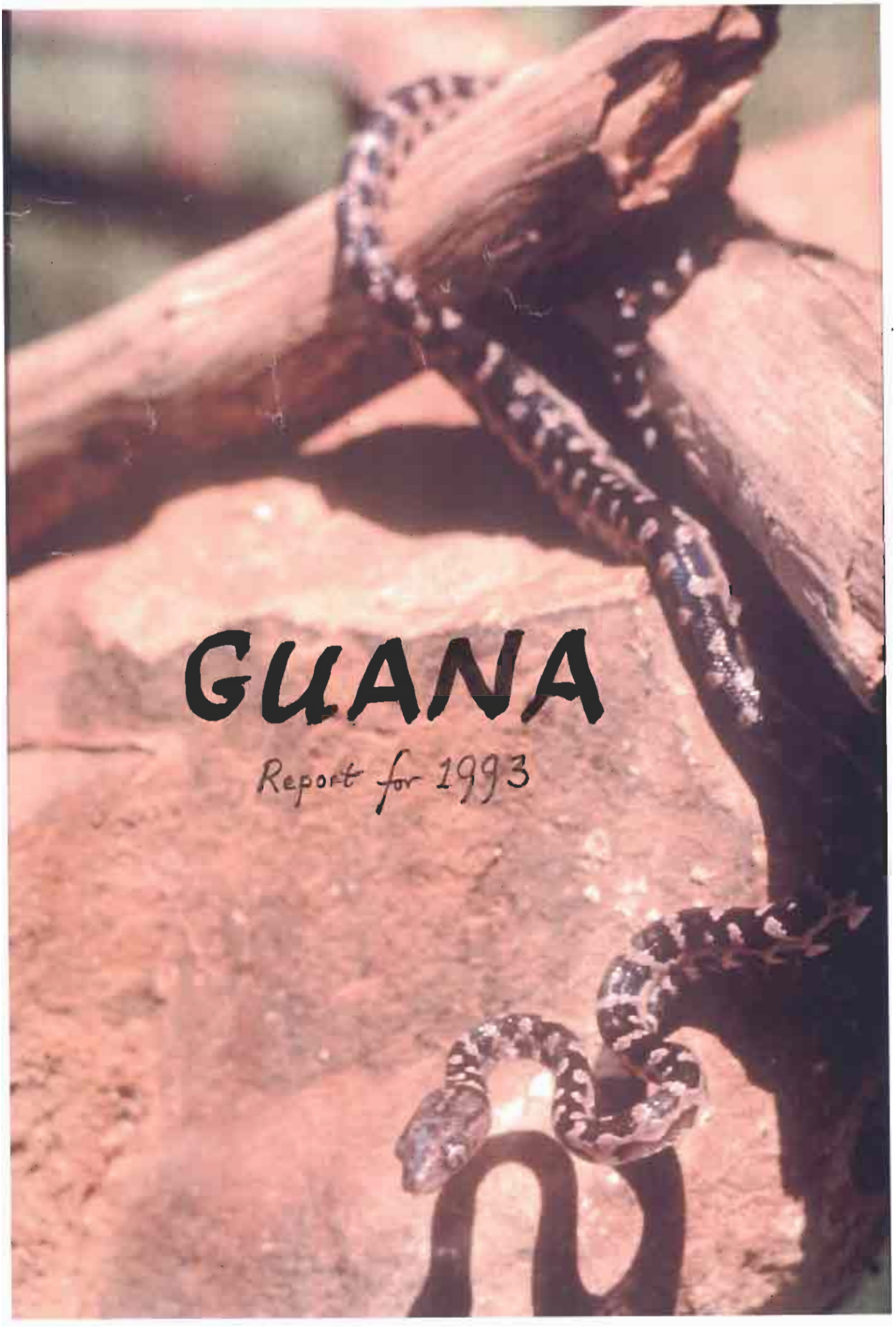


GUANA

Report for 1993

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.

20 April 1994

Dr. Henry Jarecki
Byewood, Timber Trail
Rye, NY 10580

Dear Henry:

Here it is: works and progress for 1993.

Two new species have been described and named, both small wasps:

Coiba guanaensis Marsh, family Braconidae
Thaumatodryinus snellingi Olmi, family Dryinidae

Roy Snelling has been especially productive, publishing another paper, this one on ants. His description of the magnificent, colorful wasp Psorthaspis gloriae is nearing completion, as are other works. Scott Miller is still struggling to get papers done; a new one on bee flies has been submitted and the big one, on moths, is coming along.

Dr. Lou Roth, of Harvard, is describing a new roach. I am sure you are thrilled, but this is a colorful little species of the forest, not at all like the introduced pest species. The termite gang has finally come up with a manuscript; it will be a very important paper once published. We have a bit on spiders, and Scott and I are trying to get a team together to really begin a systematic investigation of this major, but sorely neglected group.

I found an old paper on land snails. Fred Kraus already knew about it, but had not told any of us. One hopes he will someday do something with all the specimens and data he collected.

David Hill got right on the thrasher project and found Wayne Arendt, who is enthusiastic about checking things out in October. David will continue to plan for whistling ducks. Debbie Paul produced exhaustive bird notes which she wants to see made into an annotated checklist, combined with a very accurate map, and made up into a pamphlet for bird watchers. Getting that done was beyond my abilities for this report, but I am on the case - as is Numi, doing the mapping.

The white-crowned pigeon project and funding through Partners in Flight, National Fish and Wildlife Foundation, are underway as I write.

For the first time in history, reproductive and detailed habitat data were collected for our frogs. I am very happy with the frog team and hope they will return. So do they.

Boas created a stir in 1993. Lianna caught one and has it in captivity; it is doing well and growing fast. Everton and Tony Edwards salvaged several dead specimens. They resulted in correspondence and the usual difficulties with The Law and how to work within or around it. The specimens are safe now. All these boas came from Tortola, but Miguel Garcia plans to return in October and finally, definitively locate them on Guana. I have added a published paper on the tortoise mystery, calling attention to Guana.

Razi, Gad, and I have submitted a paper on anole lizards. Guana stands out here, too. And Numi and I published on Guana's 'guanas, on what is now widely acclaimed as the first ever successful attempt to reestablish a population of endangered iguanas. This is bringing us fair measure of fame, if not fortune.

Peter Cannell, Smithsonian Press, wants to do The Book, but expanded into a natural history of the West Indies. He is beginning a series that he hopes will garner the sort of readership that gets around the usual, terminal problems of regional books. In our case, the region itself will never produce sufficient demand to float the cost of publication, so a much broader market must be found and cultivated. Peter's notion is to get his series rolling with, for example, a natural history of Cape Cod and the Islands (which I will write), and then move to more readerless regions, hoping a readership will follow.

* * * *

Next year: There are already 26 people who have contacted me to say they want to come, and that does not include a half dozen that I want to have come (to do, for example, those spiders). Many, however, only want to come for very short periods.(Miguel for boas; and the Sibleys for warblers). At this point it is not worth worrying about numbers and bednights because peoples' plans change so much. I will not let things get out of hand. You were very worried last year, but nothing bad happened.

* * * *

I have saved the worst news for last. You are now the proud owner of a burgeoning population of fire ants, Solenopsis invicta.

Roy got very few in 1992 (one of his unidentified Solenopsis in his paper), but Cyran and Bartlett found fire ants the dominant species in the plantation. Both David Hill and Numi reported bites, and both have lots of experience with fire ants in the southern U.S. The bites are extremely painful. They become quickly inflamed and soon develop into white, puss-filled blisters. In numbers, they are far more scarring than a Singapore caning.

Fire ants often seem to have an uncanny ability to orchestrate their biting efforts until a large number are in place, and then all bite in beautiful synchrony. Fire ants, native to South America, were introduced to the vicinity of Mobile, Alabama, about 50 years ago. They expanded explosively throughout the South and no control or

eradication methods - despite millions spent - have ever had any effect on them. They no doubt came to Guana with Dillingham's exotic plants from Florida, where they are ubiquitous now and abundant.

We can hope fire ants do not become ubiquitous and abundant on Guana, but, as Tom Sinclair says; "When you've got hope you've got nothing." Ah well, we all told you so...

* * * *

CONTENTS

Enjoy!

Slip

The Natural History of Regions
Proposal for a New Book Series
Smithsonian Institution University Press

PROPOSAL SUMMARY

Books in this series will summarize for a semipopular and scholarly audience the natural history of individual regions. A sample outline and a tentative list of potential regions are attached.

FORMAT

The format is 6x9" books of about 300-400 printed pages (approx. 350 ms. pp.), illustrated with 40-50 b&w photographs or line art, and to be sold in the $20 to $35 price range. A signature (8 pages) of 10-15 color photographs may be included, especially if these include compelling illustrative material such as satellite imagery, photographs of key habitats, and so forth.

MARKET

Semipopular and scholarly. Semipopular audience should include general naturalists, travellers (incl. especially ecotourists), public libraries. Scholarly audience should include botanists, zoologists, geographers, anthropologists, archaeologists, paleontologists, conservation biologists, and academic libraries in these fields.

CONTENT

Books will summarize a region's natural history in the broad sense, including geological history and geomorphology, important climatic factors, biota and biotic interactions, anthropology, archaeology, land use history, as well as conservation status and management issues. The text should summarize taxonomic and ecological diversity, and discuss key habitats and species (e.g., ecologically dominant, invasive aliens, endangered, utilized by humans) in some detail.

These books are intended to serve as useful introductions to the natural history of a region. They are not intended to be comprehensive monographs, nor identification guides.

REGIONS

A "region" may be defined by political, geographic, or biotic characteristics, and may be large or small. Each region must be of sufficient interest in terms of market and biological distinctiveness to warrant a book. Examples of possible regions include Cape Cod, the Yucatan Peninsula, the Mediterranean, the Sonoran Desert, the Alps.

AUTHORSHIP

Authorship should be by individuals or, perhaps ideally, by pairs or small teams of authors with differing areas of expertise (e.g., an anthropologist or archaeologist with a zoologist, or a marine biologist with a terrestrial ecologist). In cases of two or more authors, writing must be tightly coordinated.

JUSTIFICATION

For virtually any region, it proves difficult to find sound summaries of the area's natural history. Although general natural history books do exist for some regions, they are frequently quite general, emphasize the location of natural areas over the species and ecology of those areas, are idiosyncratic in format or content, or emphasize photography over information. Many good local guides are not readily available outside of the particular region.

In addition, few existing natural histories integrate anthropology or archaeology, or consider land use, conservation, and management issues. With the maturation of conservation biology, the long term human influence on virtually any region has become more clear, as has the need to consider human relationships in conservation and management considerations.

The intent here is to provide a series of guides of consistent and dependable format and quality. We intend to publicize and distribute these throughout the world. One goal is simply to provide the pleasure of greater knowledge. Another is to enhance an interdisciplinary approach to travel, research, and conservation planning. These goals and this series are well-aligned with the Smithsonian's larger dedication to documenting and understanding human and non-human diversity throughout the world.

Comments and suggestions on the proposal, the outline, the suitability of particular regions, or, most especially, of potential authors are very welcome. Please address comments to

Peter F. Cannell, Science Editor
Smithsonian Institution University Press
470 L'Enfant Plaza, Room 7100
Washington, DC 20560

voice: 202/287-3738 ext. 328
fax: 202/287-3637
internet: sipad002@sivm.si.edu.

Natural History of Regions - Sample Outline

INTRODUCTION

o Introduction: Summary description of region, including author's experience and perspective. This may also be the place for a brief review of natural history and scientific exploration, including reference to classic books or monographs, and key individuals, expeditions, or organizations.

PART I: Geology, Geography, Paleontology

o Physical Environment: geological history, geomorphology, climatology, resources (e.g., water, minerals). Include satellite photo and information from remote sensing where possible.

o Paleontology: fossils, deposits, and history of discovery, where applicable.

PART II: Ecosystems

o Chapters in this section should present integrative discussions of key ecosystems within the region, including key constituent species. Examples might include alpine communities, coral reefs, marshes, sand plains, and so forth. For each, what are defining physical features, and what are characteristic organisms and their interactions?

PART III: Biota

o There may, in addition to habitat-based discussions above, be room for chapters or discussions on particular taxonomic groups, such as fungi, ferns, gymnosperms, angiosperms, invertebrate animals, fish, amphibians, reptiles, birds, and mammals. Topics for taxon-based discussions might include diversity, endemicity, endangered species or groups, unusual adaptations or radiations, or observable phenomenon (e.g., hawk migrations, turtle nesting).

PART III: Anthropology and Archaeology

o Archaeology and Ethnography: Describe archaeological sites, colonization, anthropological history, and extant indigenous peoples.

o Human History: Summary of modern human history as it relates to land use, conservation, and indigenous peoples, colonization and its effects (e.g., extent of agriculture, urbanization), as well as summary of current situation (e.g., parks, preserves, intact habitats, environmental laws or lack thereof), and other potential resources for the traveller (e.g., museums, universities).

PART IV: Conservation and Management

o Conservation Summary: summary of endangered species, peoples, and communities; existing problems; discussion of protected areas and conservation programs; prognosis and recommendations; gap analysis where possible.

Appendices - Resource lists (e.g., park and museum names and contacts)

Bibliography - key references, annotated, by topic and or type (e.g., herpetology, archaeology, popular book, technical article)

Literature Cited

UNIVERSITY OF MARYLAND AT COLLEGE PARK

COLLEGE OF LIFE SCIENCES • DEPARTMENT OF ENTOMOLOGY

.2 November 1992

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

Dear Skip,

Many thanks for facilitating our productive research expedition to Guana Island last month. I sincerely feel that the Guana Island Termite Project is poised to make substantial contributions towards our understandings of aspects of Caribbean termite ecology, behavior, biogeography and systematics. Perhaps we termiters occasionally appeared to be moving in our own swarm, but that team approach was truly an asset in accomplishing our major research goals.

Skip, thanks particularly for the considerable time and effort you have spent assisting our project. We appreciate your efforts to support the work through the Conservation Agency, your help in maximizing our productivity while on the island, and your special attention and patience in rendering Margaret Collins comfortable in the field for as long as possible. All has made a real difference.

Enjoy the winter; I hope to see you in Cambridge or elsewhere - if not, then on Guana again next Fall.

With best wishes,

Barbara

Barbara L. Thorne
Assistant Professor

1300 SYMONS HALL • COLLEGE PARK, MARYLAND 20742-5575 • (301) 405-3911 • FAX (301) 314-9290

1992

United States Department of Agriculture | Forest Service | Pacific Southwest Forest and Range Experiment Station | P.O. Box 245 Berkeley, CA 94701 U.S.A.

Reply to: 4500

Date: November 18, 1993

Mr. Paul Gagne
P.O. Box 245
Jamestown, RI 02835

Dear Paul:

I want to thank you for your help with our termite project on Guana Island this October. Barbara and I are extremely pleased that Skip agreed to have you help Lori instead of someone we had not yet met. She and I felt very confident that we could leave Lori with you as her assistant.

Lori told me that you were a great work companion and that your insight was very helpful. She said that she knew exactly what I wanted her to do and that you were able to figure out the best logistical approach to getting the job done. Furthermore, I am pleased that Skip allowed your time to work with Barbara and me. This truly helped by familiarizing you with what Barbara and I wanted to get accomplished and how persnickety we were in how we collected and counted out our termites.

I'm not sure how invitations are issued by Skip, but I hope that you will be able to return to Guana next year and help us, at least part of the time, with our studies of the ecology and behavior of *Nasutitermes acajutlae*. Depending on the outcome of our laboratory work this winter, we may be forging ahead with studies of foraging ecology with this species while continuing with the chemotaxonomy studies of all of the other termites on Guana Island and the BVI.

I also heard that you might possibly be visiting California this winter. If you have time, please plan to visit our laboratory. Maybe we will have a chance to put you to work sampling subterranean termites in the lower reaches of the Sierra Nevada. How does that sound? I wish I could promise you a good snake hunt, but most of ours are down for the winter in December. We might be able to find a hibernating lizard or two to tweak your interest. Hope to see you again soon.

All the best,

MIH

MICHAEL I. HAVERTY
Chief Research Entomologist
Chemical Ecology of Forest Insects

cc Barbara Thorne, Lori Nelson, Oh Skip, Skip Lazell

The Termites of Guana and other British Virgin Islands

Margaret S. Collins
Smithsonian Institution, Department of Entomology
Barbara L. Thorne
University of Maryland, Department of Entomology
Michael I. Haverty
Pacific Southwest Forest and Range Experiment Station, USDA Forest Service

Abstract

A survey of the termites (Isoptera) of Guana and seventeen nearby islands of the British Virgin complex yielded nine species belonging to three families. Brief descriptions of the termites, their flight times and other details of their biology are given, along with summaries of vegetation types of the collection sites. This report is a contribution to the on-going effort to document the flora and fauna of Guana and the larger effort to collect information on termite biodiversity resisting on islands of the West Indies.

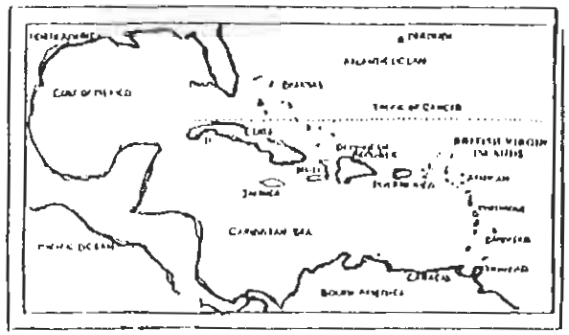
Introduction

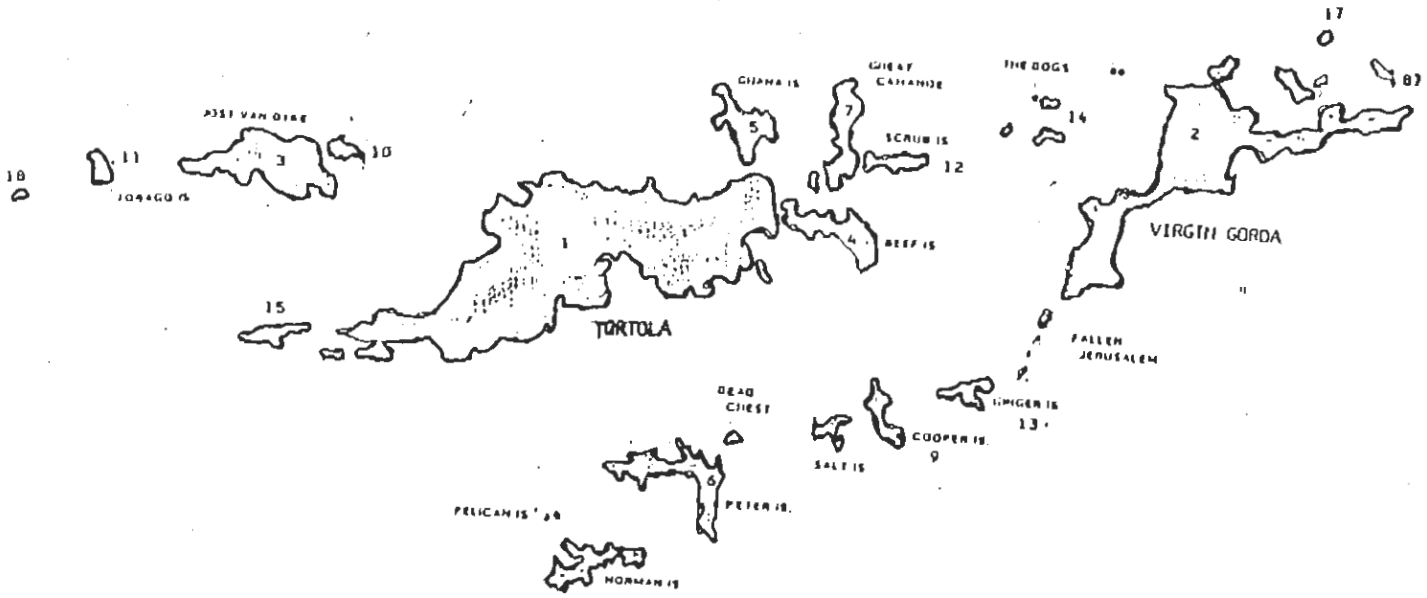
The British Virgin Islands are a complex of more than 50 land masses of various sizes, elevations, and soil types, part of the Puerto Rico Bank geological unit, a broad plateau variously dry land or submerged during geological history, depending upon the state of glaciation (See Map). Rocks underlying these islands date back to the Cretaceous. Several islands are large enough and possess soils that support Beard's "Evergreen Bushland" (Beard,1949), as well as littoral and other vegetation associations. The largest island, Tortola (1) has an area of 5444 ha.; it supports a protected remnant of ariidulate rain forest (D'Arcy 1967) on its highest point, Sage Mountain (1780 ft.). Guana is smaller (297 ha.), with a maximum elevation of about 870 ft., but has a relatively rich, less-disturbed vegetation cover. A partial listing of typical non-littoral trees and shrubs drawn up by Proctor,1993, includes 33 trees, 30 shrubs and 2 palms. The rare *Sida eggersii* grows on Guana. At least 5 species of succulents including an *Opuntia* and an *Agave* grow on drier slopes of Guana, while introduced exotics are found near the hotel and the farm area. The floral and faunal richness of Guana results from its origin, size, and history of minimal disturbance. (Lazell,1989)

IT IS NOW DESIGNATED AND MAINTAINED AS A WILDLIFE SANCTUARY BY THE JARECKI FAMILY, AND IS A CENTER FOR BIODIVERSITY STUDIES UNDER THE AUSPICES OF THE CONSERVATION AGENCY, RHODE ISLAND, USA.

RELATIVE SIZES OF THE SEVERAL ISLANDS ARE SHOWN ON THE MAP (FIG. 1.). ALL ARE OF VOLCANIC ORIGIN EXCEPT ANEGADA, (16), A CORAL AND LIMESTONE ATOLL. TABLE 1. SHOWS THE SPECIES OF TERMITES RECORDED AND THE ISLANDS COLLECTED, RANKED ON THE BASIS OF MOISTURE AVAILABILITY AS DETERMINED BY VEGETATION TYPE AND DENSITY. MANY OF THE ISLANDS HAVE BEEN STRIPPED OF THE ORIGINAL VEGETATION THROUGH OVERGRAZING AND CLEARING FOR AGRICULTURAL PURPOSES. MANGROVES ARE BECOMING LESS ABUNDANT, ESPECIALLY ON TORTOLA, AN ISLAND HEAVILY POPULATED AND DEVELOPED TO THE POINT THAT ACCESS TO COLLECTING SITES IS RESTRICTED. THE DISTRIBUTION PATTERN SHOWN IN THE TABLE REFLECTS THE IMPORTANCE OF MOISTURE AVAILABILITY. HOWEVER, THE HISTORY OF DISTURBANCE TO THE ISLAND, ALONG WITH ACCIDENTS OF SAMPLING MAY ALSO INFLUENCE THE CURRENT PICTURE. TERMITES HAVE BEEN SHOWN TO DIFFER IN THEIR MOISTURE REQUIREMENTS (COLLINS, 1969). OF THE SPECIES PRESENT ON THIS ISLAND COMPLEX, NASUTITERMES ACAJUTLAE SEEMS TO BE THE LEAST MOISTURE SENSITIVE OF THE TERMITIDAE . A SIMILAR PATTERN IS SHOWN BY THE COMPANION SPECIES, N. NIGRICEPS, FOUND ELSEWHERE IN THE CARIBBEAN, CENTRAL, AND SOUTH AMERICA. INCISITERMES SNYDERI HAS BEEN SHOWN TO HAVE GREAT FLEXIBILITY IN TOLERANCE OF DIFFERENT MOISTURE AVAILABILITIES, SURVIVING WELL IN BOTH MOIST AND ARID ENVIRONMENTS (COLLINS, 1969). THE APPARENT SCARCITY OF THE DRY-ADAPTED PROCEVOTOTERMES CORNICEPS ON ISLANDS WHERE I. SNYDERI HAS BEEN COLLECTED MAY REFLECT SAMPLING ACCIDENT ; TARGETED COLLECTING CAN ANSWER THIS QUESTION. HETEROTERMES SPECIES ARE COMMON IN BUILDINGS THROUGHOUT THE CARIBBEAN, AND IN NATURAL HABITATS WHERE SOIL TYPES PERMIT. THE SUBTERRANEAN HABIT PERMITS ACCESS TO MORE CONSTANT WATER SOURCES.

