An investigation of the native species of selected Virgin Islands, and their assemblages.

Tortola and The British Virgin Islands are part of a group of islands called The Puerto Rico Bank. This group, including all islands from Puerto Rico to Anegada (BVI) but excluding St. Croix, forms a geographical, geological, and biological province and share many natural characteristics. During glacial periods, the water receeded more than 100 meters, connecting the land, providing a bridge for plants and animals. In the last 6000 years of interglacial time, separation occured of species which may have forced some populations to extinction, and a few new species have been created (Acevedo-Rodriquez, 1996; and Lazell, 1996). There is a very low percentage of endemic species to individual islands due to their interglacial connections. When considered as a group, however, Puerto Rico and the Virgin Islands are rich in endemics like other oceanic islands isolated from continents. Less than 1% of the vegetation is virgin, having been cleared for agriculture during the European establishment. The secondary growth differs in many species, and exotics have naturalized, now appearing native (Little, Woodbury, and Wadsworth, 1974).

The natural assemblages, or communities of flora and fauna, are also called "Terrestrial Life Zones". According to the Survey of Conservation Priorities prepared by the Eastern Caribbean Natural Area Management Program in 1980, there are the following life zones in the BVI. Starting at the highest elevation, there is the moist forest, the dry woodland, the cactus scrub, littoral vegetation, and the mangrove - the vegetative connecting link between land and sea. This survey consists of a series of resource data maps, another of which is entitled, "Endangered and Locally Important Species". A new BVI terrestrial inventory may begin in 1998 by the National Park Trust (NPT). In 1993, Island Resources funded the Coastal Resource Atlas of the BVI, grouping marine life into assemblages. This mapped information has been shared with HLStoutt Community College (HLSCC), the Conservation and Fisheries Department of the Ministry of Natural Resources and Labour, Government of the BVI (C & F), as well as Town and Country Planning - also BVI Government (T & CP) (and perhaps others). The latter has digitized the information onto GIS maps.

The Joint Nature Conservation Committee produced a series of biodiversity reports for United Kingdom Dependent Territories, including one for the BVI. This report, in draft form as of 1995, has a section abbreviated from the World Conservation Monitoring Centre (Comp.), 1994, Biodiversity Data Sourcebook. According to the Country Species Diversity table, the BVI has 3 mammals, none of which are endemic; 199 total bird species, 70 breeding, and 0 endemic; 18 reptiles, 3 are endemic; 5 amphibians, with 1 endemic; and 0 freshwater fish. Plants and sealife were not surveyed. (According to Lazell, 1996, there are 4 native species of mammals on Guana Island, all bats; and more than 125 species of fish observed close to it's shore.) The Threatened Species table lists 2 birds, 5 reptiles, 1 amphibian, and also 5 plants.

There are many projects under way to establish and monitor the native species of the BVI. HLSCC has a student that did a project on native plants, summer '97, growing several from seeds and cuttings. The intent is to expand the number of plant types, plant them around campus with identifying signs, propagate and eventually sell them to the public (Seema Lutchman - the student, personal communication, July, 1997). There are other projects being done by HLSCC professors to reestablish mangroves, native tree boas, and tortoises to name a few. The NPT sells a number of native plants, as well as nonnative, which they have available to the public year round. In November they celebrate Arbor Day with a donation of trees to the local schools (personal communication, Joseph Smith-Abbott, Deputy Director NPT, October, 1997).

The NPT is monitoring the threatened native Roseate Flamingoes, *Phoenicopterus ruber ruber*, on Anegada they helped reintroduce in 1991. This project, in cooperation with (among others) The Conservation Agency (TCA), a privately funded ecological research organization, has successfully produced new hatchlings the last few years. Anagada's Flamingo Pond is protected as a bird sanctuary under The Wild Birds Protection Ordinance, Cap 98 (1959). Also on Anegada is the endangered native Rock Iguana, *Iguana pinguis*, once widespread thoughout the Puerto Rico Bank, now existing on Anegada and Guana Island. (Guana Island is the focal point of TCA's research.) The iguana suffers habitat loss, but is also preyed upon by cats, and rats plus competes for food with goats and cattle on Anegada. The NPT has a weekly feeding program to provide the iguanas with supplementary food. The protection of land for the Rock Iguana on Anegada is under debate due to long standing questions regarding land titles.