THE TERMITE FAUNA OF THE WEST INDIES WAS SUMMARISED FIRST BY BANKS (1919), WHO DESCRIBED TERMITES COLLECTED FROM THE LARGER ISLANDS EXCEPT PUERTO RICO AND OTHER ISLANDS OF THE PUERTO RICO BANK UNIT. RAMOS,(1946), SURVEYED MONA ISLAND, AND LISTED FOUR SPECIES OF KALOTERMITIDAE. MARTORELL,(1949) LISTED THESE AND OTHER SPECIES





BRITISH VIRGIN ISLANDS

Table I. DISTRIBUTION OF TERMITE SPECIES IN BRITISH VIRGIN ISLANDS RANKED BY APPARENT MOISTURE REQUIREMENTS (TERMITES) AND AVAILABILITY (ISLANDS)

HIGH ↑ — MOISTURE REQUIREMENTS — ↓ LOW

TERMITE NAMES	ISLANDS: WET ← 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 → DRY	ALSO RECORDED FROM (ISLANDS, CONTINENTS)
NEOTERMES MONA (K)	×	MONA ISLAND; TURKS AND CAICOS (BAHAMAS)
PARVITERMES WOLCOTTI (T)	× × ×	ST. THOMAS, USVI; PUERTO RICO ST. THOMAS, USVI; PUERTO RICO
HETEROTERMES SP.	× × × × × × × ×	WIDESPREAD IN NEOTROPICS; DAMAGE REPORTS FROM NEARLY EVERY CARIBBEAN ISLAND; IN BUILDINGS AND IN FIELD
NASUTITERMES COSTALIS (T)	× ×	WIDESPREAD ON LARGER WI ISLANDS, SO. AND CENT. AMERICA
INCISITERMES INCISUS (K)	× × × ×	BARBADOS, GUADELOUPE, MONA, USVI
NASUTITERMES ACAJUTLAE (T)	× × × × × × × × × × × × × × × × × ×	NIGRICEPS/ACAJUTLAE COMPLEX FOUND FROM MEXICO TO BRAZIL, NORTH AND EAST THRU CARIBBEAN
PROCRYPTOTERMES CORNICEPS (K)	× × × × × × ×	MONA, TURKS AND CAICOS, ANTIGUA, GUADELOUPE, JAMAICA, MONTSERRAT, PUERTO RICO
INCISITERMES SNYDERI (K)	× × × × × × × × × × × × × × × × × ×	SOUTHERN USA, MEXICO, CENT. AMERICA, BAHAMAS, BERMUDA, CUBA, MONA, PUERTO RICO, USVI
CRYPTOTERMES BREVIS (K)	CIRCUMTROPICAL, ONLY IN HOUSES; RECORDS OF ATTACK FROM EVERY INHABITED CARIBBEAN ISLAND; FOUND IN HOUSES IN OTHER ZOOGEOGRAPHICAL REGIONS BUT APPARENTLY EVOLVED IN THE WEST INDIES	

KEY, ISLANDS: 1. TORTOLA; 2. VIRGIN GORDA; 3. JOST VAN DYKE, G.; 4. BEEF; 5. GUANA; 6. PETER; 7. GREAT CAMANOE; 8. EUSTATIA; 9. COOPER; 10. JOST VAN DYKE, L.; 11. GREAT TOBAGO; 12. SCRUB; 13. GINGER; 14. GEORGE DOG; 15. GREAT THATCH; 16. ANEGADA; 17. NECKER; 18. LITTLE TOBAGO

OF TERMITES COLLECTED FROM PUERTO RICO IN HIS SURVEY OF THE INSECTS OF THAT ISLAND. INDIVIDUAL COLLECTIONS MADE ON OTHER WEST INDIAN ISLANDS AND PLACED IN THE US NATIONAL MUSEUM WERE INCLUDED IN SNYDER'S 1956 COMPILATION (SNYDER, 1956). HIS DISTRIBUTION RECORDS, DESCRIPTIONS AND KEYS ARE BEING GREATLY AUGMENTED BY PARTICIPATING MEMBERS OF THE CARIBBEAN TERMITE SURVEY, AN EFFORT TO WHICH THIS STUDY CONTRIBUTES. DETAILED MEASUREMENTS OF LARGE SAMPLES, USE OF THE SCANNING ELECTRON MICROSCOPE, AND UTILIZATION OF CHEMICAL METHODS (CUTICULAR HYDROCARBON SCANS, DEFENSE SECRETION ANALYSES) ARE BEING UTILIZED IN PROVIDING DATA NEEDED TO RESOLVE TAXONOMIC PROBLEMS EXISTING IN THIS DIVERSE GROUP.

THE IMPORTANT ROLE PLAYED BY TERMITES IN WOOD RECYCLING, NITROGEN FIXATION AND SOIL MODIFICATION, ALONG WITH THE RAPID DESTRUCTION OF PLANT ASSOCIATIONS NECESSARY TO TERMITE SURVIVAL MAKE THIS EFFORT URGENT AND IMPORTANT.

MATERIALS AND METHODS

SEVEN COLLECTING PERIODS OF FROM 2 TO 4 WEEKS EACH WERE SPENT ON GUANA ISLAND, WITH SHORT TRIPS AT IRREGULAR INTERVALS TO OTHER ISLANDS OF THE COMPLEX. AN ATTEMPT WAS MADE TO SAMPLE TERMITE COLONIES FROM EVERY SUITABLE HABITAT THAT COULD BE REACHED. DATA ON FLIGHT TIMES WERE OBTAINED THROUGH CENSUS OF INSECTS ATTRACTED TO LIGHTS IN LIVING QUARTERS AND TRAP LIGHTS . TREES HOUSING CARTON NESTS OF NASUTITERMES ACAJUTLAE WERE CENSUSED IN A DESIGNATED AREA ON GUANA ISLAND AND, WHERE POSSIBLE, THE HOST WOOD OR TREE DETERMINED ALSO FOR OTHER SPECIES OF TERMITES. TERMITE COLONIES WERE SAMPLED USING A MACHETE OR OTHER SUITABLE TOOL FOR ENTERING THE SOMETIMES VERY HARD SOUND WOOD, DEAD DOWN TREES AND BRANCHES, STRUCTURAL TIMBERS, DEAD VEGETATION, AND SOIL UNDER STONES OR WOOD PILES. SAMPLES WERE BAGGED AND BROUGHT TO THE LABORATORY ON GUANA, WHERE THE TERMITES WERE REMOVED AND THE SAMPLES PRESERVED IN 95% ETHANOL OR DRIED FOR CUTICULAR HYDROCARBON ANALYSIS. ESCAPES WERE GUARDED AGAINST FOR SAMPLES COMING TO GUANA FROM OTHER ISLANDS. AN ATTEMPT WAS MADE TO SECURE ADULT CASTES FOR EACH SAMPLE.

CUTICULAR HYDROCARBON ANALYSES WERE CARRIED OUT AT THE PACIFIC SOUTHWEST RESEARCH STATION, FOREST SERVICE, ALBANY, CALIFORNIA, BY HAVERTY AND NELSON. METHODS FOR PREPARATION AND COMPONENT CHARACTERIZATION ARE DESCRIBED IN HAVERTY ET AL (1988,1989, 1990).

SAMPLE SIZES NEEDED WERE INVESTIGATED, AND COMPARISONS OF RESULTS OBTAINED WHEN SAMPLES WERE FIRST DRIED, THEN EXTRACTED, AS OPPOSED TO BEING EXTRACTED FROM FRESH MATERIAL CURRENTLY UNDER WAY.

SCANNING ELECTRON MICROSCOPE PREPARATIONS NEEDED TO IDENTIFY PARVITERMES WILCOTTI WERE DONE BY R. SCHEFFRAHN, UNIVERSITY OF FLORIDA RESEARCH AND EDUCATION CENTER. IDENTIFICATIONS WERE MADE USING KEYS, ORIGINAL REFERENCES AND DESCRIPTIONS, AND COMPARISONS WITH TYPE AND PREVIOUSLY-IDENTIFIED MATERIAL. MUCH WORK NEEDS TO BE DONE IN DEVELOPING USABLE KEYS FOR THE CARIBBEAN FAUNA, AND NEW DESCRIPTIONS ARE NEEDED FOR SOME SPECIES; PREVIOUSLY-UNDESCRIBED CASTES ARE BEING COLLECTED, AND WILL BE DESCRIBED AS NEEDED MATERIAL COMES IN. THE PROBLEM OF VARIABILITY IN BODY PARTS OF TAXONOMIC IMPORTANCE, ESPECIALLY IN THE KALOTERMITIDAE, CAN BE ADDRESSED AS LARGER SAMPLES BECOME AVAILABLE, AND INDEPENDENT CONFIRMATORY TOOLS OF RELATEDNESS USED IN COMBINATION WITH MORPHOLOGICAL DATA.

RESULTS AND DISCUSSION

COLLECTIONS FROM THE COMBINED ISLANDS TOTALLED 9 SPECIES OF 7 GENERA IN 3 FAMILIES OF TERMITES, AS SHOWN IN TABLE 1. THESE WILL BE CONSIDERED INDIVIDUALLY BY FAMILY.

KALOTERMITIDAE

GENERA AND SPECIES OF THIS FAMILY ARE MORE ABUNDANT ON ISLANDS AND CONTINENTAL FRINGES THAN IN INLAND TROPICAL AREAS, WHICH ARE USUALLY SITES OF INTENSE COMPETITION WITH MOST OF THE AVAILABLE LOCATIONS BEING OCCUPIED BY SPECIES OF FAMILY TERMITIDAE. SPECIES OF FAMILY KALOTERMITIDAE, THOUGH COMMONLY KNOWN AS "DRY-WOOD" TERMITES, DIFFER WIDELY IN TOLERANCE OF VERY DRY OR VERY WET CONDITIONS; EXTREMES IN THESE TOLERANCES ARE SHOWN IN DIFFERENT GENERA OF THE FAMILY. THE GUANA ISLAND FAUNA INCLUDES SPECIES AT BOTH ENDS OF THE MOISTURE-DEPENDENCE SPECTRUM, NEOTERMES MONA AND CRYPTOTERMES BREVIS. N. MONA IS DEPENDENT UPON A HIGH CONSTANT ENVIRONMENTAL MOISTURE SUPPLY, USUALLY OBTAINED BY INHABITING LIVING TREES. CRYPTOTERMES BREVIS, THE "FURNITURE TERMITE" IS CAPABLE OF LIVING WITHOUT ACCESS TO FREE DRINKING WATER AND IS UNABLE TO THRIVE WHEN EXPOSED TO SUSTAINED PRESENCE OF FREE WATER (COLLINS, 1969; WILLIAMS, 1977; STEWARD, 1982). THE ABILITY TO TOLERATE EXTREMELY DRY CONDITIONS APPEARS TO HAVE EVOLVED

INDEPENDENTLY IN SEVERAL GROUPS OF KALOTERMITIDAE, AND DEPENDS IMPORTANTLY ON RESTRICTION OF WATER LOSS BY CUTICULAR LIPIDS; EXPERIMENTAL SOLUTION OR ABRASION OF THIS LAYER LEADS TO RAPID DESICCATION OF ANIMALS EXPOSED TO LOW ENVIRONMENTAL HUMIDITIES (COLLINS, 1969). THE KALOTERMITIDAE OF GUANA AND NEARBY ISLANDS SO FAR COLLECTED INCLUDE NEOTERMES MONA (BANKS); INCISITERMES SNYDERI (LIGHT); INCISITERMES INCISUS (SILVESTRI); PROCRYPTOTERMES CORNICEPS (SNYDER); AND CRYPTOTERMES BREVIS (WALKER) .

NEOTERMES MONA (BANKS)

THIS IS THE LARGEST TERMITE OF THE AREA, FOUND IN LIVING TREES ON THE NORTHERN, OR WETTER SIDE OF GUANA ISLAND. INVASION OF THE HOST TREE OCCURS AT SITES OF INJURY ; THE BULK OF THE COLONY DEVELOPS EXCAVATIONS IN LIVING AS WELL AS DEAD WOOD. NO SURFACE RUNWAYS ARE PRODUCED, AND COLONIES ARE NOT CONSPICUOUS. THIS SPECIES WAS ONCE THOUGHT TO BE ENDEMIC TO MONA ISLAND, BUT EXTENSIVE COLLECTING BY SCHEFFRAHN AND HIS ASSOCIATES EXTENDED THE RANGE WEST THROUGH THE DOMINICAN REPUBLIC TO THE TURKS AND CAICOS ARCHIPELAGO (SCHEFFRAHN ET AL 1990; JONES, 1991). SCHEFFRAHN AND HIS ASSOCIATES FOUND N. MONA IN BOTH NATURAL AND STRUCTURAL TIMBER, ALONG WITH NEOTERMES CASTANEUS AND JOUTELI ON PROVIDENCIALES, WESTERNMOST ISLAND OF THE GROUP. SPECIES OF THIS GENUS ARE RELATIVELY RARE IN STRUCTURAL TIMBER IN FLORIDA (N. JOUTELI). N. CASTANEUS IS FOUND IN LIVING AVOCADO AND CITRUS TREES IN SOUTH FLORIDA, AND OCCASIONALLY IN STANDING DEAD TREES IN DENSE FOREST STANDS ON KEY LARGO. IT HAS ALSO BEEN FOUND IN AVOCADO TREES AND THE ROOTS OF OLEANDERS ON GRAND CAYMAN, BWI (COLLINS, UNPUBL. OBS.) SCHEFFRAHN SUGGESTS THAT ISLAND POPULATIONS OF NEOTERMES IN THE TURKS AND CAICOS AREA MAY BE SHOWING XEROPHILIC ADAPTIVE MODIFICATION, A QUESTION THAT MERITS FURTHER STUDY AND ANALYSIS, PARTICULARLY EMPLOYING COMPARISONS OF DESICCATION TOLERANCES AND CUTICULAR HYDROCARBON PROFILES OF SAMPLES FROM THE SEVERAL ISLAND POPULATIONS.

ALATES WERE FOUND ON GUANA DURING THE MONTH OF OCTOBER ; FLIGHTS OCCURRED AT NIGHT AND EXTENDED OVER A PERIOD OF SEVERAL DAYS. THE VERY LARGE SIZE, DISTINCTIVE COLOR, CLEAR WINGS, AND LARGE EYES MAKE THIS SPECIES EASY TO DIFFERENTIATE FROM OTHER TERMITES OF THE AREA.

INCISITERMES (KRISHNA, 1961)

TWO SPECIES OF THIS GENUS HAVE BEEN RECORDED FROM GUANA AND OTHER ISLANDS OF THE COMPLEX.

I. SNYDERI(LIGHT, 1933)

THIS IS THE MOST COMMON SPECIES OF THE GENUS IN MUCH OF THE CARIBBEAN ; IT LIVES IN SOUND DEAD TREES OF MANY SPECIES AS WELL AS IN STRUCTURAL TIMBER ON GUANA AND THROUGHOUT MUCH OF ITS RANGE (SEE TABLE 1.). I. SNYDERI EXHIBITS TOLERANCE TO WIDE VARIATIONS IN MOISTURE AVAILABILITY IN THE FIELD AS WELL AS UNDER EXPERIMENTAL CHALLENGE (COLLINS,1969). THE SOLDIERS MAY HAVE HEAD SHAPES OF TWO DISTINCT TYPES, THE "LONG-HEADED" AND THE "SHORT-HEADED", DEVELOPING FROM DIFFERENT INSTARS OF THE IMMATURE STAGES, THE PSEUDERGATES. THE LONG-HEADED SOLDIERS TEND TO BE MORE DEEPLY PIGMENTED THAN THE SHORT-HEADED MORPHS. SMALL, VERY YOUNG COLONIES HAVE ONLY THE SHORT-HEADED FORM. THE DIFFERENCES IN APPEARANCE ARE SO PRONOUNCED THAT THEY MIGHT BE REGARDED AS DIFFERENT SPECIES IF COLLECTED SEPARATELY. OLDER COLONIES HAVE BOTH HEAD FORMS. THE RANGE IN SIZE AND PROPORTIONS IS SO GREAT THAT A LONG SERIES WAS COLLECTED ; THIS WILL BE UTILIZED IN DESCRIBING THE VARIATILITY IN SOLDIER FORM IN THIS WIDE-RANGING SPECIES. CUTICULAR HYDROCARBON SCANS HAVE BEEN CONSISTENT FOR ALL SAMPLES OF THIS SPECIES COLLECTED THUS FAR ; THEY CAN CONTRIBUTE IMPORTANTLY TO ESTABLISHMENT OF RANGES OF VARIABILITY WITHIN A SPECIES DETERMINED ON MORPHOLOGICAL GROUNDS.

ALATES EXHIBIT LESS MORPHOLOGICAL VARIABILITY THAN THE SOLDIERS ; THESE ARE PALE YELLOW OR YELLOW-BROWN, RELATIVELY SMALL NIGHT-FLYERS. THEY WERE COLLECTED DURING THE MONTHS OF JULY THROUGH NOVEMBER IN THE BVI.

INCISITERMES SNYDERI IS LISTED AS A MAJOR PEST ATTACKING STRUCTURES IN NORTH AND CENTRAL AMERICA AND THE CARIBBEAN INCLUDING THE BAHAMAS, CUBA AND PUERTO RICO (HARRIS,1961).

INCISITERMES INCISUS (SILVESTRI)

THIS SPECIES WAS COLLECTED IN THE MANGROVE ASSOCIATION FRINGING BEEF ISLAND AND IN TREES ON THE WETTER SIDE OF GUANA. L. HERNANDEZ COLLEC-

TED ALATES AS WELL AS SOLDIERS ON EUSTATIA. IT WAS NOT RECOGNIZED AS DISTINCT FROM I. SNYDERI UNTIL THE COLLECTIONS UPON WHICH THIS REPORT IS BASED WERE COMPLETED ; CAREFUL SCRUTINY OF THE MANGROVE ASSOCIATIONS AND DAMPER WOODLANDS OF ISLANDS OF THE COMPLEX WILL BE NEEDED TO APPRAISE RELATIVE ABUNDANCE. RECORDS SUGGEST A GREATER MOISTURE REQUIREMENT THAN IS TRUE FOR SNYDERI, AND COLONIES OF INCISUS ARE MORE LIKELY TO BE FOUND IN DEAD BRANCHES OF LIVING TREES OR IN ACTUAL LIVING WOOD THAN IS THE CASE FOR SNYDERI. NO RECORDS OF ATTACK ON BUILDINGS ARE AVAILABLE FOR THIS SPECIES.

ALATES ARE DISTINCTIVE, HAVING YELLOW-BROWN BODIES,WINGS AND HEADS, WITH THE HEADS OF SOME SHOWING A DARK BROWN BAND ACROSS THE FRONS JUST DORSAL TO THE JUNCTION OF LABRUM AND CLYPEUS. ALATES WERE PRESENT IN COLONIES DURING JULY AND AUGUST.

THIS SPECIES SHOULD BE RE-DESCRIBED USING FRESHLY-PRESERVED MATERIAL WITH MEASUREMENTS ON ENOUGH INDIVIDUALS TO PERMIT SEPARATION FROM I. SNYDERI EVEN IF ONLY SHORT-HEADED SOLDIERS COMPRISE THE ADULT VOUCHERS. LONG-HEADED SOLDIERS ARE PRESENT IN OLDER COLONIES, AS IN OTHER SPECIES OF THE GENUS, AND ARE MORE READILY DISTINGUISHED.

PROCRYPTOTERMES CORNICEPS (SNYDER)

P. CORNICEPS IS A RELATIVELY XEROPHILIC SPECIES MODERATELY ABUNDANT ON GUANA , WHERE IT IS COMMON IN OLD FENCE POSTS MADE FROM BURSERA SIMARUBA (GUMBO LIMBO), A SOFT RESINOUS WOOD NOT OFTEN ATTACKED BY OTHER SPECIES OF TERMITES, AND ACTIVELY AVOIDED BY NASUTITERMES ACAJUTLAE . SOLDIERS OF P. CORNICEPS ARE DISTINCTIVE WITH PROPORTIONALLY LONG, STRONGLY-CURVED, SHARPLY-POINTED MANDIBLES ; HEADS THAT SLOPE STEEPLY IN FRONT ; AND SHORT HORN-LIKE PROJECTIONS FROM THE FRONS NEAR THE OUTER EDGES OF THE BASES OF THE MANDIBLES.

COLONIES OF THIS SPECIES ARE FREQUENTLY FOUND IN DEAD BRANCHES ON THE GROUND, CONSTRUCTING LARGE CHAMBERS THAT ARE FREQUENTLY SECONDARILY

OCCUPIED BY A LARGE UNDESCRIBED SPECIES OF CAMPONOTUS (DESCRIPTION IN PROGRESS, R. SNELLING, PERS. COMM.).A WIDE VARIETY OF WOOD SPECIES ARE UTILIZED, BUT NO RECORDS OF ATTACK ON STRUCTURAL TIMBER ARE AVAILABLE. WOODS UTILIZED ON MONA ISLAND INCLUDED COCCOLOBA VITIFERA , GOSSYPIUM BARBADENSI, HIPPOMANE MANCINELLA , LEMAIREOCEREUS HYSTRIX, MELICOCCUS BIJUGATUS, SWIETENIA MAHOGANI, AND TAMARINDUS INDICUS , AMONG OTHERS (JONES,1991) AND IN NATURAL VEGETATION ON PROVIDENCIALES AND GRAND TURK OF THE TURKS AND CAICOS ARCHIPELAGO (SCHEFFRAHN ET AL,1990). DARLINGTON (1991 AND 1992) AND KRISHNA (1962) EXTENDED THE KNOWN RANGE TO ANTIGUA, GUADELOUPE, JAMAICA, MONTSERRAT, AND PUERTO RICO.

ALATES WERE PRESENT IN COLONIES OR APPEARED AT LIGHTS AT NIGHT DURING THE MONTHS OF JULY THROUGH OCTOBER ON GUANA ISLAND.

P. CORNICEPS ALATES AHOULD BE REDESCRIBED, AS THE SPECIES WAS NAMED FROM DEALATED IMAGOES AND SOLDIERS. IN SIZE, THESE ALATES ARE VERY NEAR THOSE OF SNYDERI, C. BREVIS, AND I. INCISUS, AND SOMEWHAT LARGER THAN ALATES OF HETEROTERMES; ALL ARE OF A YELLOW-BROWN COLOR AND ALL FLY AT NIGHT.

CRYPTOTERMES BREVIS (WALKER)

THE PHRAGMOTIC HEADS OF THE SOLDIERS, THE PRESENCE OF PILES OF DRY FAECAL PELLETS IN INFESTED BUILDINGS, AND THE PAPER-THIN OUTER WALLS OF FURNITURE OR WALLS CONTAINING COLONIES OF THIS SPECIES ARE EASILY DIAGNOSTIC OF THIS TERMITE. ON GUANA, A COLONY HAD INVADED THE ANTIQUE REFECTORY TABLE IN THE LIVING ROOM OF THE GUANA ISLAND CLUB ; ANOTHER COLONY WAS ESTABLISHED IN AN OFFICE DESK ON TORTOLA. THIS CIRCUMTROPICAL SPECIES HAS NEVER BEEN REPORTED FROM HABITATS OTHER THAN INSIDE BUILDINGS ; IT IS WIDELY DISPERSED IN STRUCTURAL TIMBER, FURNITURE AND ART OBJECTS. THE USE OF PLYWOOD PANELLING INSIDE STONE OR STUCCO BUILDINGS IS FREQUENTLY FOLLOWED BY MASSIVE INCREASES IN COLONY SIZE AND NUMBER. FLIGHTS OCCUR AT NIGHT OVER A LONG SEASON.

A PHRAGMOTIC-HEADED SOLDIER WAS FOUND IN A DEAD STUMP PROJECTING FROM A LIVING TREE ON THE NORTH SLOPE OF GUANA ISLAND, BUT THE VOUCHER WAS LOST BEFORE IDENTIFICATION COULD BE MADE. REPEATED SEARCHES HAVE SO FAR NOT RESULTED IN ADDITIONAL COLLECTING ; IF FOUND, AN ADDITIONAL SPECIES OF KALOTERMITIDAE COULD BE RECORDED FOR GUANA.

RHINOTERMITIDAE DESNEUX

THIS FAMILY INCLUDES SPECIES THAT ARE SUBTERRANEAN OR CAPABLE OF LIVING IN DAMP WOOD WITHOUT SOIL CONTACT ; MAJOR PESTS OF AGRICULTURAL CROPS, STORED PRODUCTS, AND STRUCTURAL TIMBER BELONG TO THIS FAMILY. MORE SPECIALIZED THAN THE KALOTERMITIDAE, THERE HAS BEEN THE DEVELOPMENT OF AN ADULT WORKER CASTE IN SOME REPRESENTATIVES.

COLONIES MAY BECOME ENORMOUS ; MANY SPECIES ARE SPREAD ACCIDENTALLY THROUGH HUMAN ACTIVITIES, BECOMING ESTABLISHED EITHER IN CLOSE CONTACT WITH HUMAN CONSTRUCTS OR IN THE FIELD. BOTH SOLDIERS AND ALATES ARE USUALLY SMALLER THAN REPRESENTATIVES OF FAMILY KALOTERMITIDAE. ALATES DIFFER FROM KALOTERMITIDS IN THE POSSESSION OF A VARIOUSLY-SHAPED OPENING ON THE TOP OF THE HEAD, THE FONTANELLE.

HETEROTERMES FROGGATT

SAMPLES OF SPECIES OF THIS GENUS ARE SO VARIABLE THAT SNYDER'S 1924 SUGGESTION THAT THE GENUS COMPRISES EITHER A SINGLE, HIGHLY-VARIABLE SPECIES, A COMPLEX OF CLOSELY-RELATED SPECIES, OR A CLUSTER OF EVOLVING SPECIES STILL NEEDS TO BE ADDRESSED. EMERSON BEGAN THE TASK OF RE-WORKING THE GROUP AND LEFT A SERIES OF CAREFUL, DE-TAILED MEASUREMENTS OF KNOWN SPECIES, BUT HAD NOT FINISHED THE TASK AT THE CLOSE OF HIS WORK. UNTIL USEFUL SPECIES LIMITS HAVE BEEN ACHIEVED, MEMBERS OF THIS GROUP COLLECTED IN THE BVI WILL BE REFERRED TO AS HETEROTERMES SP.; SAMPLES COLLECTED COULD BELONG TO THREE DESCRIBED SPECIES, H. TENUIS (HAGEN), H. CONVEXINOTATUS (SNYDER), OR H. CARDINI (SNYDER). LARGE SAMPLES CONTAINING BOTH ALATES AND SOLDIERS WILL BE IMPORTANT TO THIS EFFORT. CUTICULAR HYDROCARBON ANALYSES MAY CONTRIBUTE HELPFUL INFORMATION, ALSO.

SOLDIERS OF SPECIES IN THIS GENUS ARE SMALL, WITH YELLOW TO YELLOW-BROWN HEADS AND DARK, SLENDER, SMOOTH, SHARPLY-POINTED MANDIBLES CURVED ONLY NEAR THE TIPS. THE PRO-NOTUM IS NARROWER THAN THE POSTERIOR MARGIN OF THE HEAD HERE, UNLIKE THE SOLDIER OF FAMILY KALOTERMITIDAE. THE NUMEROUS SOLDIERS AND IMMATURES HAVE SLIGHTLY OFF-WHITE BODIES AND SOMEWHAT DARKER HEADS. ALATES ARE SMALL, LIGHT-BROWN NIGHT SWARMERS; THEY WERE OBSERVED DURING THE MONTH OF JULY ON GUANA. FLIGHTS INCLUDE LARGE NUMBERS OF INDIVIDUALS OVER A SHORT PERIOD OF TIME. WHILE REPORTS OF DAMAGE TO BUILDINGS, DOCKS AND RECREATIONAL FACILITIES ARE NUMEROUS THROUGHOUT THE CARIBBEAN, LITTLE IS KNOWN ABOUT THE BIOLOGY OF MEMBERS OF THIS GROUP. NO COMPLETE NEST WITH REPRODUCTIVES HAS YET BEEN REPORTED; INSTEAD, COLLECTIONS CONSIST OF FORAGING GROUPS OR PORTIONS OF A COLONY EXPLOITING A FOOD SOURCE, OR FLYING REPRODUCTIVES. WOLCOTT COLLECTED ERGATOID REPRODUCTIVES OF HETEROTERMES CARDINI IN SUGAR CANE IN THE DOMINICAN REPUBLIC IN 1951; NO OTHER COLLECTIONS ARE KNOWN (LOCATED IN THE USNM COLLECTION BY J. DARLINGTON, 1993). MUCH REMAINS TO BE LEARNED ABOUT THIS DIFFICULT GENUS.

COPTOTERMES WASMANN

ANOTHER GENUS OF THE FAMILY, COPTOTERMES , CONTAINS A NUMBER OF ECONOMICALLY-IMPORTANT PEST SPECIES. A DESCRIPTION OF THE COPTOTERMES SOLDIER SUITABLE FOR FIELD IDENTIFICATION IS INCLUDED, ALTHOUGH NO SPECIMENS WERE TAKEN. AN INFESTATION OF COPTOTERMES IN A BOAT DOCKING AT VIRGIN GORDA HAS BEEN RECORDED, BUT MULTIPLE VISITS BY A COMPETENT CONTROL AGENT HAVE FAILED TO REVEAL EVIDENCE OF ESTABLISHMENT IN THE DOCK BUILDINGS. COPTOTERMES SOLDIERS HAVE YELLOW TO YELLOW-BROWN PEAR-SHAPED HEADS WITH LONG, SLENDER SMOOTH MANDIBLES. A LARGE PORE AT THE FRONT END OF THE HEAD, JUST DORSAL TO THE BASES OF THE MANDIBLES, PERMITS THE RELEASE OF DROPLETS OF A WHITE STICKY SECRETION UPON DISTURBANCE OF NEST OR RUNWAYS. THIS PROVIDES THE MOST RAPID MEANS OF IDENTIFICATION. PRESENCE OF SUCH SOLDIERS SHOULD BE REPORTED TO THE NEAREST CONTROL AGENCY, AS THIS GENUS CONTAINS MAJOR PESTS OF STRUCTURAL TIMBERS, STORED PRODUCTS, AND LIVING TREES. AT LEAST ONE SPECIES OF EXOTIC HAS BECOME ESTABLISHED ON ISLANDS OF THE WEST INDIES. C. HAVILANDI, A FAR-EASTERN SPECIES NOW ESTABLISHED ON BARBADOS, JAMAICA, AND, MOST RECENTLY RECOGNIZED, CUBA (HERNANDEZ, PERS. COMM.). THE EVEN MORE DESTRUCTIVE C. FORMOSANUS IS ESTABLISHED IN THE UNITED STATES, ALONG THE GULF COAST NORTH TO TENNESSEE. THE ABILITY TO ESTABLISH COLONIES IN CARGO ON BOATS PROMOTES DISPERSAL; SUCCESSFUL COMPETITION WITH INDIGENOUS SPECIES OF SUBTERRANEAN TERMITES IS INDICATED BY SPREAD INTO UNDISTURBED AREAS.

TERMITIDAE WESTWOOD

THIS IS THE MOST SPECIALIZED, WIDE-RANGING AND BIOLOGICALLY-SUCCESSFUL OF THE ISOPTERAN FAMILIES ; SOME SPECIES OF THE TAXON ARE PROMINENT FEATURES OF THE TROPICAL LANDSCAPE. THREE SPECIES BELONGING TO TWO GENERA HAVE BEEN COLLECTED ON GUANA AND NEARBY ISLANDS.

NASUTITERMES (DUDLEY)

SOLDIERS IN COLONIES OF THIS GENUS ARE SMALL AND FAST-MOVING, WITH HEADS PRODUCED INTO NOZZLE-LIKE PROTUBERANCES AND REDUCED JAWS. A RESINOUS ODOR CAN USUALLY BE DETECTED WHEN COLONIES ARE DISTURBED, COMING FROM THE DEFENSE SECRETION PRODUCED BY THE SOLDIERS. COLONIES RANGE FROM VERY LARGE TO ENORMOUS (SEVERAL MILLION INDIVIDUALS), HOUSED IN CONSPICUOUS CARTON NESTS THAT MAY BE ARBOREAL, NEAR THE BASES OF TREES, IN

THE GROUND, OR UNDER LARGE BOULDERS (IN AREAS WHERE TREE COVER HAS BEEN REMOVED AND CONTROL MEASURES DIRECTED AGAINST COLONIES. PROMINENT COVERED RUNWAYS CONNECT SUB-UNITS OF NESTS TO EACH OTHER AND TO FORAGING SITES.

NASUTITERMES ACAJUTLAE (HOLMGREN)

MOST OBVIOUS AND ABUNDANT TERMITE IN THE BVI COMPLEX, COLONIES OF THIS SPECIES CONSTRUCT ENORMOUS (8+ FT. IN DIAMETER) NESTS COMPOSED OF SILVERY-BROWN, DELICATE AND FRIABLE PARCHMENT-LIKE OUTER WALLS ENCLOSING NUMEROUS VARI-SIZED, HEAVIER-WALLED CELLS OF CARTON. NESTS ARE USUALLY SPINDLE-SHAPED OR IRREGULARLY ROUNDED. THEY AND THEIR NODULAR FOOD STORAGE BODIES ARE DESCRIBED IN MORE DETAIL IN A STUDY BY THORNE, BJORNDAL AND COLLINS (MS. IN PREP.). COLONIES MAY PRODUCE SUBSIDIARY NESTS IN ADDITION TO THE PRIMARY, OR QUEEN-CONTAINING ONE, A POLYCALIC SYSTEM. NEST UNITS, OR CALIES, ARE CONNECTED BY RUNWAYS OR TUNNELS. ONE SUCH, ISOLATED FROM THE MAIN UNIT, WAS FOUND TO HAVE ONLY NORMAL-SIZED SOLDIERS AND VERY LARGE WORKERS 2 YEARS AFTER SEPARATION FROM THE MAIN NEST. THIS MAIN NEST, REMOVED TO REDUCE DAMAGE TO THE HOTEL CISTERN, WAS FOUND TO HOUSE A LARGE QUEEN, 4-5 GALLONS OF EGGS, YOUNG, WORKERS AND SOLDIERS, PLUS A LARGE SERIES OF MUSHROOM-SHAPED BODIES COMPOSED OF COMMINUTED, PARTIALLY-DIGESTED REFASHIONED WOOD, THE STORAGE NODULES.

COLONIES OF THIS SPECIES MAINTAIN A SINGLE PAIR OF FUNCTIONAL REPRODUCTIVES IN ONE OF THE SOMETIMES-NUMEROUS CALIES COMPRISING THE NEST SYSTEM. DIFFERENTIATING BETWEEN THE CALIES OF DIFFERENT NEST SYSTEMS IN A HEAVILY-POPULATED AREA WAS ATTEMPTED USING AGONISTIC BEHAVIOR WHEN SAMPLES OF TERMITES FROM DIFFERENT CALIES OR RUNWAYS WERE MIXED, A METHOD OF SOMETIMES LOW RELIABILITY, ESPECIALLY WHEN SAMPLES ARE BROUGHT BACK TO THE LABORATORY AND THEN BROUGHT INTO CONTACT; OTHER TECHNIQUES INCLUDING ANALYSES OF CUTICULAR HYDROCARBON COMPONENTS OFFER PROMISE.

A STUDY OF WOOD SPECIES UTILIZED FOR FOOD AND NESTING SITES BY COLONIES OF THIS SPECIES ON GUANA ISLAND WAS PROMPTED BY THE OBSERVATION THAT BURSERA SEMIRUBA (GUMBO LIMBO OR "TURPENTINE TREE") SHOWED NO FEEDING TUNNELS, AND RARELY HAD EITHER NESTS OR RUNWAYS LEADING TO FORAGING SITES ON STEMS OR BRANCHES. TRAILS THAT WERE OBSERVED WERE SUPERFICIAL, IN NO CASE PENETRATING THE BARK. A STUDY SITE ON AND BEHIND WHITE BAY BEACH WAS SELECTED AND TREES COUNTED, IDENTIFIED, AND SCORED FOR THE PRESENCE OF N. ACAJUTLAE NESTS, RUNWAYS, OR EVIDENCE OF FEEDING. THE STUDY SITE INCLUDED 578 TREES OF 7 SPECIES, AS FOLLOWS : COCONUT (18); CASUARINA (2); TABEBUIA LEPIDOTA (355); SEA GRAPE, COCCOLOBA UVIFERA (153); PISONIA SUBCORDATA (43); TAMARIND (3); AND BURSERA SEMIRUBA (4). OF THE TREES ON THE SITE, 2 SPECIES SHOWED NEITHER TRAILS, NESTS NOR SIGNS OF FEEDING, THE COCONUTS AND THE CASUARINA. THIS LAST TREE SPECIES WAS ON THE BEACH IN FRONT OF A CAREFULLY-MAINTAINED BEACH HOUSE AND REFRESHMENT CENTER, AND MAY HAVE BEEN THE SUBJECT OF CARETAKING OPERATIONS. COCONUT TREES WERE IN THE OPEN FLAT BESIDE A ROAD, EXPOSED TO CONTINUOUS SUN AND PROBABLY ALSO MAINTENANCE ACTIVITIES; COCONUTS ARE USED RATHER FREQUENTLY BY TERMITES ELSEWHERE. THE MOST HEAVILY EXPLOITED SPECIES, THE SEA GRAPE, SHOWED NESTS, TRAILS, AND EXTENSIVE FEEDING ACTIVITY IN 79 % OF THE PLANTS; TABEBUIA , THE MOST ABUNDANT SPECIES, SHOWED A 49.6 % ATTACK RATE, WITH MANY RUNWAYS BUT FEW NESTS ; PISONIA SUBCORDATA SHOWED A 64% ATTACK RATE INCLUDING 3 NESTS. A SECOND SURVEY FURTHER INLAND SHOWED A 90% UTILIZATION RATE FOR SEA GRAPE AND A 53% RATE FOR TABEBUIA ON THE BASIS OF THIS INFORMATION, SEA GRAPE WAS CHOSEN AS A FOOD SOURCE FOR MAINTAINING COLONIES IN THE LABORATORY.

THE ABSENCE OF UTILIZATION OF BURSERA SEMIRUBA COULD BE RELATED TO THE SIMILARITY BETWEEN SOME COMPONENTS OF THE SAP OF THE LIVING TREE AND THE DEFENSE SECRETION OF THE NASUTE SOLDIERS. MOORE,1956 (IN LEE AND WOODS,1971) SUGGESTED THAT THE TERPENE CONSTITUENTS OF CERTAIN RESINOID TREES OF AUSTRALIA WERE SIMILAR TO CONSTITUENTS OF THE DEFENSE SECRETION OF A COMMON AUSTRALIAN NASUTE TERMITE, N. EXITIOSUS, AND THAT THESE CONSTITUENTS COULD INFLUENCE TERMITE BEHAVIOR. VRKOC, KRECEK AND HRDY, 1978, AND VALTEROVA, KRECEK AND VRKOC,1984, SHOWED THAT MONOTERPENE COMPONENTS OF THE TERMITE DEFENSE SECRETION, ESPECIALLY

α- AND β-PINENES FUNCTIONED AS ALARM PHEROMONES, CAUSING ASSEMBLY OF SOLDIERS AND RELEASE OF LARGER AMOUNTS OF THE DEFENSE SECRETION ; THIS PROBABLY PREVENTS WORKER TERMITES OF THE COLONY FROM COMING TO REST AND FEEDING IN AREAS OF SUFFICIENT CONCENTRATION. TRANIELLO, 1981, REPORTED THAT SOLDIERS OF SOME CENTRAL AND SOUTH AMERICAN SPECIES OF NASUTITERMES PLAY A KEY ROLE IN FORAGING BY LOCATING ACCEPTABLE FOOD SOURCES AND RECRUITING WORKERS TO THAT SITE. TO EXPLORE THIS QUESTION, A SERIES OF FOOD ACCEPTABILITY COMPARISONS WERE MADE USING TWO SPECIES OF TERMITES AND TWO TYPES OF WOOD : PROCRYPTOTERMES CORNICEPS AND NASUTITERMES ACAJUTLAE WERE OFFERED COCCOLOBA UVIFERA AND BURSERA SEMIRUBA . GIVEN THE CHOICE OF EQUAL-SIZED HALF TWIGS OF THE TWO SPECIES OF WOOD, GROUPS OF N. ACAJUTLAE CLUSTERED AND FED ON THE COCCOLOBA BUT NOT THE BURSERA , WHILE P. CORNICEPS GATHERED AND FED ON BOTH TYPES OF TWIGS IN ABOUT EQUAL NUMBERS. REFINEMENT OF THESE PRELIMINARY OBSERVATIONS COULD REVEAL A POSSIBLE ROLE OF THE SOLDIER IN FOOD SELECTION UNDER THESE CONDITIONS.

TERMITES OF THE ACAJUTLAE/NIGRICEPS COMPLEX RANGE FROM MEXICO SOUTH TO BRAZIL, THEN EAST AND NORTH THROUGH THE CARIBBEAN. REESTABLISHMENT OF ACAJUTLAE AS A SPECIES MORPHOLOGICALLY DISTINGUISHABLE FROM N. NIGRICEPS (THORNE, HAVERTY AND COLLINS, IN PRESS) CAN CONTRIBUTE TO BIOGEOGRAPHICAL UNDERSTANDINGS. MEMBERS OF THE TWO SPECIES SHARE MANY FEATURES, HOWEVER, INCLUDING TOLERANCE OF WIDE VARIATIONS IN ENVIRONMENTAL MOISTURE AVAILABILITY; USE OF A WIDE VARIETY OF FOODS AND NESTING SITES; POLYCALIC, MONOGYNOUS NESTING SYSTEMS; THE HABIT OF FORMING AND STORING NODULES OF PARTIALLY-DIGESTED WOOD IN THE CALIE HOUSING THE PRIMARY REPRODUCTIVE PAIR; AND WORKERS CAPABLE OF DELIVERING STRONG BITES TO INDIVIDUALS, INCLUDING HUMANS, THAT DISTURB NESTS OR RUNWAYS.

NESTS AND INDIVIDUALS OF N. ACAJUTLAE ARE LARGER THAN THOSE OF THE OTHER CARTON-NEST BUILDING NASUTE OF THE ISLAND, N. COSTALIS. N. ACAJUTLAE SOLDIERS HAVE REDDISH TO DARK BROWN HEADS ; ALATES ARE QUITE LARGE, AND CHESTNUT BROWN IN COLOR. FLIGHTS WERE OBSERVED TO OCCUR DURING EVENING HOURS IN OCTOBER. LARGE NUMBERS OF ALATES ARE RELEASED AT ONCE, AND ARE ATTRACTED TO LIGHTS.

NASUTITERMES COSTALIS (HOLMGREN)

THIS CARTON-NEST BUILDING NASUTE IS MUCH LESS COMMON THAN ACAJUTLAE ON GUANA, AND IS FOUND ONLY IN THE WETTER, DENSELY-FORESTED GHUTS. THE ONLY OTHER ISLAND WITH COLONIES OF THIS SPECIES WAS TORTOLA, WHERE NESTS WERE COMMON ON TREES BESIDE THE ROAD ON THE NORTH (WETTER) SIDE OF THE ISLAND AND IN THE ARIDULATE RAIN FOREST AT THE SUMMIT OF SAGE MOUNTAIN. NESTS OF THIS SPECIES ARE SMALLER AND DARKER IN COLOR THAN THOSE OF ACAJUTLAE , AND HAVE A STRONGLY MAMMILATE OUTER WALL. LIKE ACAJUTLAE, THE NESTS ARE POLYCALIC, CONNECTED BY COVERED RUNWAYS ; SOME WERE ARBOREAL, OTHERS WERE FOUND NEAR THE BASES OF TREES OR ON THE GROUND. MULTIPLE PRIMARY REPRODUCTIVES ARE COMMON IN THIS SPECIES, RESTRICTED TO A SINGLE CALIE OF THE COMPLEX. QUEENS OF A COLONY COVER SEVERAL GENERATIONS (ROISIN AND PASTEELS,1986). POLYGYNY PERMITS A GREATER RATE OF GROWTH OF THE NEUTER POPULATION IN A COLONY, WITH IMPROVED FOOD-GATHERING, DEFENSE AND CONSTRUCTION CAPABILITIES (THORNE 1985). REPRODUCTIVES, BOTH MALE AND FEMALE, ARE HOUSED IN ONE OR TWO LARGE THICKER-WALLED CELLS OF THE PRIMARY CALIE. POLYCALISM HAS CERTAIN ECOLOGICAL ADVANTAGES : MULTIPLE NESTS REDUCE THE DISTANCE TO BE RUN AND TIME SPENT BY FORAGERS GATHERING FOOD; AND THEY PROVIDE REST AREAS FOR FORAGERS AND A RESERVE OF NEUTERS CLOSE TO A FOOD SOURCE WHEN CONSTRUCTION, REPAIR OR AGONISTIC ENCOUNTERS WITH ANOTHER COLONY ARE INVOLVED (LEVINGS AND ADAMS, 1984).

SOLDIERS OF N. COSTALIS ARE SMALLER AND HAVE DARKER HEADS THAN SOLDIERS OF N. ACAJUTLAE ; THE ALATES ARE ALSO SMALLER AND DARKER, WITH DARK BROWN TO BLACK BODIES AND BLACK WINGS. FLIGHTS OCCUR DURING THE DAY, DURING THE MONTH OF OCTOBER ON TORTOLA. ROISIN AND PASTEELS, 1986, OBSERVED A FLIGHT OF N. COSTALIS ON ANTIGUA IN LATE AUGUST; IT EXTENDED FROM NOON TO EARLY HOURS AFTER SUNSET, ON A DAY MARKED WITH INTERMITTENT RAINFALL. THEIR OBSERVATIONS OF POSTFLIGHT BEHAVIOR DID NOT SUPPORT THE POSSIBILITY THAT POLYGYNY IN THESE COLONIES ARISES FROM COOPERATION OF MULTIPLE PAIRS IN COLONY FOUNDATION .

HARRIS,1961, LISTS N. COSTALIS WITH OTHER SPECIES ATTACKING STRUCTURES IN CENTRAL AMERICA AND THE CARIBBEAN ; HE DESIGNATES IT AS A MAJOR PEST IN GUYANA, SOUTH AMERICA. IT IS RECORDED AS AN AGRICULTURAL PEST, ALSO, ATTACKING SUGAR CANE IN THE CARIBBEAN, ON CUBA, PUERTO RICO, BARBADOS AND THE LEEWARD ISLANDS. ROISIN AND PASTEELS (1986) DESCRIBE IT AS THE DOMINANT TERMITE SPECIES ON ANTIGUA.

THE RELATIVE SCARCITY OF COSTALIS IN THE BVI IS PROBABLY RELATED TO THE LOWER MOISTURE AVAILABILITY ON MOST OF THE ISLANDS OF THE COMPLEX.

KRECEK (1970) FOUND THAT N. COSTALIS DISTRIBUTION PATTERNS AND NEST COMPOSITION ON CUBA INDICATED A HIGHER MOISTURE DEMAND THAN THAT SHOWN BY THE OTHER COMMON NASUTE, N. RIPPERTII.