Regarding marine species, the C & F is now managing the BVI Fisheries Complex. The February, 1997 newsletter states, "Preliminary stock assessments have indicated declining reef stocks, however, this can be arrested and reversed through stringent management strategies. The near-shore and offshore pelagic stocks (dolphin, tunas, kingfish, and swordfish) are extensive and presently underutilized" (Spotlight On The Environment, vol 3, issue 1, C & F Dept.). Lobster and Queen Conch stocks are reported to have undergone some depletion (Rogers, 1985), and concern is on the rise. Black coral, used for jewelry (and sculpture) is in danger of overcollection (Canoy, 1981). Sea Turtles have a protected season, and have a Recovery Action Plan, written in 1992. On a wider scale, the plan - A parks and Protected Areas System Plan for the BVI's (BVINPT/ ECNAMP, 1986) seeks to "... incorporate the existing parks into a larger system of comprehensive ecological units." Additionally, the Marine Parks and Protected Areas Ordinance (1979) allows a marine park to include adjoining land as required to make an ecological unit or units.

In conclusion, the native species of the BVI have been and are in the process of being recorded, monitored and reestablished. Legislation is ongoingly being updated as more information is produced by reports and projects. Exotic species have a strong foothold on the islands, continue to be imported and bred, and some are being eliminated over time. There are a number of concerned organizations and individuals who participate in the survival and promotion of the native flora and fauna of the BVI.

This report has been made possible by the assistance of: The National Parks Trust, especially Joseph Smith-Abbott; Conservation and Fisheries Dept. of the Government of the BVI, especially Calvin Penn; The Conservation Agency, especially Skip Lazell; HLStoutt Community College, especially Seema Lutchman, Lianna Jarecki, and Clive Petrovic.

DISTRESS!

James Lazell, 5.xi.97

The number of animals that make distress calls is as remarkable as the number that do not. Consider:

Cave bat, *Brachyphylla cavernarum*, both adult male and female, Guana, 19.x.97: shriek-chattering when handled, very loud. Of course, they roost socially, so a warning to others?

Red-legged tortoise, *Geochelone carbonaria*, adult male, Guana, 28.x.97: cluck-grunting when picked up. Adult female, 24.x.97, does not do it. Release call? Well, male did not do it when I held him down with a foot, only when I picked him up.

Soldier crabs, *Coenobita clypeata*, bigger ones, North Bay woods, Guana, 28.x.97: One out of three chirp-squeak when picked up. No noise when held down.

Cerambycid beetles, three species, Guana, 28.x.97. All of a dozen squeak-whine when picked up. The little (>1cm) guys have to be held up to my ear for me to hear them. The >2cm brown-with-white-spots kind is audible at arm's length. The giant mango borers raise the roof. One I was holding at the orchard attracted an ocelot, two caimans, a small tribe of Tainos, four Masai warriors, and the ghost of Sir Francis Drake. I threw the thing as far as I could, leapt on my golf cart and got outta there.

Anyway, I can't stand any more. I am already auditorially challenged (my doctor says it's just ear wax buildup) and quantitatively challenged (my wife says I'm a moron). I just can't take anymore distress calling. I wake up screaming in the night.

Sent to Kate LeVering, University of Texas, who is writing her doctoral dissertation on distress calling and its adaptive values. Can you imagine / perceive the adaptive values for most of the above?

Proposals: 1998 and Further

Biomass. As we discussed at length last October, this business consumes a large number of bednights -- 180 (six people, full-time, for 30 days) -- and will add to our slush fund costs: we will have to purchase or rent some kinds of equipment like tools (shovels, trowels, chain saw). We hope Guana can provide most of this, but we cannot mess around -- this is not like boat days, where we schedule in advance, then Mr. Worthy I. Gotrocks blows in and all our plans get cancelled to accommodate his -- No. We have to have the equipment when we need it. The schedule on this project is much too tight to screw around with the typical tropo man-yana syndrome we have all come to know and love so well.