PARVITERMES WOLCOTTI (SNYDER)

P. WOLCOTTI IS A SMALL,NOCTURNALLY-FORAGING NASUTE THAT LIVES ON DEAD WOOD IN OR ON THE GROUND IN AREAS WITH FAIRLY DENSE TREE COVER. MAIN NESTS SO FAR OBSERVED HAVE BEEN UNDER STONES IN THE COMPARATIVELY MOIST PINGUIN GHUT AREA OF GUANA ISLAND. FORAGING GROUPS HAVE BEEN TAKEN ON OTHER ISLANDS WITH FAIRLY HIGH MOISTURE AVAILABLIITY. THE FIRST KNOWN ALATES OF THIS SPECIES WERE FOUND ON TWO OCCASIONS : A PAIR OF ALATES FOUND IN A DAMAGED CHAMBER OF A CRYPTOTERMES GALLERY IN A BUILDING ON VIRGIN GORDA, AND A LARGER SAMPLE OF UNFLOWN IMAGOES AND LATE-

STAGE REPRODUCTIVE NYMPHS TAKEN AT PINGUIN GHUT ON GUANA ISLAND IN LATE JULY. LATER, KRECEK FOUND A COLONY WITH ALATES ON THE WETTER SLOPE OF GUANA NEAR THE SITE OF COLLECTION OF NEOTERMES MONA , IN LATE OCTOBER. THE WOLCOTTI ALATE HAS VERY LARGE, PROTRUDING COMPOUND EYES, AND LARGE OCELLI MOUNTED ON RAISED PROJECTIONS. IT WILL BE DESCRIBED IN DETAIL WITH OTHER UNDESCRIBED CASTES OF SPECIES TAKEN DURING THE SURVEY.

A COMPARATIVE STUDY OF CARIBBEAN REPRESENTATIVES OF SEVERAL GENERA OF SMALL, NON-CARTON NEST BUILDING NASUTES WITH MORE OR LESS CONSTRICTED HEADS AND CYLINDRICALLY-SHAPED NASAL PROJECTIONS HAS BEEN UNDERTAKEN, (SPAETH, PHD THESIS, UNIV. WISC.) BUT THE MATERIAL HAS NEVER BEEN PUBLISHED. NEW COLLECTIONS HAVE REVEALED THE PRESENCE OF DIMORPHIC SOLDIERS IN WOLCOTTI FROM PUERTO RICO (SCHEFFRAHN AND JONES, UNPUBL.) REQUIRING REMOVAL FROM GENUS PARVITERMES . STUDY OF GUT MORPHOLOGY OF WORKERS, DEFENSE SECRETIONS OF SOLDIERS, AND CUTICULAR HYDROCARBON ARRAYS, ALONG WITH COLLECTIONS OF ALATES FOR THE SEVERAL GROUPS SHOULD PERMIT USEFUL TAXONOMIC REORDERING OF THIS LITTLE-KNOWN CLUSTER OF GENERA AND SPECIES.

THE DISTRIBUTION PATTERN SHOWN BY TERMITE SPECIES COLLECTED IN THE BVI DURING THIS STUDY REFLECTS THE IMPORTANCE OF MOISTURE WHICH, WITH TEMPERATURE, DIRECTLY AFFECTS TERMITE DISTRIBUTION. HOWEVER, FACTORS SUCH AS DEFORESTATION, AGRICULTURAL, RESIDENTIAL, AND INDUSTRIAL DEVELOPMENT, OVERGRAZING BY SHEEP AND GOATS, AND RESTRICTIONS OF ACCESS TO COLLECTORS ALL DETERMINE WHETHER OR NOT A TERMITE SPECIES IS COLLECTED ON A GIVEN ISLAND.

NASUTITERMES ACAJUTLAE IS THE LEAST MOISTURE-SENSITIVE OF THE TERMITIDAE SO FAR STUDIED; THIS IS REFLECTED IN COLLECTIONS OF THIS SPECIES ON EVEN THE MOST ARID OF THE ISLANDS. DETERMINING THE RESPECTIVE ROLES OF SOCIAL CONTROL OVER THE ENVIRONMENT AND PHYSIOLOGICAL TOLERANCE DIFFERENCES SHOULD PROVE OF INTEREST.

BISHOP MUSEUM
CELEBRATING A
CENTURY OF DISCOVERY

November 29, 1993

Dr. Louis Roth
Museum of Comparative Zoology
Harvard University
Cambridge, MA 02138

Dear Lou:

Thanks for your letter of November 9, which was awaiting my return from Malaysia.

I will discuss the *Allacta* manuscript with the publications committee at its next meeting. However, I do not expect another meeting until January.

I am taking the liberty of sending you all the Virgin Islands *Symploce* that we have here (except of course, your two paratypes), for identification. They are all from Guana Island, except a few specimens from Necker Island. Four of the specimens were seen by you in 1984. My specimens are mostly from black-light traps, so some are covered with moth scales. Your *pararuficollis* paratypes were taken from my Malaise trap (which was being run by Dale Ford and James Lazell after I left the island) and mounted from alcohol.

If the *Symploce pararuficollis* paper focuses on Guana Island, it might be worth noting the other roaches that are found there? I have specimens here of *Panchlora sagax* Hebard (det. Roth 1984), *Pycnoscelus surinamensis*, and four unidentified species. The specimens you identified for me in 1984 are mostly at USNM, but I think a set of duplicates stayed at MCZ.

Thanks again for your help.

Best Regards,

Scott E. Miller
Chair, Natural History

cc: James Lazell

Cockroaches from Guana Island, BVI

det. L.M. Roth, 1994
collected by S.E. Miller et al.; specimens in Bishop Museum

Symploce ruficollis (Fabricius):vii-1984, vii-1987, vii-1988
[also Necker Island: vii-1988]

Symploce pararuficollis n. sp.: vii-1984, vii-1987, vii-1988

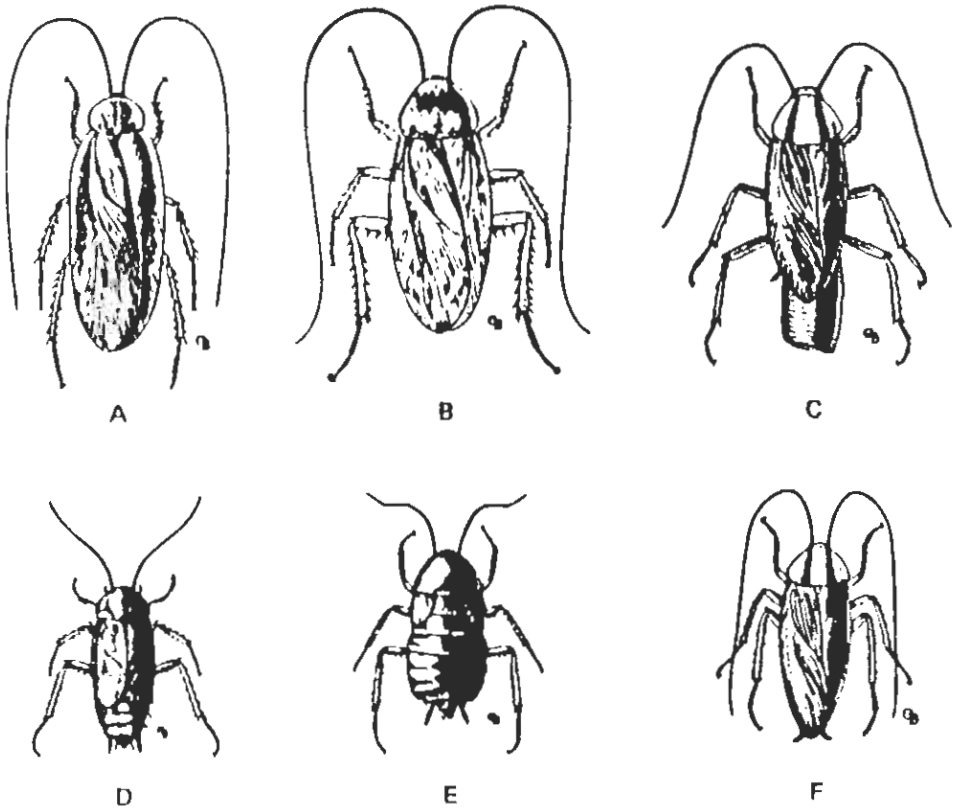
Panchlora sagax Rehn & Hebard: vii-1984, vii-1987, vii-1988

Pycnoscelus surinamensis (Linnaeus): vii-1988

Euthlastoblatta facies (Walker): vii-1987 (1 male)

Cariblatta antiguensis Rehn & Hebard: vii-1987, vii-1988

Plectoptera rhabdota Rehn & Hebard: vii-1988 (1 female)



(NB: These are not Guana roaches, just an assortment of representative species from North America.)

Invertebr. Taxon. 1991, 5, 953–1021

New Combinations, Synonymies, Redescriptions and New Species of Cockroaches, mostly Indo-Australian Blattellidae

Louis M. Roth

Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, U.S.A.
Correspondence: 81 Bush Hill Road, Box 540, Sherborn, MA 01770, U.S.A.

'It quite saddens me to think that when I cross the river Styx I may find myself among so many professional biologists condemned to keep on trying to solve problems, and that Pluto, or whoever is in charge down there now, may condemn me to sit forever trying to identify specimens from my own specific and generic diagnoses, while the amateur entomologists, who have not been damned professors, are permitted to roam at will among the fragrant asphodels of the Elysian meadows, netting gorgeous, ghostly butterflies until the end of time.'

Wheeler (1939: 142)

Steyskal (1965) found that the majority of 16 130 species of Diptera known in 1965 were described by 40 authors. Each was responsible for 100 or more scientific names and of the 14 478 species which they described, 2384 were then considered to be synonyms. The 'great masters' of fly taxonomy averaged 16·5% synonyms. 'The spread is between 1·9 per cent and 42·7 per cent. The most recent authors have the best scores, probably because time has not yet told on them.' About 10 years ago, after I had 'retired', I decided to do for cockroaches what Steyskal calculated for Diptera, using Princis's catalogues. The following figures are approximations because, in addition to my errors in compilation, some names have become synonyms, and new species have been described. About 177 authors were responsible for approximately 4600 names, of which 20% were synonyms. Only 12 authors (all deceased) described some 3257 species (71%) of which 565 (17%) were synonyms. These masters each described from 120 to 392 species and averaged from 5 to 44% synonyms. Some of the older masters have not necessarily faired more poorly than the more recent ones, but time may still tell on all of them. Most of their errors will be uncovered only when taxonomic generic revisions are made.

One of my professors once told me that a taxonomist's reputation is not made by the number of species he describes, but rather by the number of synonyms he creates. One of the supposed perquisites of being a taxonomist is that his errors are not discovered until long after he is 'netting gorgeous, ghostly butterflies' in Nirvana. This isn't true for taxonomists who live long enough to discover their own mistakes and are willing to correct them in print. I have made my quota of errors (some of which I correct below) and the only consolation I have is that even the 'great masters' were not infallible.

MUSEUM OF COMPARATIVE ZOOLOGY
The Agassiz Museum

HARVARD UNIVERSITY
26 OXFORD STREET
CAMBRIDGE, MASSACHUSETTS 02138

14 April 1994

Dr. James Lazell
3930 D Marcom St.
Raleigh, N.C. 27606

Dear Skip,

I've just corrected my 9 page paper "Cockroaches from Guana Island, British West Indies (Blattaria: Blattellidae: Blaberidae". Page costs come to $299. Any chance of getting your wealthy friends to subsidize this?

I just realized that if they did pay the costs I haven't thanked them in the acknowledgements! Any chance of letting me know as quickly as possible?

Sincerely,

Louis M. Roth

Check mailed 18 April 1994. He will acknowledge TCA and Falconwood.

Skip

North Carolina State University

Department of Entomology
College of Agriculture and Life Sciences

Box 7613
Raleigh, NC 27695-7613

17 March 1994

Dr. James (Skip) Lazelle
The Conservation Agency

Dear Dr. Lazelle:

The purpose of this letter is to inform you of our preliminary findings from the insects we collected on Guana Island, B.V.I., in the course of our work there during October, 1993.

In total, we collected nearly 2,500 arthropod specimens on Guana Island and Tortola Island, including representatives of at least 15 insect orders (Lepidoptera, Hymenoptera, Coleoptera, Homoptera, Hemiptera, Neuroptera, Phasmida, Blattaria, Isoptera, Thysanura, Diplura, Psocoptera, Thysanoptera, Embiidina, and Orthoptera). Most of the material collected has either been pinned and dried, or permanently preserved in 80% (museum-grade) ethanol. The specimens are currently being identified and/or sorted for shipping to other experts interested in particular insects. The weevils have already been delivered to Dr. Charles W. O'Brien of Florida A&M University (who is working on Caribbean weevils for Mike Ivie). In addition, a checklist is being prepared for the Fulgoroidea (Homoptera) of Guana Island. A preliminary copy is attached.

Two important discoveries have been made through examination of the Guana Island insect material:

1). we collected 1 adult specimen of *Deiroderes inermis* Ramos, a rare treehopper (Homoptera: Membracidae) previously known from Puerto Rico, Cuba, Jamaica, and St. John, U.S. Virgin Islands. Although both male and female adults are known, there are no records of the immature stages.

2). an expert examined the ant specimens from Guana and Tortola Islands, and informed us that among the ants we had collected was a large number of *Solenopsis invicta* - Red Imported Fire Ants (last year, Dr. Roy Snelling wrote a checklist of the ants on Guana Island, but did not find fire ants; in fact, Dr. Snelling recorded the co-dominance of two species of ants, *Paratrechina longicornis* and *Wasmannia auropunctata*, which we found in smaller numbers than *S. invicta*).

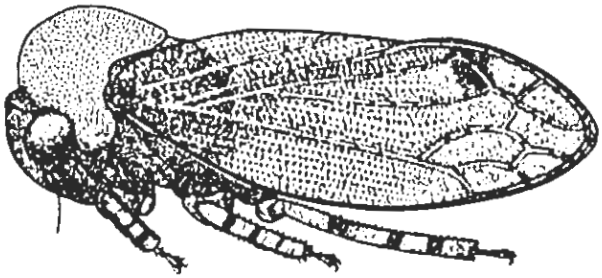
In the future, it would be important to locate and describe the immature stages of *Deiroderes inermis*, to monitor the colonization of *S. invicta* and its effect on the endemic ant populations, as well as to continue collecting fulgoroid Homoptera for inclusion in the checklist.

We wish to thank you and the staff of Guana Island for the opportunity to work on this project, and look forward to hearing from you again.

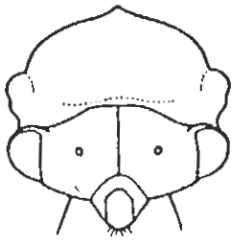
Sincerely,

Jason R. Cryan

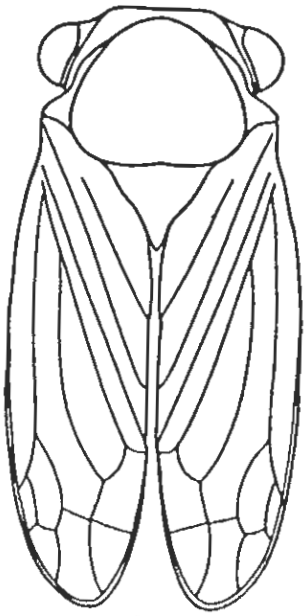
Charles R. Bartlett



A



B



D

A, *Deiroderes inermis* sp. n., lateral view. B, *D. inermis* sp. n., frontal view.

A preliminary list of the Fulgoroids Collected from Guana and Tortola Islands[1]:

Cixiidae
Oliaris sp.
Pintalia alta Osborn

Delphacidae
Neopunana sp.
Saccharosydne saccharivora (Westwood)
Neomegamelanus prob. *elongatus* Ball
Sogata sp.

Derbidae
Omolicna puertana Caldwell & Martorell (from Tortola only)

Achilidae
Catonia prob. *cinerea* Osborn
Catonia prob. *arida* Caldwell & Martorell

Tropiduchidae
Neurotmeta viridis Fennah

Flatidae
Petrusa marginata (Brunnich)
Flatormenis sp.
Melormenis prob. *antillarum* (Kirklady)

Issidae
Thionia argo fennah
Colpoptera poss. *brunneus* Muir
? *Neocolpoptera* poss. *rara* Caldwell & Martorell

Acanaloniidae
Acanalonia brevifrons Muir

Kinnaridae
1 sp.

---

[1]All identifications are tenative at this point.

Submitted to
"Florida Entomologist"
11/93

Correspondence:

Scott E. Miller
Bishop Museum
Box 19,000-A
Honolulu, HI 96817

808-848-4193
scottm@bishop.bishop.
hawaii.org

Bee flies of the British Virgin Islands

(Diptera: Bombyliidae)

Neal L. Evenhuis and Scott E. Miller

Bishop Museum, Box 19000-A, Honolulu, Hawaii 96817-0916

Heretofore no bee flies have been recorded from the British Virgin Islands (BVI) (Evenhuis, 1983, 1992). Survey work for other insects in the BVI by The Conservation Agency from 1984 to 1993 has recorded 6 species of bee flies from a total of 9 islands. Intensity of survey has varied considerably from island to island. Guana Island has been extensively surveyed, while some islands were visited only briefly (e.g., Eustacia, Necker, Scrub).

Fieldwork was based on Guana Island and many specimens were collected in Malaise traps at North Bay. Guana is a small island on the north side of Tortola in the British Virgin Islands (18°28'N, 64°35'W). While it is small, only 297 ha, and the maximum elevation is 266 m, it bears a relatively rich biota and has sustained less damage by feral animals and man than have many adjacent islands (Becker and Miller, 1992). Scott E. Miller and collaborators were in the field VII-1984, VII-1985, VII-1986, VII-1987, VII-1988, and X-XI-1990. Roy R. Snelling was in the field X-1991, X-1992, IV-1993, and VI-VII-1993. Material is split between the Bishop Museum and Smithsonian Institution, with synoptic vouchers in Natural History Museum of Los Angeles County and The Natural History Museum (London). A few additional records were provided from the private collections of Michael Ivie (Norman Island) and Richard Miller.

Table 1 summarizes the material available. All the BVI species are known from Puerto Rico, and all but Exoprosopa cubana are known from the U.S. Virgin Islands (Curran, 1928, 1931). Despite recent collecting the BVI and U.S. Virgin Islands, Chrysanthax nero Fabricius remains known only from the type described from "Americae meridionalis insulis" (either St. Thomas or St. Croix).

Fieldwork by Miller and Snelling was supported by The Conservation Agency, through a grant from the Falconwood Corporation. We thank Michael Ivie, Tina M. Kuklenski, James D. Lazell, Richard Miller, and Roy R. Snelling for assistance in obtaining specimens.

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Curran, C.H. 1928. Diptera. Scientific Survey of Porto Rico and the Virgin Islands 11: 1-118. New York Academy of Sciences.

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Evenhuis, N.L. 1983. An indexed bibliography of Bombyliidae (Insecta, Diptera). Theses Zoologicae 4: 1-493.

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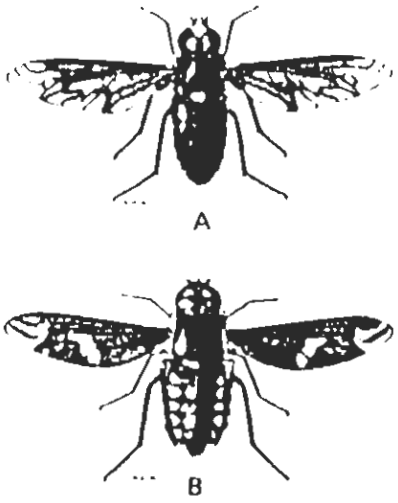


Bee flies.

Family **Bombyliidae** - Bee Flies: This is a large group (over 750 North American species) and its members are widely distributed; bee flies are fairly common insects, but are probably more common in the arid areas of the Southwest than elsewhere. Most of them are stout-bodied, densely hairy flies of medium to large size, a few are slender and not very hairy, and a few are very small (some Mythicomyiinae are only 1.2 mm in length). Many have the proboscis long and slender. The adults are found on flowers or hovering over or resting on the ground or grass in open sunny places. They often visit water holes in arid regions. The wings at rest are usually held outstretched. Most species are very fast fliers, and when caught in an insect net, buzz much like a bee. Many have banded or spotted wings (Figure 495). The larvae, as far as known, are parasitic and attack caterpillars, grubs, hymenopterous larvae, and the eggs of grasshoppers. Some females hover over holes and crevices, dipping quickly to throw in an egg. The larvae crawl into the nest cell of a bee or wasp and wait until the host larva has completed its feeding before they consume it.

DISTRIBUTION OF BOMBYLIIDAE IN THE BRITISH VIRGIN ISLANDS

	Eustacia	Anegada	Necker	Guana	Scrub	Virgin Gorda	Norman	Tortola	Great Camanoe
Heterostylum ferrugineum (Fabr. 1805)				x					
Anthrax oedipus Fabricius 1805				x	x				
Chrysanthrax gorgon (Fabricius 1805)		x		x	x	x			x
Neodiplocampta roederi (Curran 1931)		x		x				x	
Villa lateralis (Say 1825)	x		x	x	x	x	x	x	x
Exoprosopa cubana Loew 1869								x	

NATURAL HISTORY MUSEUM
of Los Angeles County

36

900 Exposition Boulevard
Los Angeles, California 90007

24 February 1994

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

Dear Skip:

Here is the description of a recently published new wasp species that I collected on Guana. I haven't copied the entire paper, just the description of the Guana species. The complete citation is: M. Olmi, 1993: **A new generic classification for Thaumatodryininae, Dryininae and Gonatopodinae, with descriptions of new species (Hymenoptera Dryinidae).** Bollettino di Zoologia agraria e di Bachicoltura (ser. II) 25:57-89.

I have another manuscript nearing completion on a small family of wasps. There are several new species in the Guana material as well as a bunch of good distribution records for several other species. The family itself has never before been recorded from the BVI, although there is one record from St. Thomas, several from St. Croix. The manuscript is for a "festschrift" and has to be ready to go in August. I am still working on an ant identification manual for a workshop that I'll be giving in June. Science marches on!

Next week I'll send the Psorthaspis paper off to Acta Cientifica. I don't intend to hit you guys up for the cost of the color figure.

Cheers, etc., to you and Wen Hua. Nummi, too!

Sincerely yours,

Roy R. Snelling

Boll. Zool. agr. Bachic.
Ser. II, 25 (1), 1993: 57-89

M. OLMI

A new generic classification for Thaumatodryininae, Dryininae and Gonatopodinae, with descriptions of new species (Hymenoptera Dryinidae)

Abstract - A new generic classification is proposed for Thaumatodryininae, Dryininae and Gonatopodinae. In the subfamily Dryininae the following new names are proposed in the genus *Dryinus: hansonianus, harpax, arimensis, kovariki, parkerianus, ater, australiae, gibbosoides, pseudoafer* and *dayianus*. The following new species of Dryininae are described: *Dryinus madagascolus*, from Madagascar; *Dryinus lini* and *choui*, from Taiwan; *Megadryinus pulawskii*, from Peru; *Dryinus cruciatus*, from U.S. Virgin Islands; *Dryinus wasbaueri*, from Papua. In the subfamily Gonatopodinae the following new names are proposed in the genus *Gonatopus: aegypti, fortunatus, tussacensis, owaini, pilosoides, ceballosi, operosus, rufoniger, asiae, insulae, variabilis, americae, cobbenianus, flavoides, stephani, boucekianus*. In the same subfamily the following new combinations are proposed: *Gonatopus helleni* (Raatikainen) and *Gonatopus nearcticus* (Fenton). The following new species of Gonatopodinae is described: *Gonatopus sensitivus*, from Madagascar. In the subfamily Anteoninae the following new names are proposed in the genus *Anteon: hirashimai, paraflaccum, gauldense*. The male of *Anteon minimum* (Fenton), from the U.S.A., is described. In the subfamily Bocchinae the new species *Bocchus rossi*, from Western Australia, is described. In the subfamily Apodryininae the male of *Apodryinus masneri* Olmi, from Chile, is described and the genus *Bocchopsis* Olmi is considered senior synonym of *Australodryinus* Olmi. The new name *Bocchopsis australis* is proposed.

Riassunto - *Una nuova classificazione per i generi di Thaumatodryininae, Dryininae e Gonatopodinae, con descrizione di nuove specie (Hymenoptera Dryinidae).*

Viene proposta una nuova classificazione per i generi di Thaumatodryininae, Dryininae e Gonatopodinae. Nella sottofamiglia Dryininae sono proposti, nel genere *Dryinus*, i seguenti nuovi nomi: *hansonianus, harpax, arimensis, kovariki, parkerianus, ater, australiae, gibbosoides, pseudoafer* e *dayianus*. Sono inoltre descritte le seguenti nuove specie di Dryininae: *Dryi-*

Females

1 Enlarged claw very reduced; approximately as long or slightly longer than arolium (fig. 709 in Olmi, 1984) .... 4. *Dryinus autumnalis* (Olmi) group (formerly *Perodryinus*)
— Enlarged claw not reduced, much longer than arolium (fig. 567 in Olmi, 1984) ... 2
2 Enlarged claw without subapical tooth (fig. 669 in Olmi, 1984) or with at least 2 subapical teeth (fig. 702 in Olmi, 1984); rarely with one only subapical tooth, but in this case with a very broad apical lamella (fig. 41 E in Olmi, 1989) .... 3. *Dryinus lamellatus* (Olmi) group (formerly *Alphadryinus, Mesodryinus, Chelothelius, Bocchoides*)
— Enlarged claw with one subapical tooth, never with a broad apical lamella (fig. 567 in Olmi, 1984) 3
3 Notaulices at least partly visible .... 1. *Dryinus constans* Olmi group (formerly *Dryinus, Richardsidryinus*)
— Notaulices invisible .. 2. *Dryinus ruficauda* (Richards) group (formerly *Tridryinus*)

The new species *Dryinus cruciatus* is belonging to the group 1, where it's near *Dryinus citricolus* Olmi and *Dryinus flavoniger* Olmi. In the key to the females of the Neotropic *Dryinus* proposed by Olmi (1989) *D. cruciatus* can be inserted at number 3, as follows:

1 Occipital carina invisible ..... 1.*constans* Olmi
— Occipital carina complete or incomplete 2
2 Thorax and propodeum fully or almost fully testaceous 3
— Thorax and propodeum mostly or fully black 4
3 Enlarged claw without lamellae (fig. 563 in Olmi, 1984) ..... 2. *citricolus* Olmi
— Enlarged claw with a row of lamellae (fig. 7) ..... 3'
3' Occipital carina incomplete; head with POL almost 0,5 as long as OL ..... 3. *flavoniger* Olmi
— Occipital carina complete; head with POL longer than OL ..... 24. *cruciatus* n. sp.

Thaumatodryinus snellingi n. sp.

DESCRIPTION OF THE FEMALE: fully winged; length 3,75 mm; testaceous, with scutellum brown and petiole black; antennae short, approximately as long as head + mesosoma, with tufts of long hairs on segments 5-10; antennal segments in following proportions: 12:5,5:13:12:13:14:11:9,5:8:9,5; antennal segment 5 less than ten times as long as broad (13:2); head swollen, granulated, dull; frontal line absent; occipital carina complete; POL = 5; OL = 2,5; OOL = 8,5; OPL = 2; TL = 3; breadth of the anterior ocellus slightly longer than OL (3:2,5); pronotum hairy, crossed by a strong transversal impression, dull, granulated, with tracks of numerous transversal striae; pronotal tubercles reaching the tegulae; scutum dull, granulated; notaulices little visible,

incomplete, reaching approximately 0,8-0,9 length of scutum; scutellum dull, granulated; metanotum shiny, smooth, without sculpture; propodeum dull, reticulate rugose, without transversal or longitudinal keels; fore wing with a dark spot beneath the pterostigma; distal part of radial vein longer than proximal part (32:12); radial cell almost closed; fore tarsal segments in following proportions: 17:4:6:14:22; enlarged claw (fig. 8) with two subapical teeth and a row of 25 lamellae; segment 5 of front tarsus (fig. 8) with 24 lamellae without interruption to the apex; apex with a group of 9 lamellae; tibial spurs 1, 1, 2.

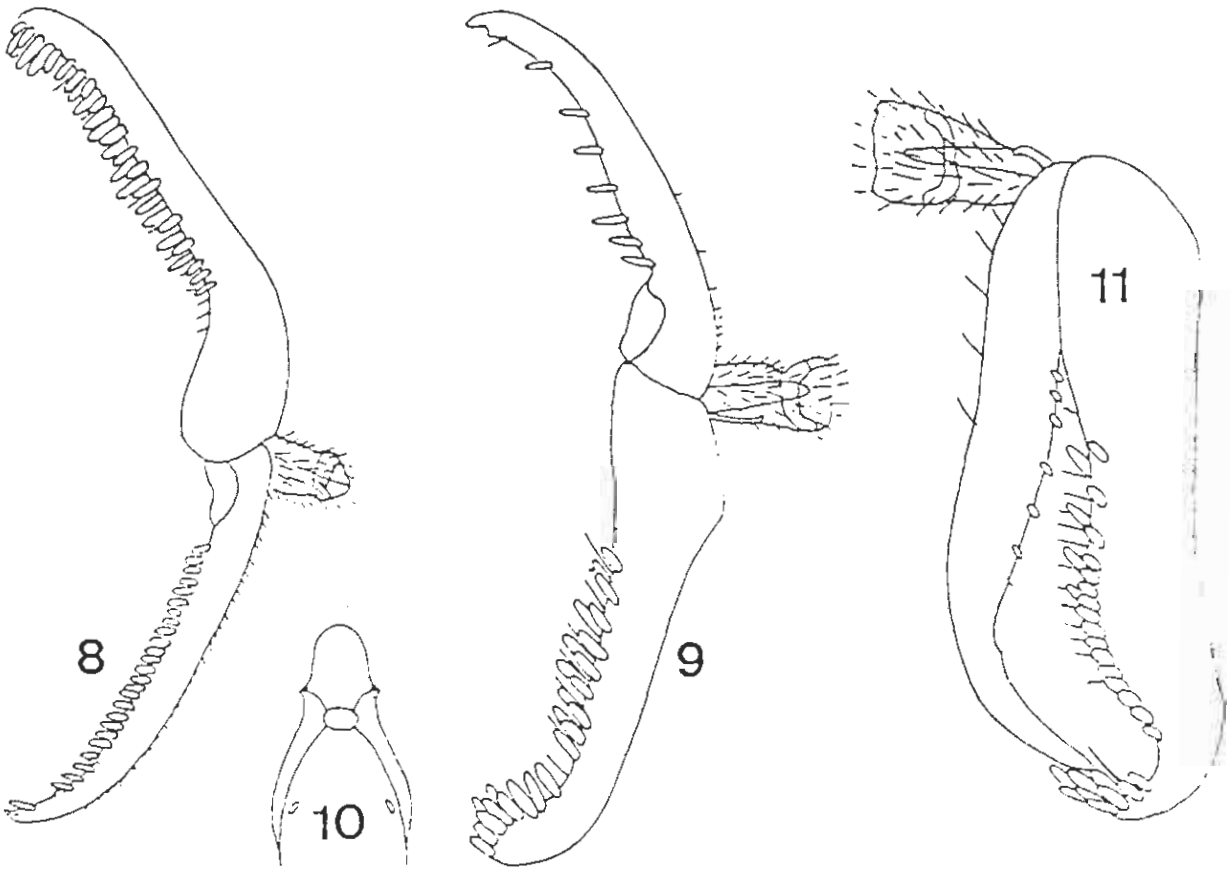
MALE: unknown

LOCUS TYPICUS: Long Man's Pt. trail (Guana I., British Virgin Islands)

TYPICAL MATERIAL: holotype ♀ in LA

DISTRIBUTION: only known of the typical locality.

NOTES: the species is named in honor of the collector of the holotype, Mr. Roy



Figs. 8-11 - Chelae of holotypes of *Thaumatodryinus snellingi* n. sp. (fig. 8); *Dryinus wasbaueri* n. sp. (fig. 9); *Gonatopus sensitivus* n. sp. (fig. 11); scutum and part of metathorax + propodeum of holotype of *Gonatopus sensitivus* n. sp. (fig. 10) (in dorsal view).

R. Snelling; the holotype was collected by a Malaise trap in a dry evergreen forest on October 21-24, 1992. For the very short antenna *Th. snellingi* is an anomalous species of *Thaumatodryinus*. Usually in fact in this genus the female antennae are much longer.

In the key to the females of Neotropic *Thaumatodryinus* proposed by Olmi (1984) *Th. snellingi* can be inserted at number 4, as follows:

4 Antennae very short and less slender, approximately as long as head + mesosoma ..... 7. *snellingi* n. sp.
— Antennae very long and slender, at least 1,5 times as long as head + mesosoma . 5
5 Segment 1 of front tarsus approximately as long as segment 4; head black or brown-black ..... 3. *macilentus* De Santis & Vidal Sarm.
— Segment 1 of front tarsus longer than segment 4; head fully reddish or reddish-testaceous or testaceous 6
6 Ocellar triangle very swollen; breadth of the anterior ocellus more than twice as long as OL ..... 5. *bruchi* De Santis & Vidal Sarm.
— Ocellar triangle slightly swollen; breadth of the anterior ocellus as long as, or shorter, or less than twice as long as OL ..... 4. *rufus* Richards

Family Dryinidae: The Dryinidae are rare wasps, and in most species the two sexes are quite different in appearance. Some females are wingless and antlike. The antennae are 10-segmented, and the front tarsi of the female are usually pincerlike.

The peculiar front tarsi of some females in this family are used in holding the host during oviposition. The dryinids whose life histories are known are parasites of nymphs and adults of the homopterous groups Fulgoroidea, Cicadellidae, and Membracidae. Dryinid larvae feed internally on their host, although during most of their development a part of the body of the larva protrudes from the host in a sac like structure. The parasite, when full grown, leaves the host and spins a silken cocoon nearby. Polyembryony occurs in *Aphelopus theliae* Gahan, which attacks the treehopper *Thelia bimaculata* (Fabricius), with 40 to 60 young developing from a single egg.

Contributions
of the
American Entomological Institute

Volume 28, Number 1, 1993 58 pp.

DESCRIPTIONS OF NEW WESTERN HEMISPHERE GENERA OF THE SUBFAMILY DORYCTINAE (HYMENOPTERA: BRACONIDAE)

By

Paul M. Marsh

Associated Publishers
The American Entomological Institute
1993

Braconid Wasps *Family Bracónidae*

ADULTS: Another important group of parasites, averaging very much smaller than the ichneumon wasps, few attaining ½ inch in length, and differing further in having a relatively shorter abdomen, which is more or less cylindrical rather than laterally compressed. In habits they are very similar to the preceding family. The adults are often found at flowers. The eggs of some braconids give rise to more than one wasp. Such eggs are said to be polyembryonic.

YOUNG: In general, very much like those of ichneumon wasps.

IMPORTANCE: Almost as important as the ichneumons as destroyers of the larvae or pupae of moths and butterflies, other Hymenóptera, and, to a lesser extent, beetles. Being smaller, some of these insects can parasitize such tiny hosts as aphids; bloated, dead aphids with round holes cut in the top of their abdomens once contained these little wasps.

Coiba guanaensis Marsh, new species

(Fig. 19)

Female. Color: entire body black; scape, pedicel and basal 1/2 of flagellum yellow, apical 1/2 brown; legs honey yellow; wings hyaline, stigma light yellow. Body length, 2.0 mm. Head with vertex and frons strigate, face and temples smooth, 14 antennomeres; mesonotum, scutellum, propleuron and mesopleuron coriaceous; anterior corners of mesonotum rounded; notauli weakly scrobiculate; sternaulus coriaceous; propodeum with distinct carinae but without median raised tubercle, coriaceous laterally and within basal lateral areas, rugose posteriorly within areola; first and second metasomal terga strigate-rugose, second tergum with two transverse scrobiculate grooves, remainder of terga smooth and shining; ovipositor about 1/3 length of metasoma.

Male. Essentially as in female; stigma in hind wing triangular (Fig. 19).

Holotype. Female: BRITISH VIRGIN ISLANDS, Guana Island, 0-80m, July 5-23, 1985, S.E. & P.M. Miller. Deposited in USNM.

Paratypes. BRITISH VIRGIN ISLANDS: 1 female, 1 male, same data as holotype. Deposited in USNM.

Etymology. Named for the type locality, Guana Island.

NATURAL HISTORY MUSEUM
of Los Angeles County

900 Exposition Boulevard
Los Angeles, California 90007

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June 15, 1993

Dr. James Lazell
The Conservation Agency
6 Swinburne Street
Jamestown, RI 02835

Dear Skip:

Notes from Underground finally came out. Enclosed is a copy of the 2 pages relating to my October '92 Guana trip.

The April trip added species and I hope to sort out a few problems with my trip coming up on the 23rd of this month. Lianna managed to get me on.

The description of Psorthaspis gloria is finished and my illustrator is now working up the final color rendering of this spectacular wasp. I will keep you informed. Especially when the bills come due.

Two other papers now in progress, both involving Guana, including the description of the new bee species.

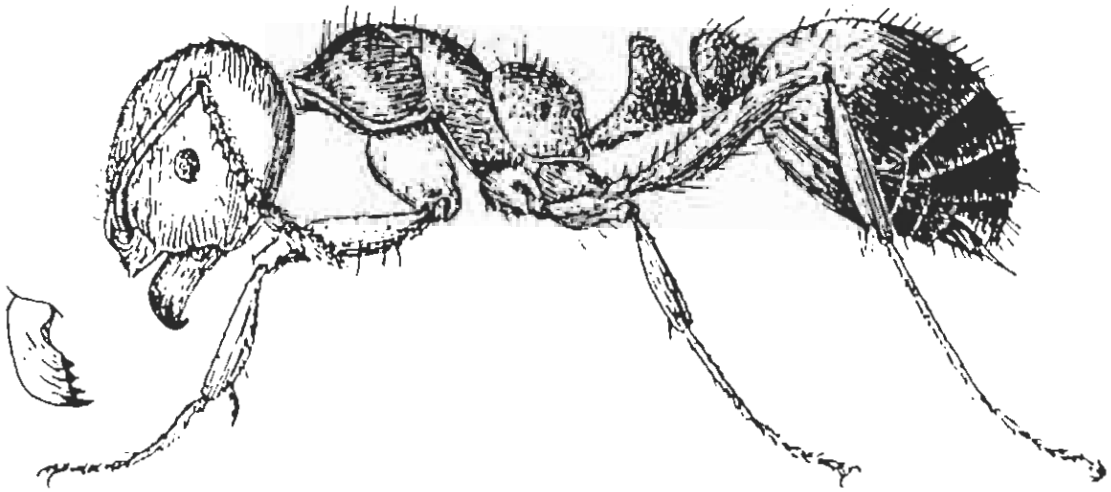
Would like to return to Guana in October, if possible. Let me know.

Sincerely yours,

Roy

Roy R. Snelling
Entomology

RRS/tvr



Solenopsis

Solenopsis invicta, United States (Smith, 1965)

Ants of Guana Island, British Virgin Islands

Roy Snelling
Los Angeles County Museum of Natural History

I've now twice had the opportunity to collect ants in the British Virgin Islands, on a small piece of real estate known as Guana Island. My report in SPHECOS 23 last year briefly described Guana and provided a simple map to the collecting areas indicated on my data labels, so I'll not repeat all that, noting only that it's a small (ca. 340 hectares in area), low (highest point 246 m), dry forest island.

The entire month of October 1992 was spent on Guana, except a few day-trips to Anegada, Cooper, Ginger, Tortola and virgin Gorda Islands. In 1991 I was also there during October and collected 11 species of ants. My latest trip added 18 species (asterisked on following list) in addition to those collected last year, so I guess I can say that it was a pretty successful month. There were a few surprises, mostly in the form of range extensions for species known from elsewhere in the Puerto Rico Bank but not previously recorded from the Virgin Islands. Things like *Mycetophylax conformis*, *Trachymyrmex jamaicensis*, *Camponotus* sp. 2, *Discothyrea* sp. and *Amblyopone* sp.

The last named is represented by two males taken in a malaise trap. Since they are not associated with any workers, there's no way to hang a name on them now. Only one *Amblyopone* is known from this area of the Greater Antilles, *A. falcata*, described last year by John Lattke from Puerto Rico. Most interesting, however, is a single male ponerine also from malaise trap. I thought at first it was a

Hyponera - until I had it pointed could examine it. Turned out to be a *Discothyrea* species, but there things get difficult, since there appear to be no prior records for the genus in the Greater Antilles. Several are known from Central and South America and one from the U.S.' The systematics of *Discothyrea* is very imperfect at present and is based solely on workers; ergo nothing further can be done with my lone specimen at this time.

At present *Odontomachus* has not been taken, but I suspect it must be present. Similarly absent are native species of *Paratrechina* (*P. longicornis* is introduced from the Old World); whether they were once present and subsequently displaced by *P. longicornis* or never had been there cannot now be answered. But, of the several species of *Paratrechina present* on Puerto Rico, all are decidedly scarce in the drier forest areas on the south side.

Camponotus sp. 1 and sp. 2 are both undescribed and are apparently widely distributed in the Puerto Rico Bank. Both are common on Puerto Rico, where they have been misidentified by Wheeler and all subsequent authors as *C. ustus* Forel. The types of *C. ustus* are from St. Thomas (American V.I.) and, while in pretty poor condition, are very definitely not the same as the ants commonly identified as *C. ustus*. However, the several infraspecific taxa from Hispaniola attributed to *C. ustus* do appear to be correctly so placed. The variety described from Colombia (var. *arhuacus* Forel) is something else. C. usyus is common on Mona, but apparently consistently absent elsewhere in Puerto Rico, and I've seen no recent collections of it from any of the virgin Islands. The two undescribed species will be described in "The Ants of Puerto Rico" (co-authored with Juan Torres) ; we hope to have the manuscript finished and subnitted later this year.

Myrmicines were the usual mixed bag of mostly native species as well as a few introduced species: *Cardiocondyla emeryi*, *Monomorium floricola*, *Pheidole megacephala* . Of these, only *M. floricola* appears to be common, but never a problem for native ants. *Wasmannia auropunctata* and *Paratrechina longicornis* appear to share honors as co-dominant ant species on the island, although *Wasmannia* is largely restricted to the forested areas. But, while common enough, it does not appear in any way to be a limiting factor for the other ants. Clark, et al. (1982, Biotropica 14:196-207) have noted that *W. auropunctata* proved to be a very destructive competitor for other ants following its introduction into the Galapagos.

Mycetophylax conformis has not been previously reported from the Virgin Islands, but it does occur on Puerto Rico. Nests are small and inconspicuous; the cryptically colored workers forage at night and are very timid. My Guana record is based on a single female collected in a flight trip.

Another fungus-grower not hitherto reported from the Virgin Islands is *Trachymyrmex jamaicensis*, although it is common in Puerto Rico. Nests were common on Guana, usually on or near trails. They are easily spotted by the conspicuous light brownish refuse piles, normally located some distance (up to ca. 30 cm) from the entrance. The entrance itself is about 5-7 mm in diameter, sometimes with a short turret. Workers forage mostly at night, but even at midday a few may be found moving very slowly through leaf litter. Fruit pulp is commonly used as a substrate for the fungus which is grown in lacey "curtains" suspended from roots or (occasionally) stones.

Two species of *Rogeria* were collected in flight traps as sexual forms only. *R. foreli* is represented in some numbers by both sexes; *R.* sp. is based on a single male. Other *Rogeria* in this part of the Caribbean include the one recorded by M.R. Smith (1936, The Ants of Puerto Rico) as *R. curvipubens* Emery. According to Kugler's unpublished revision of *Rogeria*, Smith's material represents an undescribed species collected on Tortola and Puerto Rico, but known only from workers. Kugler also states that true *R. curvipubens* has been collected on St. Thomas and St. Croix, in addition to Jamaica and, on the mainland, Mexico south to northern South America; males are unknown. So...

That's it for now. With luck, next year will answer some questions and generate new ones.

Ponerinae
**Amblypone sp.*
**Discothyrea sp.*
Leptogenys pubiceps Emery
Pachycondyla stigma (Fabricius)

Myrmecine
Cardiocondyla emeryi Forel
Crematogaster steinheili Forel
Cyphomyrmex minutus Mayr
Monomorium ebininum Forel
Monomorium floricola (Jerdon)
Mycetophylax conformis (Mayr)
Pheidole fallax Mayr
Pheidole megacephala (Fabricius)
Pheidole moerens Wheeler?
Pheidole susannae Forel
Rogeria foreli Emery
Rogeria sp.
Solenopsis germinata (Fabricius)
Solenopsis sp. 1
Solenopsis sp. 2
Trachymyrmex jamaicensis (Andre)

Dolichoderinae
Dorymyrmex jamaicensis Forel
**Tapinoma melanocephalum* (Fabricius)

Formicinae
Brachymyrmex heeri Forel
Brachymyrmex obscurior Forel (= *B. "obscurus"* in SPHECOS 23; *lapsus*)
Camponotus sexguttatus (Fabricius)
Camponotus sp. 1 (undescribed)
Camponotus sp. 2 (undescribed)
**Myrmelachista ramulorum* Wheeler
Paratrechina longicornis (Latreille)

Revta bras. Ent. 37(1):131-139 31.03.1993

ARANHAS DO GÊNERO *HIBANA* BRESCOVIT: ESPÉCIE NOVA, COMBINAÇÕES, SINONÍMIAS E NOVAS OCORRÊNCIAS PARA A REGIÃO NEOTROPICAL (ARANEAE, ANYPHAENIDAE)

Antonio D. Brescovit[1,2]

ABSTRACT. SPIDER GENUS *HIBANA* BRESCOVIT: NEW SPECIES, NEW COMBINATIONS, SYNONYMIES AND RECORDS FROM NEOTROPICAL REGION (ARANEAE, ANYPHAENIDAE). *Osoriella discolor* Mello-Leitão and *Teudis bicolor* Banks are transferred to *Hibana* and redescribed. *H. talmina*, sp. n., from Guyana, Colombia and Brazil is described. Two specific names are herein synonymyzed: *Hibana septena* (Franganillo) with *H. tenuis* (Koch) and *H. pallidula* (Franganillo) with *H. velox* (Becker). New records of *H. similaris* (Banks), *H. tenuis* (Koch), *H. melloleitaoi* (Caporiacco), *H. futilis* (Banks) and *H. velox* (Becker) are included.

KEYWORDS. ANYPHAENIDAE; ARANEAE; *HIBANA*; NEOTROPICAL REGION; TAXONOMY.

INTRODUÇÃO

O exame dos tipos de *Osoriella discolor* Mello-leitão, 1929 e *Teudis bicolor* Banks, 1909, permitiu apontar os caracteres diagnósticos do gênero *Hibana*, recentemente proposto por BRESCOVIT (1991), para o qual as espécies são transferidas e redescritas.

A triagem de extenso material enviado por diversas instituições nos últimos meses, possibilitou detectar uma espécie nova do gênero, *H. talmina*, duas sinonímias novas e ampliar os registros de ocorrência de outras cinco espécies: *H. similaris* (Banks, 1929), *H. tenuis* (Koch, 1866), *H. melloleitaoi* (Caporiacco, 1947), *H. futilis* (Banks, 1898) e *H. velox* (Becker, 1879).