Four 100 m² plots -- three in tam-tam, one in North Bay Woods -- will be cleared to bare ground. Everything in them will be quantified. Some will be fenced and some purposefully replanted. The results will be monitored over time.

Vegetation plots. Originally this was conceived as part of the above, but it got started last October by Numi and Glenn, and has its own separate life as a project. Extra funding -- exactly the same as last year -- will be needed to purchase the fencing. Six 100 m² plots are surveyed for all vegetation. They are in three side-by-side pairs selected for similarity. One pair will include the North Bay biomass plot (none will be tam-tam). Three, one of each pair, will be fenced; the other three are "controls" -- Results will be monitored over time. Three pairs were done last year; want to bet we will be able to see the results already?

Ornithology. Our two teams, led by Betty-Anne Schreiber and Fred Sibley are producing some of our best results ever. Because birds are so popular, and because of so much conservation and ecotourism interest, ornithology assumes great importance. Saving an ecosystem for the birds is easier than saving it for iguanas or snakes or spiders but it works perfectly for all of those. Showing that North American migrants visit a site catapults it into international attention. Showing that a striking species, like the stilt, travels from a protected habitat like Guana to an unprotected one like the "small pond at Frank Bay," U.S.V.I., will really help get that small pond protected. Birds are a Big Deal.

This year, we want to bring Stephen Durand, of Dominica Forestry and Wildlife, up to apprentice in ornithology, especially with Fred, but also (as time allows) with Betty-Anne. Stephen was one of the participants in Lianna's summer course a couple years back; that is where we met him. We want for him to soon be able to operate a banding station on Dominica. This will involve the additional expense of a round-trip airfare from Dominica.

We want also to purchase two telescopes for bird work. One would be set aside for scientists' use only. The second would be available year 'round for guests when not needed by scientists. These 'scopes are not solely for bird work. They will also be used

for botany (to see epiphytes and vine foliage, and flowers, high up), and for lizards like Roosevelt giant anoles. They cost about $600.00 each.

Lizard Physiology. This year we are undertaking an ambitious extension of our work: three full months of water loss monitoring. The project will commence at the end of July, when Gad Perry will go to Guana and work daily with Dawn Lutchman (teacher at East End) and Clive Petrovic setting up lizards from Guana, Necker, Sage Mountain, and Paraquita Bay at the community college. Dawn will be in charge of feeding and weighing through August and September -- Clive will assist -- Razi will take over in October, with Dawn and me assisting. The goal is to test the limits of phenotypic plasticity. Dawn will get to coauthor -- maybe senior author -- the resulting paper. She is planning to go on for a master's degree and sees this project as a building bloek in her career. If it works, this will be a dandy.

The Beetle Problem. This one does not cost money. Dr. Mike Ivie, who we have sponsored several times (with his crew) in the past, is holding up progress. Papers he is supposed to coauthor -- even just to the extent of adding a reference or two -- are log-jamming. The worst case is the mordellid paper, alluded to above (last year's cover story). Dr. Greg Mayer did this to me on the skink paper. I solved the problem by writing to the Provost of his University. However, I had two big items on my side: he was actually in possession of museum specimens that did not belong to him (and which he had failed to return in spite of repeated requests and promises), and he was not tenured. My letter got immediate results. Unfortunately, Ivie owns all the specimens and is tenured. I cannot threaten him in either way. I want you to consider writing him a letter as Chairman of Falconwood -- our funding institution -- explaining that results are expected. If that failed, you could then write his Provost, President, whatever. Think about it and we will discuss it after I get back from Africa (no sooner than August).

The Big Symposium. Forgotten for 1999, several of us still think this is a grand idea. Lianna believes she can orchestrate enthusiasm at the CC and within the ranks of BVI Conservation. I think so too. I will try bringing this forward again this October, aiming for 2000.

Bottom Line. I estimate we will need a slush fund this October of about $3,500.00.

I will be in Africa 24 May to early August. I'll be harder to reach than I was in Hong Kong in previous years, but email will get to me c/o

tina.kuklenski@mailexcite.com....

Geastrum sp.

Heimiomyces rheicolor