Coleções examinadas (curadores entre parênteses): AMNH, *American Museum of Natural History*, Nova Iorque (N.I. Platnick); BMNH, *The Natural History Museum*, Londres (P.D. Hillyard); BPBM, *Bernice P. Bishop Museum*, Honolulu (S.F. Swift); CAS, *California Academy of Sciences*, São Francisco (C.E. Griswold); FSCA, *Florida State Collection of Arthropods*, Gainesville (G.B. Edwards); IBSP, Instituto Butantan, São Paulo (V.R. von Eickestedt); IJNH, *Institute of Jamaica, Natural History* Division (T.H. Farr), INPA, Instituto Nacional de Pesquisas da Amazônia, Manaus (C. Magalhães Filho); JAK, Coleção particular John A. Kochalka; LNK, *Staatliches Museum für Naturkunde*, Karlsruhe (H. Höfer); MACN, *Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"*, Buenos Aires (E. Maury); MCN, Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre (E.H. Buckup); MCZ, *Museum of Comparative Zoology*, Cambridge, Mass. (H.W. Levi); MNHN, *Museum National d' Histoire Naturelle*, Paris (C. Rollard); MNRJ, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro (A. Timotheo da Costa); MUCV, *Museo de Biologia, Universidad Central de Caracas*, Caracas (G.A. Pereira); MZSP, Museu de Zoologia, Universidade de São Paulo (J.L.M. Leme); RLCB, Coleção particular de Renner L.C. Baptista.

1. Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Caixa Postal 1188; 90001-970 Porto Alegre RS, Brasil.
2. Bolsista CAPES.

Hibana tenuis (Koch)

Anyphaena tenuis Koch, 1866: 211-213, pr. IX, fig. 140 (holótipo ♀, BMNH 1916.6.1.839, Santo Domingo, Republica Dominicana, examinado)

Aysha tenuis; Simon, 1897: 97, 103.

Aysha septena Franganillo, 1935: 23 (sintipos 1 ♂ 1 ♀, de Serra Maestra e Santiago de Cuba, Cuba, provavelmente na Academia de Ciências de Cuba, Havana, não examinado, *partim*, apenas a fêmea); 1936: 117 (*partim*, apenas fig. 65b); Bonnet, 1955: 837. **Syn. n.**

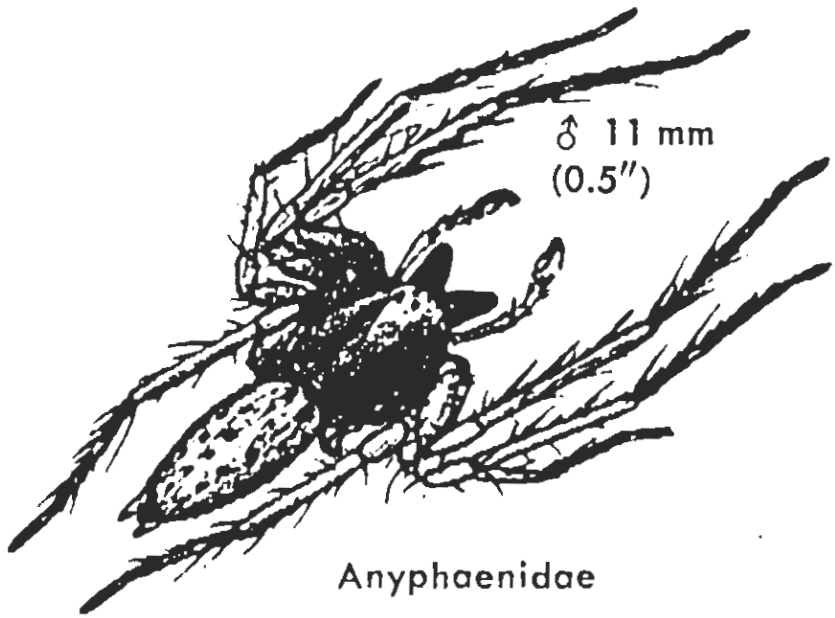
Hibana tenuis; Brescovit, 1991: 734-736.

Sinonimia. A fêmea de *A. septena* figurada por FRANGANILLO (1937) apresenta as bordas laterais do epígino largas, alongadas e afiladas no ápice como em *H. tenuis*.

Registros novos. ILHAS BAHAMAS. Ilha Bimini: South Bimini, 1 ♀, 12-18.XII.1952, A.M. Nadler col. (AMNH); Ilha Eleuthera: James Cistern, 1 ♀, 1.IV.1953, E.B. Hayden, L. Giovanelli col. (AMNH 258); Ilha Nassau: 2 ♀, 1945, A.S. Vernay col. (AMNH); Ilha New Providence (7 milhas oeste da I. Nassau), 1 ♀, 4.I.1953, E.B. Hayden, L. Giovanelli col. (AMNH); Ilha Long: (coletado no mangue), 1 ♂, 12-15.I.1966, Island Project Staff, Univ. P. Rico col. (AMNH); Ilhas Caicos; Cays (4 milhas ao sudeste), 1 ♀, 27.II.1953, E.B. Hayden, Rabb, L. Giovanelli col. (AMNH 178). CUBA. *Pinar del Rio*: Ilha de Pinos, 1 ♀, 7.I.1950 (FMNH); Sierra de Anafe, 1 ♀, 1.I.1947, M. Barro col (AMNH). *Cienfuegos*: próximo a Cienfuegos (Passo Caballos), 1 ♀, 18.I.1954, L. Ross col. (FMNH); 1 ♀, 20.I.1954, L. Ross col. (FMNH). *Havana*: Santiago de Las Vegas, 1 ♀, III.1952, N.L.H. Krauss col. (AMNH); Havana, 1 ♀, 20.IX.1944, Ossuo-Alemain col. (AMNH); Santa Fé, 1 ♀, A. Archer col (AMNH); Sierra Maestra (Loma del Gato), 1 ♀, 26-28.V.1959, M.W. Sanderson col. (AMNH C59-5). *Santiago de Cuba*: Cuabitas, 1 ♀, 10.XII.1955 (AMNH). JAMAICA. Montego Bay, St. James, 2 ♂ 1 ♀, III.1952, H.V. Southby col (IJNH); St. Andrew (Monte View), 1 ♂, IX.1950, C.B. Lewis col (IJNH); 1 ♀, 7.II.1960, C.B. Lewis col. (IJNH); (Cross Roads), 1 ♂, 28.VII.1955, A. Archer col. (AMNH); Parish (Campus, University of the West Indies); 1 ♂, 17.XI.1986, W.J. Pulawski col. (CAS); Kingston, 1 ♂ 1 ♀, XI.1958, G.R. Proctor col. (IJNH); Golden Grove, 1 ♂, 26.VII.1960, P. e V. Vauries col. (AMNH); Torrington, 1 ♂, 18.VII.1960, Vauries col. (AMNH). REPÚBLICA DOMINICANA. Santiago Rodrigues: Moncion (Mao River), 1 ♀, 23.X.1986 (BPBM; 3 km a leste de Moncion (350 m alt.), 1 ♀, 30.X.1986, G. Greenfield col. (BPBM). PORTO RICO. Mayaguez, 1 ♀, 21-22.II.1955, A.M. Nadler col. (AMNH); Muertos Island, 7 ♂ 3 ♀, 28.V - 24.VI.1959, Medina, Martonell col. (AMNH); Lajas, 1 ♂, 13.II.1961, A.M. Nadler col. (AMNH); Camuy, 1 ♀, 24.IV.1930, Leonard col. (AMNH); Vega Alta (em folha de pimenta), 1 ♀, 29.XII.1931, A.S. Mills col. (AMNH); Cayo Ahogado, 2 ♀, 4.I.1964 - 3.VII.1966, Isl. Project Staff, Univ. P. Rico col. (AMNH); Vivero de Catalina (Palmer), 2 ♀, 17.II.1961, A.M. Nadler col. (AMNH); Vega Baja, 1 ♀, 8.XII.1931, A.S. Mills col. (AMNH); San Sebastian, 2 ♀, IV.1963, S. Acevedo col. (AMNH); Palominitos Island, 2 ♂, 17.II - 15.IX.1966, H. Heatwole, F. Mekenzie col. (AMNH); Pineros Island, 1 ♂, 24.IX.1964, H. Heatwole, F. Mekenzie col. (AMNH); Desecheo Island, 1 ♂, 27-29.V.1965, H. Heatwole, F. Mekenzie col. (AMNH); San German (Port Grilo), 2 ♂, 23.II - 4.IV.1955, A.M. Nadler col. (AMNH); Ahogado Key, 1 ♀, 12-16.III.1966, Isl. Project Staff, Univ. P. Rico col. (AMNH); Cayo Enmedio, 1 ♂, 6-11.II.1966, Isl. Project Staff, Univ. P. Rico col. (AMNH). ILHAS VIRGENS. Saint John: 1 ♂ 2 ♀, VI-VII.1958, A.F. Archer col. (AMNH); 1 ♀, 9.III.1925, F.E. Lutz col. (AMNH); 2 ♀, 18.XII.1965, Isl. Project Staff, Univ. P. Rico col. (AMNH); Saint Thomas: Crown Monts (1500 m alt.), 1 ♂, 7.VII.1958, A.F. Archer col. (AMNH); Denmark Hill, 1 ♀, 30.VIII-2.IX.1957, A.F. Archer col. (AMNH); Flagstok Hill (Stumpy Bay), 1 ♂, 7.VII.1958, Sanderson col. (AMNH); Charlote Amilia, 1 ♀, 3.VI.1911, F.E. Lutz col. (AMNH); Saint Croix, 2 ♀, 22.II.1925, F.E. Lutz col. (AMNH); East End, 1 ♂ 1 ♀, 15.XII.1965, Isl. Project Staff, Univ. P. Rico col. (AMNH); Cristiansted, 1 ♀ (AMNH); 1 ♂ 2 ♀, 15-16.I.1955, A.M. Nadler col. (AMNH). ANTILHAS HOLANDESAS. Ilha Saba: (400 m alt.), 1 ♂, 12-15.I.1968, B. Malkin col. (AMNH). ILHAS VIRGENS BRITÂNICAS. Ilha Guana: 1 ♀, 2.VII.1965, Isl. Project Staff, Univ. P. Rico col. (AMNH); North Bay, 1 ♂ (MCZ); Ilha Tortola: Marina Key, 1 ♀, 4.VII.1965, H. Heatwole, R. Lewins col. (AMNH); Ilha Great Thatch, 2 ♂ 4 ♀, 30.VI.1965, H. Heatwole, R. Lewis, F. Mekenzie col. (AMNH); Ilha Scrub, 1 ♂ 2 ♀, 3.VII.1965, Isl. Project Staff, Univ. P. Rico col. (AMNH); Road Town (100 m alt.), 2 ♂, VII.1972, N.L.H. Krauss col. (AMNH); Long Bay Estate, 1 ♂, 21.VII.1965, Isl. Project Staff, Univ. P. Rico col. (AMNH); Ilha Anegada: 1 ♀, 12.XI.1966, H. Beatty col.

(AMNH); Ilha Virgem Gorda, 1 ♂ 4 ♀, VIII.1976, A.M. Chickering col. (MCZ); 1 ♂ 1 ♀, XI.1966, H. Beatty col. (AMNH); Ilha Nevis: Charlestown, 3 ♀, XI.1967, N.L.H. Krauss col. (AMNH); Ilha Redonda: próximo de Antigua, 1 ♀, W.L. Branch (MCZ); Ilha Saint Kitts: Basse-Terre (50 m alt.), 1 ♀, VII.1976, N.L.H. Krauss col. (AMNH); Antigua: Crosbies, 1 ♀, 21.VIII.1967, Sabath col (MCZ); Reeds Point (próximo de Jolly Beach, sob rochas vulcânicas), 2 ♂, 2.VIII.1963, Wacring col. (AMNH); Saint John's (100 m alt.), 1 ♀, VII.1979, N.L.H. Krauss col. (AMNH); Ilha Montserrat: Plymouth (100-200 m alt.), 5 ♀, VII.1971, N.L.H. Krauss col. (AMNH); Ilha Ginger: 1 ♀, 25.V.1966 (AMNH); Ilha Necker: 1 ♀, 6.VI.1966 (AMNH); Ilha Norman: 1 ♀, 26.VI.1966 (AMNH); (Dead Man's Chest), 1 ♀, 26.V.1966 (AMNH); Ilha Peter: 2 ♀, 9.VII.1965 (AMNH); Ilha Fallen Jerusalem: 1 ♀, 24.V.1966 (AMNH); Ilha Little Jost Van Dyke: 1 ♂, 27.VII.1965 (AMNH); Ilha George Dog, 1 ♀, 7.VI.1966 (AMNH); Ilha Cooper, 2 ♂, 23.V.1966 (AMNH); todos coletados pelo Isl. Project Staff, Univ. P. Rico col. GUADALUPE. Dumaine Duclos, 1 ♂, 24-26.VI.1960, Vaurics col (AMNH); Ilhas de Saintes (Terre-de-Haut), 1 ♀, 1-4.VII.1960, Vaurics col. (AMNH). DOMINICA. Batako, 1 ♂, 30.I.1968, B. Malkin col. (AMNH); Portsmouth (100 m alt.) 1 ♂, VII.1979, N.L.H. Krauss col. (AMNH). MARTINICA. Diamant, 1 ♂, 18.VI.1960 (AMNH); Trois Lletes (Ansemitan), 1 ♀, 10-11.VI.1960 (AMNH); Point Ferret (la Caravelle), 1 ♀, 19.VI.1960 (AMNH); Saint Anne, 1 ♀, 20.VI.1960 (AMNH); todos coletados por P. Vaurics; Fond-La-Haye, 1 ♂, 8-9.I.1955, A.M. Nadler col. (AMNH). SAINT VINCENT. Kingston (200 m alt.), 1 ♀, VIII.1976, N.L.H. Krauss col. (AMNH). GRANADA. Próximo de Saint George, 1 ♂ 1 ♀, 3.VI.1950, L. Isaacs col. (AMNH). TRINDAD Y TOBAGO. Ilha Little Tobago: 2 ♀, 4.IV.1966 (AMNH); Trinidad. Mont Saint Benedict, 1 ♀, XII.1931, J.G. Meyers col. (AMNH 2312). NICARAGUA. Granada: Granada, 1 ♂, N. Banks col. (MCZ). COLOMBIA. *Antioquia*: Medellin, 1 ♂, I-II.1963, P.B. Schneble col. (MCZ).

Distribuição geográfica. América Central, Ilhas Bahamas, Grandes e Pequenas Antilhas, Trinidad, Tobago, Venezuela e Colômbia.



Anyphaenidae

LAND SHELLS OF GUANA ISLAND, VIRGIN ISLANDS, WEST INDIES

BY WILLIAM J. CLENCH

Surprinsingly little is known about the land mollusks of the various islands composing the Virgin Island group. St. Thomas and St. Croix, among the larger islands, are well known, the others very imperfectly so, and their few records are scattered in many different reports. Most of the smaller islands are wholly unknown regarding their terrestrial mollusk fauna, though of course, there is no reason to suppose that their faunistic relationships would differ from the larger islands in their immediate vicinity.

Recently Mr. and Mrs. George T. Dewey, Jr., of Worcester, Massachusetts, have paid three visits to Guana Island[1] one of the smaller islands in this group and very kindly collected a series of land shells, as well as a large series of the marine forms. Though the following list is small, it is the first, so far as I have been able to trace, for this island.

Guana Island, though irregular in outline, is aproximately one and one-half miles in diameter and is only one half mile off the northeastern end of Tortola Island. Both islands are within the ten fathom contour line on the Virgin Island Bank. The approximate center of this island is North Latitude 18°29′; West Longitude 64°34′. The highest altitude is 180 feet (United States Hydrographic Chart no. 905).

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(1) The name of this island has, until very recently, been called Guano, a change from Guana, a much earlier spelling on the charts. The older spelling has now been newly adopted in the West Indian Pilot. The name is very probably a corruption of the word "Iguana" and not a direct use of the word guano. There are no present indications that guano deposits ever existed on the island, at least in any commercial quantities.

Neritina virginea Linn.

Alcadia fovcata Pfr.

Helicina fovcata Pfeiffer 1853, Proc. Zool. Soc. London, p. 53 (St. Thomas).
Alcadia (Eualcadia) fovcata Prf., A. Wagner 1907, Conchy Cab. 1, pt. 18, sec. 2, p. 58, pl. 9, figs. 1-3.

Wagner's figure of the base of the shell (fig. 2) does not indicate the granulose surface of the umbilical depression and the parietal wall. Individual specimens are generally unicolorous though two distinct color types of yellow and brown exist. There is a faint and narrow band at the whorl periphery.

Chondropoma tortolense Pfr.
Tralia pusilla Gmel.
Melampus flavus Gmel.
Pedipes mirabilis v. Mühl.
Physa cubensis Pfr.
Subulina octona Brug.
Opeas micra Orb.
Obeliscus swiftianus Pfr.
Hojeda subaquila Shutt. (Plate 36, fig. 2.)
Plagioptycha nemoralina Petit

Plagioptycha cuclasta Shutt.

Helix cuclasta Shutt. 1854, Mitth. Natur. Ges., p. 38 (Ponce, Puerto Rico).

This species has been considered a *Thysanophora*, but on conchological grounds it appears to be a *Plagioptycha*, and not far removed from the *P. indistincta* Fér. group of Hispaniola. It possesses a columellar fold, similar to this latter species, though it lacks the basal or apertural tooth. The axial costae in *cuclasta* are exceedingly fine, much finer than that exhibited by *indistincta*.

Aguayo[2] first indicated its cepoloid relationships, but I am inclined to believe that this species is in the genus *Plagioptycha* rather then *Hemitrochus*.

(2) 1934, Mem. Soc. Cubana Hist. Nat. 8, p. 94.

Department of Biology
The University of Michigan Ann Arbor, Michigan 48109-1048

Telephone (313)
Fax (313) 747-0884

11/8/93

Dear Skip,

Thanks for the copy of Clench's list of land snails from Guana in the 1930's. I've already got a copy, though, and provided one or two to the famed Guana Island library of natural history. Clench made a little cottage industry out of publishing lists of snails from small Caribbean islands. By and large, they are not very useful, though this one is somewhat interesting inasmuch as there are several differences between his lists and mine. Perhaps these would interest you.

Clench lists 13 species of "land" snails. Of these, 5 are associated with either fresh water or salty zones around the island (though he doesn't discuss this), and currently I cannot find any of these species alive on Guana. Of the 22 species of strictly land snails I have found on Guana, the two most obvious species to a casual observer are not even listed by Clench, suggesting they were imported to Guana since his report. Most of the others are microsnails which his collector simply overlooked because he wasn't using the required collecting method. Of the native land snails of the BVI, another 1-3 species of macrosnails might possibly be expected from Guana, but I have yet to see them there. This is because they would be inhabiting hot, dry scrub areas and I haven't really searched those few areas on Guana for snails.

I hope you had another exciting season on the island. I'd be interested to know if Roy is able to convince the managers/owners to let him on the island for a week or so in February. If he does, please let me know, since I'd like to make sure he surveys flowering Sida eggersii for pollinators.

Cheers,

Fred

P.S. My first snail paper will be sent off to Nautilus soon, though it doesn't deal with the BVI much.

RARE Center for tropical conservation

1616 Walnut Street, Suite 911, Philadelphia, Pennsylvania 19103
TEL: (215) 735-3510 · FAX: (215) 735-3515

28 October 1993

Dr. James D. Lazell, President
The Conservation Agency
6 Swinburne Street
Jamestown, RI 02835

Dear Skip:

I have just written to Noel Snyder and Herb Raffaele (sample enclosed) to sound them out on our plan. I hope that I shall be hearing from them shortly.

I am also enclosing a copy of suggested wording for the ad that I suggested be put in *Ornithological Newsletter*. Once approved, this should be submitted without delay. I believe the deadline for the next issue (published quarterly) is December 1st.

When you were on Necker Is. I did reiterate to Henry my feeling that offering some salary might be money well spent in this case. He offered no objection at the time. I was tempted to send him copies of the ad plus letter so that he would be reminded of what essentially was agreed upon, and that, as promised, I am moving forward on these issues. But I thought that perhaps you might not like my dealing with him directly, so I leave all that to you.

We leave shortly for the Bahamas, so I am anxious to get this to you before departing.

Thanks again for inviting me to Guana. I hope that useful things will result from that visit.

Regards to you and Numi,

2948 Southern Avenue
Memphis, TN 38111

encl.

PS: You might make note of RARE's new address/phone.

28 October 1993

Mr. Herbert A. Raffaele
5232 Cherokee Avenue
Alexandria, VA 22312

Dear Herb:

I am writing to get your opinion about a proposed ecological study of Pearly-eyed Thrasher. I have just returned from a week on Guana Is., B.V.I., where I was deeply impressed by both the thrasher's abundance and the paucity of other small birdlife, and couldn't help wonder about a possible connection. The relative lushness of Guana would suggest an ability to support a richer avifauna, both in terms of variety and numbers.

The present owner of Guana is very much concerned with the island's biota, and has expressed interest in supporting some basic research on the thrasher. Attached is a proposed ad for possible placement in *Ornithological Newsletter* giving some of the parameters of this support.

My question to you is: do you think the thrasher is implicated in the seemingly diminished bird fauna on Guana and other small islands in the region, and do you think basic research in this area would be productive and useful in the context of biodiversity and conservation?

Before pushing further in this direction, I thought it prudent to solicit your views.

Very sincerely,

David O. Hill
Founder

2948 Southern Ave.
Memphis, TN 38111
(901)458-2050 or 323-8126

attachment

5 December 1993

Dear Skip:

Enclosed is a copy of a letter just received from Herb Raffaele in response to my letter of Oct. 28 asking his opinion about Pearly-eyed Thrasher research. It contains several valuable suggestions.

At this point I haven't a clue as to what you wish me to do, if anything, from here on. I'll assume, for now, that you wish to follow through with this yourself.

Charlotte and I are just back from Connecticut where we left a nearly full moving van being loaded with the last of our stuff. As of Friday, Dec. 3rd, we are out of CT for good.

Best wishes to you for the coming holidays.

Sincerely,

2948 Southern Avenue
Memphis, TN 38111

Phone conf: 12.1.94: David will track down Arndt and Tapkin

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

TAKE PRIDE IN AMERICA

ADDRESS ONLY THE DIRECTOR
FISH AND WILDLIFE SERVICE

In Reply Refer To:
FWS/IA

November 22, 1993

Mr. David O. Hill
RARE Center for Tropical Conservation
1616 Walnut Street, Suite 911
Philadelphia, PA 19103

Dear David:

Thank you for your letter of October 28 inquiring about the possible impact of the Pearly-eyed Thrasher on Guana Island. Off hand, I would not be surprised if the Thrasher did have a significant impact on the avifauna of such a small island. However, this is conjecture. For starters, you will want to review the work of Wayne Arndt who did his Ph.D. on the bird, and that of a former Puerto Rican Parrot field worker, John Tapkin(?), who did his M.S. on the Thrasher. Perhaps the existing research on the Pearly-eye is enough to permit intelligent guesses as to what may be happening on Guana. If new research is needed, so be it, but I would not simply jump into it.

As to the utility of such research in the context of biodiversity conservation, I would say that research, in and of itself, contributes little. I would want to know how directly the research is connected with the interests of local managers, what is the capacity of the local managers to use the data, whether the data has any use beyond the particular case at hand, whether skills have been transferred to local individuals, etc.

I hope these comments are useful to you. If you desire to discuss this matter further, please give me a call at 703 358-1767. I will be out of the office until the first week of December.

Sincerely,

Herbert Raffaele
Western Hemisphere Coordinator

December 17, 1993
P.O. Box 426
Portal, AZ 85632

David O. Hill
2948 Southern Ave.
Memphis, TN 38111

Dear Mr. Hill,

I apologize for being slow in responding to your letter of 28 October. I have a strong bias toward attributing almost everything in the world to the influence of Pearly-eyed Thrashers -- after watching their impacts on Puerto Rican Parrots for a number years. In our Puerto Rican Parrot study we were able to document a very significant negative correlation of abundance of thrashers with abundance of other species, across a wide variety of habitat types, and we strongly suspect this was a direct result of predation by the thrashers. This was all written up in our book on the Puerto Rican Parrot (published by Western Foundation of Vertebrate Zoology in 1987 -- see enclosure).

In more recent years thrashers have continued to increase in Luquillo Forest, while other birds have continued to decline. One species appears to have disappeared virtually entirely now -- the Puerto Rican Sharp-shinned Hawks -- and for this species such a result may trace both to direct predation on sharpshin eggs and young and to negative effects on the sharpshin's food supplies.

Thus, I strongly support your interest in developing research on the thrashers, although I cannot give you any direct data on impacts of the thrashers on other birds on the particular islands you are working with. I've been recommending such research to prospective graduate students for many years now.

Best wishes,

Noel Snyder

METRO

MEMPHIS, MONDAY, DECEMBER 27, 1993 THE COMMERCIAL APPEAL

Pilot strives to aid winged friend

By William Thomas
The Commercial Appeal

It's not easy to find a West Indian whistling duck.

David O. Hill, a Memphis pilot for Federal Express, began looking for one in 1962. Almost 30 years later, on a January night in 1990, he caught a glimpse of three sitting on a pond in Little Cayman Island. In that moment, things changed for both Hill and the whistling duck.

"I was afraid this threatened bird might quietly fade out of existence while nobody noticed," said Hill, noting that the duck's nocturnal habits, retiring nature and its range outside the United States keeps it out of the public eye. "So I decided to try to do something about it."

It was not the first time Hill, who likes birding almost as much as flying, had tried to help nature along. Twenty years ago, while based in Philadelphia, he founded the RARE Center for Tropical Conservation to save threatened species and their habitats in the Americas.

David Hill

The organization initiated the save-the-whales movement and focused attention on dwindling tropical forests. It also worked to protect rare parrots.

In fact, it was on a parrot trip to Little Cayman Island that Hill, on the night of a full moon, saw the three whistling ducks. He returned to Memphis and put together a recovery plan for what has been called the most endangered duck in North America.

The latest phase of that plan involves 11,000 color posters — some in English, some in Spanish — that call attention to the plight of the duck and urge its protection. The posters were produced by a Memphis advertising firm (Rutland Simmons Group) and will be hung in the Bahamas, Jamaica, the Virgin Islands, the Dominican Republic, Puerto Rico, even Cuba.

"It will take five or six trips over the next two years to put up the posters in airports, post offices, schools, groceries, even bars where hunters gather," said Hill. The idea is to build awareness of the bird in its shrinking habitat.

"We're also looking for refuges where we can re-introduce the birds. And we're looking for help, particularly from volunteers who have some connection in the Caribbean and would like to join the effort to save the whistling duck." (Hill can be contacted at 458-2050.)

Is whistling duck North America's "most endangered"?

NATIONAL MUSEUM of
NATURAL HISTORY
SMITHSONIAN INSTITUTION

Skip Lazell
Box 32 Road Town, Tortola
Guana Island Wildlife Sanctuary
British Virgin Islands

02 December 1992

Dear Skip:

A short while ago we received a package of bird bones (of a flamingo) which your nephew kindly sent to us through the post office on St. Thomas. Although his letter is neatly written, I can't make out his signature. Please thank him profusely on our behalf and if you would clarify his name, we will put him in the record as the collector.

Lots of unfortunate incidents have occured in the last year between Fish and Wildlife Law Enforcement and museum collectors that has caused us to be afraid of "donations" (particularly imports) that arrive sans salvage or collecting permit. The innocent acceptance of a picked-up, dead bird, even of a non-endangered/threatened species could mean that the museum could lose all collecting permits (minimally), or be heavily fined, or both. I hate to be such a bureaucratic turd, but do you have any sort of permit from the "gov'mint" of BVI that allows you to collect or export salvaged birds, of which you have sent us two this year (the Phoenicopterus and a Black-Bellied Tree Duck) ? If you have such, could you please send me a good copy? Sorry to have to ask this of you... and thank your nephew !

Very truly yours,

Phil

J. Phillip Angle
Collections Manager
Division of Birds

Answ: 2.x.93 - not me!

The Conservation Agency

Exploration, Education, and Research

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

21.ii.94

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

Dr. Rose Chabert
DNR Scientific Research
P.O. Box 5887
San Juan, PR 00906

Re: White-crowned pigeons

Dear Jose:

For many years. it has been our hope to reestablish the white-crowned pigeon in the British Virgin Islands. They formerly nested there, but were hunted out by about 1950. Now, no hunting is allowed in these islands.

We would like to obtain up to six fledgling birds and put them on Guana Island. The entire island, ca 300 ha, is a wildlife sanctuary. Miguel Garcia and George Proctor know it well and can attest to the good quality of the habitat.

If you agree, I will come to San Juan and transport the birds directly to the BVI. I would need someone to help me catch the birds (Miguel might be able to organize this). I would also need a veterinary certificate.

Let me know what costs or expenses you anticipate this Agency will need to cover, apart from my room and board (I would probably stay at U.P.R., Rio Piedras). I do not know, for example, how difficult or time-consuming it will be to catch the birds. I do remember seeing nests in trees on a golf course that looked fairly easy to reach by ladder.

I look forward to seeing you soon.

All best wishes

James (Skip) Lazell, Ph.D.

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.

24 March 1994

WHITE-CROWNED PIGEON RESTORATION: BRITISH VIRGIN ISLANDS

The white-crowned pigeon, la paloma cabeza blanca (Columba leucocephala) was formerly abundant in the British Virgin Islands but extirpated there as a breeding bird before 1970 (Mirecki, D.N. 1976. Report of the Cambridge Ornithological Expedition to the British Virgin Islands. Churchill College, Cambridge, UK: 44 pp.) It is the hope of The Conservation Agency to restore a breeding population to these islands.

Reasons for Extirpation

Mirecki, (op. cit.) gives no reason for his statement that this species "declined drastically" to the point where only it is now "only a casual visitor." Local authorities vary in opinions. Wiley (1985. Bird Conservation 2:107-159) listed habitat loss as the principal cause of general avian decline in these islands, but it seems as though suitable habitat remains in the BVI, especially on Guana Island. I have made direct comparisons of Puerto Rican breeding habitat with that available on Guana, and the Guana site seems less disturbed and more diverse. Wiley (op. cit.) listed shooting as the second greatest cause of loss, and this seems likely to me. White crowned pigeons are delicious, in strong contrast to the scaly-naped pigeon (Columba squamosa), which local people disdain as food. After World War II, it is said that guns were plentiful and hunting was a regular thing. Prior to making all hunting illegal in 1972, the white-crowned pigeon, West Indian whistling duck, masked duck, and roseate flamingo all disappeared. Populations of bridled quail dove and Bahama duck were reduced to rarity, but these species have come back and are now common on some islands (Lazell, J. 1989. Guana: a natural history guide. The Conservation Agency, Jamestown, Rhode Island, USA:

20 pp). Because gun ownership and hunting are now both illegal throughout the BVI, we believe restoration can succeed.

Restoration Site

We believe the Guana Island Wildlife Sanctuary is an ideal site to attempt restoration. The island is 340 ha and has extensive mangrove swamp bordering a salt pond. The staff will feed and care for the birds throughout their acclimatization period, and can continue to supply food indefinitely. According to Dr. George Proctor, P.R.D.N.R., who has conducted detailed studies of Guana's flora over a span of several years, the vegetation there today is in unusually fine condition and species diversity is remarkably high. We believe the Island's resources can easily support a population, especially if subsidized in the early stages.

Plan

We would like to bring six (6) fledgling white-crowned pigeons from Puerto Rico, or Culebra, or any other island within the purview of P.R.D.N.R., to Guana Island in the spring of 1994. The birds would be reared in captivity until able to fend for themselves, then released in the immediate area of the Island manager's home. The birds would continue to be fed around this building so as to monitor their health. We hope this nucleus would breed as soon as 1995, and possibly attract some of the reported strays from other populations.

To complete this project we need to obtain the young pigeons and a veterinary certificate, presumably from Dr. Juan Torres or Dr. Guzman, of U.S. Dept. Agriculture, or both, and the cooperation of the BVI Ministry of Natural Resources. This Agency will cover any costs involved provided they are not too great!). We will make plans and ascertain costs well in advance.

James D. Lazell, Ph.D.

5 December 1993

Dr. Skip Lazell
The Conservation Agency
6 Swinburne Street
Jamestown, RI 02835

Dear Skip,

First of all, both Jeannine and I would like to thank you for inviting us to Guana. We had a great time and wish to return next year. I just finished analyzing our survey data and am sending you (a) two computer print-outs of our raw data (in chronological order and sorted by island, species and sex), and (b) tables that summarize these data. The sound recordings are yet to be analyzed, but I have a contact at Univ. Victoria, who may be able to help us.

In total, we obtained information on 193 Eleutherodactylus antillensis and on 62 E. schwartzi (Tables 1A and 1B). Females and juveniles are under-represented on all islands, probably because they are so hard to locate. All the observations are independent, because we did not collect data in the same location more than once. We carried out the surveys systematically each night, usually by walking along the path in two groups and recording captures/sightings/calls of frogs within a certain, variable distance from the path. We attempted to investigated all habitats from ground to as high up in the vegetation as we could see. On Guana and Virgin Gorda, we systematically recorded every male, including cases when the male was too high up in the vegetation to reach or when it escaped. This provides us with an estimate of the potential bias in our data, resulting from the fact that we could only measure males that we could catch. On Guana, this bias is 61%, and on Virgin Gorda, it is 30%.

The data show some interesting patterns in terms of (a) size of both species on different islands, and (b) their habitat use. Adult males of E. antillensis are significantly smaller, in terms of their weight and length, on Virgin Gorda than they are on Guana and Tortola (Tables 2A and B). Similarly, adult males of E. schwartzi are smaller on Virgin Gorda than on Tortola (Tables 3A and B). Several explanations for this are of course possible. However, it would be interesting to compare male mating tactics of E. antillensis on Guana, where the population density is lower and males are larger, to those of males on Virgin Gorda, where the population densities are higher and males are smaller (on the average; we did catch some large males).

The perch height of male E. antillensis also appears to differ between Guana and Virgin Gorda (Table 4A). The data for Tortola lack recordings of males above 250 cm and thus are not directly comparable. On Guana, a larger proportion of males called from

above 250 cm than on Virgin Gorda (48% versus 9%, respectively). Male E. antillensis were found in a variety of microhabitats, including trees (usually leaves, occasionally woody branches or trunks), low woody understory shrubs, agave, bromeliads, herbaceous plants, dead vegetation and cacti (Table 5A). The microhabitats used, as well as perch heights, probably reflect the availability of different types of vegetation on the different islands. The limited data for females and juveniles suggest that they use similar microhabitats as do males.

Most male E. schwartzi perched below 200 cm in the vegetation on both Tortola and Virgin Gorda (Table 4B). Interestingly, on Virgin Gorda, most male E. schwartzi, unlike male E. antillensis, called from bromeliads, but no such trend is evident on Tortola (Table 5B). However, we noticed that E. schwartzi appears to be associated with moister microhabitats than E. antillensis on both Tortola and Virgin Gorda, and it would be interesting to test this hypothesis next year. Perhaps a close association with bromeliads is not necessary on Sage Mountain, if this area indeed is wetter than Gorda Peak. Notice the relatively large number of females that were found in unusual habitats (Table 5B).

On Guana, the distribution of E. antillensis appears to be patchy. The green lines on the map show the paths that we walked at night during or just after a rain. The approximate locations of areas where we heard calling frogs are marked in red. We heard calling in only two patches along the Monkey Point trail: in Pinguin Ghut and just before Harris Cove. Dense stands of agave occurred in the latter patch. Bromeliads are common along the Long Point trail, where frogs also are common. We saw no similar bromeliad patches in the other areas that we covered and where we heard no frogs. Suitable moist microhabitats may limit the population on Guana.

I think our data on habitat use and size differences of the frogs among islands, as well as between the two species, provides material for a paper, perhaps in Journal of Herpetology. However, we should include data for another year and increase some sample sizes, as well as carry out a more quantitative study to compare habitat use between the two species. We would also like to carry out some play-back experiments to examine the function of the different types of advertizement calls.

Do you have any suggestions, where we could apply for a research grant for such short-term work? For example, we would like to purchase proper recording equipment next year.

We wish you happy holidays and all the best,

TABLE 1A. SUMMARY OF SURVEY DATA FOR *ELEUTHERODACTYLUS ANTILLENSIS* (OCTOBER 1993).

	FREQUENCY			
	GUANA	TORTOLA	VIRGIN GORDA	**TOTAL**
MALES (CAUGHT)	33	21	50	**104**
MALES (SEEN OR HEARD)	49	-	22	**71**
FEMALES	6	6	1	**13**
JUVENILES	0	4	1	**5**
TOTAL	**88**	**31**	**74**	**193**

TABLE 1B. SUMMARY OF SURVEY DATA FOR *ELEUTHERODACTYLUS SCHWARTZI* (OCTOBER 1993).

	FREQUENCY		
	TORTOLA	VIRGIN GORDA	**TOTAL**
MALES (CAUGHT)	10	17	**27**
MALES (SEEN OR HEARD)	-	19	**19**
FEMALES	10	0	**10**
JUVENILES	6	0	**6**
TOTAL	**26**	**36**	**62**

TABLE 2A. SNOUT-VENT LENGTH (mm) OF *ELEUTHERODACTYLUS ANTILLENSIS*.

	ISLAND			
	GUANA	TORTOLA	VIRGIN GORDA	P
MALES:				
MEAN	29.1	29.2	27.2	
SD	1.1	1.6	1.5	
RANGE	27.0-31.5	26.0-32.0	24.4-30.3	
N	33	21	50	
DIFFERENCE AMONG ISLANDS (one-way ANOVA)				<0.001
FEMALES:				
RANGE	36.0-43.2	28.0-32.0		
N	4	6		

TABLE 2B. WEIGHT (g) OF *ELEUTHERODACTYLUS ANTILLENSIS*.

	ISLAND			
	GUANA	TORTOLA	VIRGIN GORDA	P
MALES:				
MEAN	1.7	1.7	1.3	
SD	0.2	0.2	0.2	
RANGE	1.4-2.1	1.3-2.0	0.8-1.6	
N	33	21	49	
DIFFERENCE AMONG ISLANDS (one-way ANOVA)				<0.001
FEMALES:				
RANGE	3.9-4.8	1.2-1.9		
N	4	6		

TABLE 3A. SNOUT-VENT LENGTH (mm) OF *ELEUTHERODACTYLUS SCHWARTZI*.

	ISLAND		
	TORTOLA	VIRGIN GORDA	P
MALES:			
MEAN	24.9	22.4	
SD	1.5	1.2	
RANGE	23.0-28.0	20.2-24.9	
N	9	17	
DIFFERENCE AMONG ISLANDS (one-way ANOVA)			<0.001
FEMALES:			
MEAN	31.7		
SD	3.0		
RANGE	25.5-32.5		
N	10		

TABLE 3B. WEIGHT (g) OF *ELEUTHERODACTYLUS SCHWARTZI*.

	ISLAND		
	TORTOLA	VIRGIN GORDA	P
MALES:			
MEAN	1.1	0.8	
SD	0.3	0.1	
RANGE	0.9-1.0	0.6-1.0	
N	8	17	
DIFFERENCE AMONG ISLANDS (one-way ANOVA)			0.002
FEMALES:			
MEAN	1.9		
SD	0.4		
RANGE	1.2-2.7		
N	10		

TABLE 4A. PERCH HEIGHT OF *ELEUTHERODACTYLUS ANTILLENSIS*.

PERCH HEIGHT (cm)	**FREQUENCY**			
	GUANA	TORTOLA	VIRGIN GORDA	**TOTAL**
MALES:				
GROUND	1	0	0	**1**
1-50	6	2	5	**13**
51-100	9	10	42	**61**
101-150	12	5	9	**26**
151-200	10	4	6	**20**
201-250	4	0	2	**6**
251-500 (appr.)	38	-	6	**44**
TOTAL	**80**	**21**	**70**	**171**

TABLE 4B. PERCH HEIGHT OF *ELEUTHERODACTYLUS SCHWARTZI*.

PERCH HEIGHT (cm)	**FREQUENCY**		
	TORTOLA	VIRGIN GORDA	**TOTAL**
MALES:			
GROUND	0	0	**0**
5-50	1	10	**11**
51-100	3	11	**14**
101-150	2	5	**7**
151-200	1	5	**6**
201-250	2	0	**2**
250-500 (appr.)	-	5	**5**
TOTAL	**9**	**36**	**45**

TABLE 5A. MICROHABITAT USE BY ELEUTHERODACTYLUS ANTILLENSIS.

MICROHABITAT	FREQUENCY			
	GUANA	TORTOLA	VIRGIN GORDA	**TOTAL**
MALES:				
TREE	49	8	32	**89**
SHRUB[1]	2	5	29	**36**
PINGUIN BROMELIAD	4	0	2	**6**
OTHER BROMELIAD	4	0	2	**6**
AGAVE	18	0	0	**18**
HERBACEOUS PLANT	0	6	4	**10**
CACTUS	1	0	0	**1**
DEAD VEGETATION	2	2	2	**6**
TOTAL	**80**	**21**	**71**	**172**

	GUANA + TORTOLA	
	FEMALES	JUVENILES
TREE	7	1
SHRUB	0	0
PINGUIN BROMELIAD	0	0
OTHER BROMELIAD	1	0
AGAVE	2	0
HERBACEOUS PLANT	2	3
TOTAL	**12**	**4**

[1]low woody understory plant

TABLE 5B. MICROHABITAT USE BY ELEUTHERODACTYLUS SCHWARTZI.

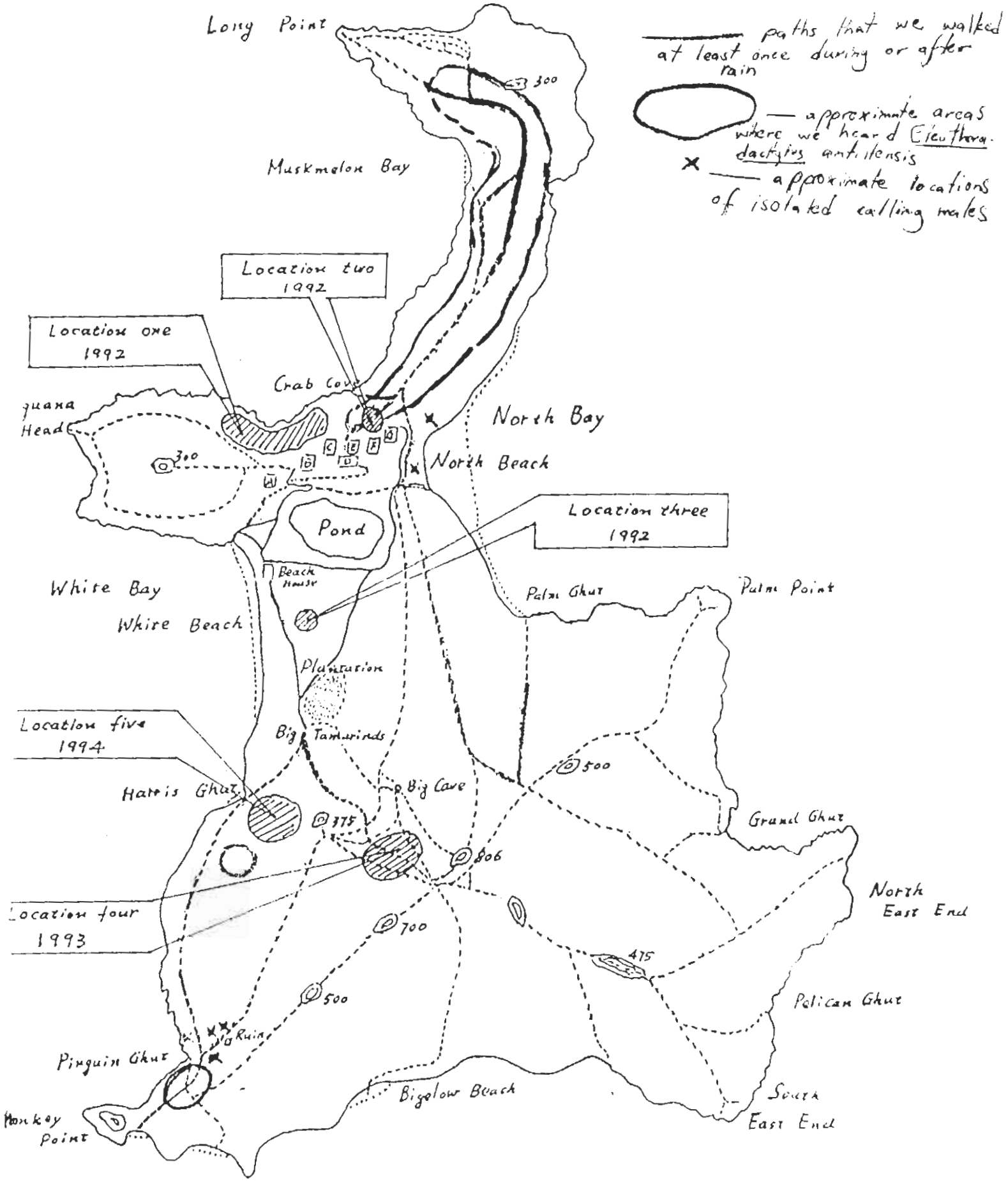
MICROHABITAT	FREQUENCY		
	TORTOLA	VIRGIN GORDA	TOTAL
MALES:			
TREE	0	5	**5**
SHRUB	5	0	**5**
PINGUIN BROMELIAD	0	1	**1**
OTHER BROMELIAD	0	29	**29**
AGAVE	0	0	**0**
HERBACEOUS PLANT	3	1	**4**
OTHER[2]	2	0	**2**
TOTAL	**10**	**36**	**46**

	TORTOLA	
	FEMALES	JUVENILES
TREE	0	0
SHRUB	0	1
PINGUIN BROMELIAD	0	0
OTHER BROMELIAD	0	1
AGAVE	0	0
HERBACEOUS PLANT	1	4
DEAD VEGETATION	1	0
OTHER[3]	8	1
TOTAL	**10**	**7**

[2]outhouse wall

[3]outhouse wall, rope, picnic table

Recommended Planting Areas, 1992–1994



Arnold Grobman
The Valley
Virgin Gorda
British Virgin Islands
Ph: (809) 495-5221

October 29, 1993

Dr. Ronald I. Crombie
Division of Amphibians and Reptiles
United States National Museum
Smithsonian Institution
Washington, DC 20560
USA

Dear Ron:

Under separate cover I will be sending two packets of eleuths from Virgin Gorda. One packet of ten specimens has been identified as *E. antilliensis* and the other, of nine specimens, *E. schwartzi*. The specimens are in isopropyl.

The collection data for both groups of specimens is as follows:

> Gorda Peak Park, Virgin Gorda, British Virgin Islands
> ca. 1300'; ca. 2300 hrs.; October 27, 1993.
> Kristina Ovaska & Jeannine Caldbeck

Ovaska and Caldbeck are part of the group of visiting scientists whom Dr. James Lazell brings down to the BVI for various kinds of investigations and, as I understand it, they are doing comparative life history studies of the anurans of these islands.

I have no information for you, unfortunately, on *Peltaphryne*.

My wife and I are planning to leave Virgin Gorda and move to the States. Because of our advancing years it seems prudent to be closer to adequate medical care than is available here. So the message is that if you plan to visit Virgin Gorda and stay at our place, you should do so before spring.

We had a splendid trip to Costa Rica; I saw many herps in the field that I had only read about. I'd like to go back. I hope you had a profitable trip to the Pacific.

Cordially,

A

Skip - Sorry we didn't have more time to chat. A

Copies: Lazell, Ovaska, and Caldbeck

SMITHSONIAN INSTITUTION
WASHINGTON, D.C. 20560

10 December 1993

Dr. Arnold B. Grobman
168 Crown Bay - Suite 310
Charlotte Amalie, St. Thomas
Virgin Islands 00802

Dear Arnold:

We've catalogued the eleuths collected by Skip Lazell's troops on Gorda Peak and they are now USNM 329472-81 (E. antillensis) and 329482-91 (Schwartzi). Thanks for forwarding them along.

Hope you have a happy holiday season.

Best,

Ronald I. Crombie
Co-Collection Manager
Division of Amphibians & Reptiles

cc: Registrar
J.D. Lazell

SMITHSONIAN INSTITUTION
WASHINGTON, D. C. 20560

21 December 1993

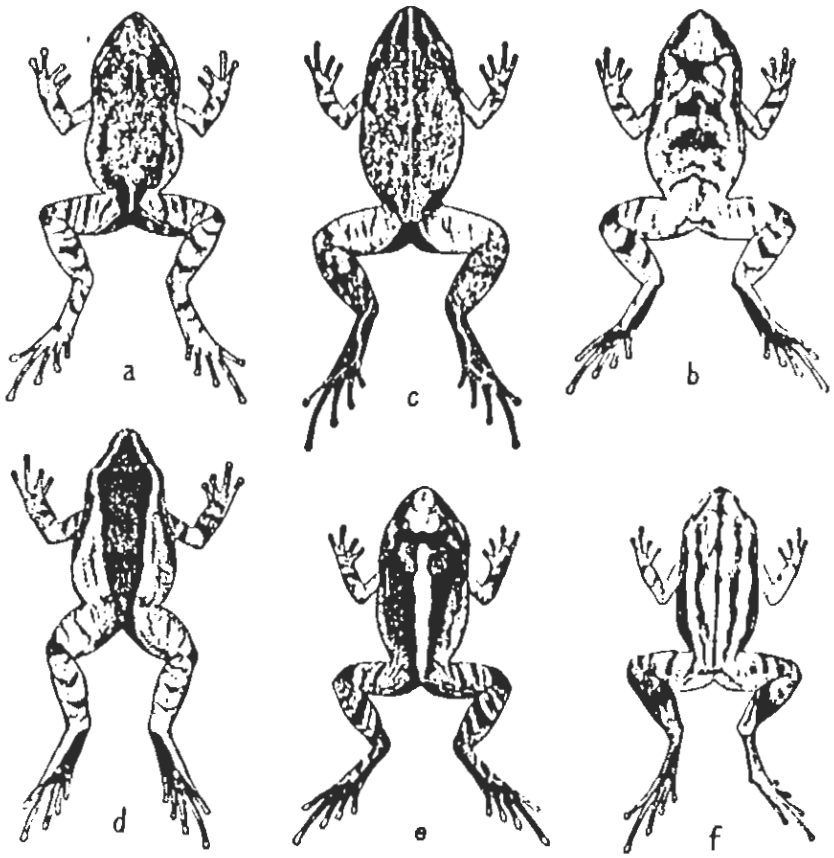
Dr. J.D. Lazell, Jr.
The Conservation Agency
6 Swinburne Street
Jamestown, Rhode Island 02835

Dear Skip:

For your records, I enclose a printout of the eleuths Ovaska & Caldbeck collected on Virgin Gorda, subsequently forwarded on to us by Arnold Grobman.

I had a decent trip to the Pacific. How's about you?

Ronald I. Crombie
Co-Collection Manager
Division of Amphibians & Reptiles



The bewildering array of pattern variation within one population of Eleutherodactylus frogs.

DEPARTAMENTO DE RECURSOS NATURALES

August 2 1993

Dr. James Lazell
The Conservation Agency
6 Swinburne Street
St. Jamestown
RI 02835

Dear Skip:

Sorry by my delay in notify about my boa surveys in Guana Island. Everything is moving slow because the change in the puertorican government. Even though I spent three nights in Guana, I did not completely check the suitable areas for the presence of boas. A tremendous rain limited the searching during the first night (may 26), then the next two nights, I decided to concentrate my efforts in the North Beach an areas nearby. During daytime I walked around Guana prioritizing areas to search later. Although no boas were found, the habitat for boas in Guana is excellent, but it is necessary to spend more time searching and if possible with one more person. I would recommend a one week, two persons survey. The problem is that Guana lacks (fortunately) the patchiness of habitat that characterizes other areas (islands). More than ever I would like to continue the boa surveys in Guana and if no boas are found the idea of introducing them (from Tortola) might be consider.

Miguel A. García

Letter ex Guana, 5.x.93: next year.

722-7517

Ave. Muñoz Rivera, Pda. 3, San Juan, P.R./ Aptdo. 5887, Pta. de Tierra, P.R. 00906

TOLEDO ZOOLOGICAL SOCIETY
2700 BROADWAY TOLEDO, OHIO 43609 (419)385-5721

TOLEDO ZOO

9 DEC 93

Dr. James D. Lazell
The Conservation Agency
6 Swinburne St.
Conanicut Is. RI 02835

Dear Skip:

Thank you for your entertaining and informative letter of 26 NOV. There is absolutely no question in my mind that *E. inornatus* is not endangered and *E. monensis granti* is more common than originally thought, and it may come as some surprise to you to know that I have held this opinion for some time. Certainly they should be down listed. I have problems removing *granti* completely from the endangered species list because it has **clearly** been extirpated from many islands. I would really like to know who received $600K for working with these creatures, because it certainly was not me! If you are talking about figures presented in the budgets of the recovery plans, you ought to know by now that those figures are flights of fancy- hardly any big money gets spent on lowly reptiles and amphibians.

If there are so many boas on Tortola, why cannot you collect a series to study and place them (establish?) in a small museum on Guana or elsewhere in the BVI? The USFWS has no jurisdiction there, and you could study them to your heart's content. I do agree that it is sometimes a real trial to get permits from the USFWS to import boas (my mentor Arnold Kluge tried getting a roadkill specimen in from the BVI and gave up in disgust). I would certainly like you to relay to me what nefarious acts I am guilty of that have prevented you or anyone else from working with boas. As I have told you in the past, I would gladly endorse any permit application you or Richard would make to collect a reasonable series of these animals. What's the beef?

My real interest is restoration of Puerto Rican ecosystems, a concept that is dear to your own heart. Our work on La Cordillera, particularly the feral mammal eradication efforts, can only help **all** the native fauna of those cays, even though it was done with the boa in mind. God, how I would like to see *Cyclura pinguis* returned to the Puerto Rican satellites. By the way, what is your perception of the success of the reintroduction of flamingos to Anegada? Many thanx for the update and best wishes for the holidays.

Sincerely,

Peter J. Tolson
Conservation Biologist

The Conservation Agency

Exploration, Education, and Research

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

6 Swinburne Street
Gmanicut Island
R.I. 02885 U.S.A.

26.i.94

Dr. Bertrand Lettsome
Conservation Officer
Ministry of Natural Resources
Road Town, Tortola
British Virgin Islands

Re: Boa, Epicrates monensis granti

Dear Dr. Lettsome:

I would like to apply for an export permit for salvaged carcasses of the small, native boa in the BVI, noticed above.

From time to time, bodies of these snakes are found dead on roads, or killed by people, or electrocuted on fences. Some years ago, I sent a roadkill to the British Museum (Natural History). Most recently, Fred Kraus -- then doing botanical work on Guana Island -- got another dead one (cause of death unknown to me), which was taken by Julie Overing to your offices to serve as an official voucher specimen within the BVI. I believe other specimens are around, in bottles of preserving fluid, or frozen.

While I believe it is useful to have a specimen on hand in the BVI (such as the one Ms. Overing got from Dr. Kraus), I believe it is equally useful to put additional salvaged specimens in a major museum for worldwide public access. There are great taxonomic questions about the identities of monensis group boas from the various different islands (Tortola, St. Thomas, Cayo Diablo, Puerto Rico, and Mona being the largest). These questions can only be answered by examination and comparison of actual specimens.

If you look favorably upon my request to gather up and properly preserve and document BVI boas found dead in the field, I would specifically propose deposition in the Museum of Comparative Zoology at Cambridge, Massachusetts, U.S.A. This is the world's largest herpetological collection, superbly curated, and wide-open to qualified researchers and students from all over the world. The original type specimen of your boa, Epicrates

monensis granti, from Tortola, is in this museum, as are other specimens from St. Thomas and Mona (at least).

I hope you will consider exhibiting the specimen at your offices, and consider some educational publicity about these harmless, beneficial, rodent-eating snakes. They seem to be fairly common on Tortola, but they remain very little-known to most of the public -- either in the BVI or the world.

Sincerely yours

James Lazell, Ph.D.

cc: Dr. John Cadle, Museum of Comparative Zoology.
Dr. Peter Tolson, Toledo Zoological Society.

Journal of Herpetology, Vol. 27, No. 4, pp. 485-486, 1993

Tortoise, cf. *Geochelone carbonaria*, from the Pleistocene of Anguilla, Northern Lesser Antilles

JAMES LAZELL, *The Conservation Agency, 6 Swinburne Street, Jamestown, Rhode Island 02835, USA.*

Perhaps the most pervasive and problematical questions facing Caribbean biogeographers involve the native versus introduced status of many species and populations; these questions color all attempts to choose between dispersal, land bridge, and land barge explanations of the fauna (Williams, 1989). The tortoises of the genus *Geochelone* are a classic case in point (Censky, 1988). Other examples include frogs like *Eleutherodactylus johnstonei* (Schwartz, 1967) and various geckos of genera *Hemidactylus* and *Thecadactylus* (Schwartz and Henderson, 1991). Some evidence for resolution of the question has been presented for one species, *Iguana iguana*. For decades this widespread South American species was considered introduced in the Antilles (Schmidt and Inger, 1957; Underwood, 1962). Data on meristics and color characters, however, suggested some populations were native (Lazell, 1973). This seems to have been confirmed by a study of colic folds (Iverson, 1980), and native status has been accepted for some populations (MacLean, 1982). However, other populations, such as those on Puerto Rico, are probably recently introduced stock (Rivero, 1978).

The tortoise or morocoy, *Geochelone carbonaria*, presents a comparable geographic picture, with widespread scattered extant populations conspecific with South American populations (Underwood, 1962; Schwartz and Thomas, 1975). Schwartz and Henderson (1991) suggest some populations may be native, some aboriginal introductions, some early European introductions, and some very recent introductions (i.e., escaped pets). Censky (1988) documented an extant population of *Geochelone carbonaria* on Anguilla, but left open the issue of native or exotic origin.

Populations of *Geochelone carbonaria*, regardless of their ultimate origin, have declined or disappeared from a number of islands (Lazell, 1980). It is difficult to decide whether to restore or conserve this species in these islands if its status as native or exotic is unknown. For example, six *G. carbonaria* were brought from Water Island and St. Thomas, U.S. Virgin Islands, to found a population on Guana Island in the British Virgins (Lazell, 1991). Was this restoration or exotic introduction?

I recently received assorted reptilian bones from Anguilla for determination from the American Museum of Natural History (AMNH). Among them are remains of *Iguana* cf. *delicatissima* (AMNH 91108: right tibia) and several tortoise elements including a nearly complete left tibia (AMNH 90188), another probable (partial) right tibia (AMNH 91285), a distal right humerus (AMNH 90063), and a distal right radius (AMNH 90025). Cope (1883, pl. 1:9) figured an Anguillan tortoise left tibia almost identical to AMNH 90188, but did not identify the taxon or element.

Assignment of these bones to any species would be presumptuous. Indeed, the claim that they represent *Geochelone* is based on the facts that they are certainly from tortoises (Testudinae), virtually identical to the corresponding elements from modern *Geochelone*, and come from the Antilles whence *Geochelone* is the sole tortoise genus known (Auffenberg, 1974).

I have compared these elements to many specimens of tortoises in the Museum of Comparative Zoology (MCZ), including (especially) complete skeletons of *G. carbonaria* (MCZ 173379) and *Geochelone* sp. indet. (MCZ 165001, probably a young *G. gigantea* from Aldabra). There is nothing distinctive about the comparable elements of these individuals I can determine except size (see below).

No fossil or subfossil material of *Geochelone* has been attributed to *G. carbonaria*, the only living species in these islands ever known (Auffenberg, 1974). *Geochelone sombrerensis* occurred on the closely adjacent Sombrero Bank. Auffenberg's (1967) reconstruction of the plastral lobe indicates significant differences in bone/scute relations compared to *G. carbonaria* (Williams, 1960). *Geochelone sombrerensis* was a giant. Auffenberg (1967) does not give a carapace estimate, but does estimate the largest known plastron "at least 32 inches." I estimate a minimum carapace length (CL) corresponding to this as 95 cm and think 100 cm reasonable.

Ray (1964) estimated the size of the Barbados tortoise tentatively regarded as *Geochelone* (for the same reasons I have given above) as about 70 cm CL, and noted his elements were about the same size as those of *Geochelone cubensis* of Cuba. The distinctive *G. monensis* on Mona, between Hispaniola and Puerto Rico, was also very large. Auffenberg (1967) estimated Bahamian remains of *Geochelone* sp. indet. from individuals up to 60 cm CL.

All of these are certainly larger than the Anguilla material before me. Comparisons to MCZ specimens indicate the humerus, AMNH 90063, came from an individual ca. 38 cm CL; the tibia, AMNH 90188, from one ca. 44 cm CL; and the radius, AMNH 90025, from a specimen the same size as MCZ 165001: 46 cm CL. The largest *G. carbonaria* museum specimen on hand is MCZ 160814, 42 cm CL, but I have encountered individuals in the field larger than this, to ca. 46 cm CL (Lazell, 1989).

The presence of these elements from as yet undated Pleistocene deposits (pre-Columbian fide MacPhee, pers. comm.) does not prove *Geochelone carbonaria* is native to Anguilla. It will require evidence from far more detailed morphometric and biochemical studies to support or refute that possibility. However, we can be sure now that a tortoise of about the right size was present in the Anguillan Pleistocene, and this makes study of extant *Geochelone carbonaria* populations all the more important and timely.

Acknowledgments.—I am indebted to numerous colleagues at MCZ for assistance on this project, and to Ross MacPhee at AMNH for the opportunity to examine the material. This work was funded by The Conservation Agency and is dedicated to the memories of William P. MacLean and Albert Schwartz.

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TEL AVIV UNIVERSITY אוניברסיטת תל-אביב
GEORGE S. WISE FACULTY OF LIFE SCIENCES
DEPARTMENT OF ZOOLOGY
הפקולטה למדעי החיים
ע"ש ג'ורג' ס. וייז
המחלקה לזואולוגיה

18 November 1993

Dr. James D. Lazell
The Conservation Agency
6 Swinburne St.
Jamestown, RI 02835
U.S.A.

Dear Skip,

The last two weeks were really hectic: a huge pile of letters and memos has been awaited for my attention, and only now could I find the time to write this preliminary report.

First, I would like to express my sincere thanks for the excellent hospitality I received in Guana. The most friendly, intimate and informal atmosphere that you have created and cultivated among the scientists; the administration staff, led by Beverley and Walter, who made every effort to help us and to solve even the smallest problems; the accommodation (housing and especially the food...), all were just great.

Second, I would like to refer to the scientific aspect(s).

A. My principal purpose was to find out whether the existence of a certain species in a particular habitat and the geographical distribution of the species, can be explained by and attributed to physiological traits. We addressed this question by studying the evaporative water loss (EWL) of one of the most common lizard species living in the Caribbean region. The fact that the very same species, *Anolis cristatellus*, inhabits virtually all the islands of the BVI, enabled us to correlate intra-specific EWL with habitat aridity ("HORIZONTAL" comparison). Our main findings are: (a). There is a clear-cut, negative correlation between the habitat aridity and the lizard's EWL. The highest rates of EWL were found in populations representing wetter habitats, such as Gorda Peak (Virgin Gorda) and Sage Mountain (Tortola), whereas the lowest EWL rates were obtained in lizards from drier islands (Necker and Carrot Rock). (b). In all of the populations studied, some 70-75% of the total EWL took place through the skin. This means, that any physiological control on the cutaneous evaporation may play a significant role in the lizard's water balance. (c). Consequently, we measured the skin resistance to water loss, Rs, and found that, indeed, it increased markedly with increasing the aridity of the island. This finding indicates a potential involvement of physiological processes (such as lipids precipitation and vasomotor responses) at the skin level. Based on these results we may conclude that although we were dealing with a single species, its populations are different from one another physiologically. Assuming that water availability ("wetness" or aridity of the habitat) is a selection factor, then given sufficient time each of these populations may become a separate species.

In conclusion: the research was very fruitful. Despite the rather short period and the technical difficulties we had to overcome, especially during the first week, the data obtained so far were much above my previous expectations. The results, even at this stage, are publishable. Next month (December 1993) Gad Perry will visit me at TAU. We will write then the paper and your draft will be incorporated.

B. Plans for the next year(s). Whether this will be done by me or by another scientist, I would suggest to continue the research in two directions. (a) To enlarge the present sample, i.e., to collect more specimens and more experimental data from each of

6407403
קרית האוניברסיטה, רמת-אביב, תל-אביב 69978. טל' 415025 ,03-5459812, פקס' ~~03-6425518~~
TEL AVIV UNIVERSITY, RAMAT AVIV, TEL AVIV 69978. TEL. ~~03-5450812, 415025~~, FAX. 972 3 ~~6425518~~, BITNET ZOOL@TAUNOS
972-3-6409338 6409403

the previously studied *A. cristatellus* populations. (b). To compare EWL and Rs of different species on the same island ("VERTICAL" comparison). The latter direction is very promising. It can be done rather easily on Guana (e.g., a comparison between the three *Anolis* species found in different habitats on the island).

C. Some comments and suggestions: (1). A meaningful analysis of our results requires reliable meteorological data: temperature (max-min), solar radiation, relative humidity, precipitation (especially rain) and wind directions and velocities. Except, however, for a very few sporadic reports, official multiannual meteorological information concerning Guana (or for this matter - any other island in the BVI) is virtually not available. A case in point is the EWL and Rs obtained from the Guana population. According to these physiological parameters it seems as if Guana lizards live in a very dry island, whereas according to the common "feeling" (real measurements are absent) Guana is much wetter than Necker, Anegada or Norman islands. It seems, therefore, that a small meteorological station ("weather station") based in Guana is a real necessity. I estimate that such a station will cost approximately 3000 U.S. Dollars. Easily handled instruments and an automatic data processing will save manpower (two visits a week, 15-20 minutes a visit, should be more than enough to run the station). As you remember, I raised my suggestion during our meeting with Dr. Henry Jarecki on the evening of October 26. I think that we all got the impression that Dr. Jarecki generously agreed to establish a weather station in Guana. What is the next step?

(2). The temperature and humidity in Guana do not fluctuate too much during October (ca 27 to 32°C, 60-80%); yet, the nature of the physiological research and the sensitivity of the instruments require much more stable experimental conditions. This can be achieved by constructing a small "environmental-room" (connected to and as a part of the museum?), which will be equipped with the necessary items, such as electricity connections, tables, good lighting etc. Experimental systems and sensitive instruments (electronic scales, gas analyzers) can be set up and stored in this room for relatively long periods. Such a mini-lab will be to the benefit of all scientists working in Guana: botanists, entomologists, as well as herpetologists.

(3). I was impressed by the great number of scientists from various fields, who worked concomitantly in Guana during such a short period. To encourage exchange of information and scientific ideas, I would like to suggest that each scientist will have, upon coming into Guana, to give a short presentation of her/his work: a background, aims, techniques and expectations. Similarly, a day or two before leaving Guana, each one will give a final report: achievement, plans for the future, etc. Both presentations will be given before the audience - all of the participants in your expedition. Allow me to add, in this connection, that a slide projector, an over-head projector and a screen - will be most welcomed.

I told our dean, Prof. Y. Loya, about Liana Jarecki. Loya, who is an international expert in marine ecology, and has specialized in choral ecosystems, suggested that Liana would send her CV. According to him, the requirements for a PhD in TAU are high but flexible enough. Therefore, if you think it is worthwhile to contact Liana, please let me know.

And again, many thanks. Best regards from Ofra to you and your wife.

Yours,

Razi Dmi'el

Note back: 14 Jan. '94

6.XII.93

Dear Dr. Lazell,

I am writing to thank you for the opportunity to work on Guana this fall and to inquire about the possibility of conducting additional research there next year.

As you know, I was involved in three separate projects this year. One of them, the study of intraspecific variation in resistance to water loss in Anolis cristatellus and A. ernestwilliamsi, is completed. Although data analysis is not yet complete, it appears that Guana lizards are the one exception to the generally good correlation between water loss and island aridity, being much more resistant than we would predict. It would be very interesting to figure out why, and to expand the study to interspecific comparisons as a means of possibly explaining habitat choice. However, Dr. Dmi'el expertise and equipment are absolutely necessary for us to be able to do that.

The other projects are also yielding interesting results. I have sufficient data on the foraging behavior of several species of lizards to be able to incorporate it into my large scale analysis of the evolution of foraging behavior, though I would love to be able to come back and study some of the other species as well. Incomplete analysis suggests that there is no detectable difference in the foraging behavior of A. cristatellus on the ten islands I've observed it on, but it is possible that analyzing the rest of my observations will change these rather preliminary conclusions.

Finally, the pilot study I started to look at the relationship between crest size, reproductive success, and foraging behavior. This is the main project I would like to work on next year. Preliminary results suggest there could be such a link, but more work is needed. The diet specimens I collected have only recently arrived, and will take a while to fully analyze. Clearly, there are not enough data to conclude anything yet. However, it is also clear that the technical problems have been licked and that the study is feasible.

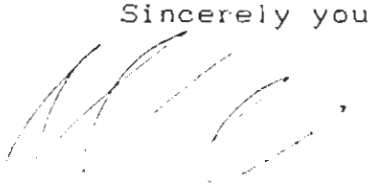
More specifically, what I would like to do is individually mark (using colored bird bands) all the males in a relatively small area and conduct repeated observations on the amount of territory they control in the wild. If I am correct, then crest size is a critical attribute signifying male "quality". Thus, I predict a positive correlation between crest size and territory size, regardless of body size. Additionally, I would like to perform several experiments. One is a laboratory choice experiments, in which females will be allowed to associate with males of different size. In some species of anoles, females choose

territories based on availability of resources alone; if this is the case then females should demonstrate no preference. However, if there is any element of female choice involved then a preference for large-crested males is predicted. Another experiment involves selective removal of tails in wild males, to examine the effects of tail loss on social status and reproductive success.

These will be combined with detailed observations on the foraging behavior of the lizards for several reasons. First, I have found in other anoles that males are less concerned with diet than with reproductive success. This can have serious implications for foraging theory, which assumes animals are attempting to optimize food intake. Information on additional species would be critical for estimating the generality of this pattern. It will also be important to evaluate the trade-offs between reproduction (probably manifested by time spent guarding the territory in this species) and foraging. I predict that dominant males will have less time to feed, and consequently will have different foraging behaviors and diets. Finally, it will be interesting to evaluate the effect of tail loss on foraging behavior. If it is indeed as important as I think, then I expect to see a large increase in foraging behavior following autotomy; if reproduction is highly dependent on tail crest size then the added risk of predation incurred by more active foraging will be more than offset by the greater reproductive success obtained.

I hope this provides you with enough information regarding my proposed work on Guana in 1994. If you have any questions, please contact me the address below.

Sincerely yours,



Gad Perry
Dept. of Zoology
Univ. of Texas
Austin, TX 78712

Evaporative water loss in nine insular populations of the *Anolis cristatellus* group in the British Virgin Islands

Razi Dmi'el[1], Gad Perry[2] and James Lazell[3]

[1] Department of Zoology, Tel Aviv University, 69978 Tel Aviv, Israel

[2] Department of Zoology, University of Texas, Austin, TX 78712, USA

[3] The Conservation Agency, 6 Swinburne St, Jamestown, RI 02835, USA

Corresponding author: Gad Perry, Zoology Dept., Univ. of Texas, Austin, TX 78712.

Fax: (512) 471-9651
Phone: (512) 471-1456
E-mail: Gad.Perry@utxvm.cc.utexas.edu

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Key words: Evaporative water loss, Habitat aridity, Sauria, *Anolis cristatellus*, *A. erneswilliamsi*, scale size

This MS contains 13 text pages, 2 Figures (line), and 1 Table.

We studied water loss in eight insular populations of the lizard Anolis cristatellus wileyae and in one population of A. ernestwilliamsi in the British Virgin Islands. There was a strong negative correlation between habitat aridity and water loss rate (ranging from 1.5-10.3 mg/g/h) and between habitat aridity and integument resistance to water loss (28.5-199.0 s/cm). Water loss and integumentary resistance of A. ernestwilliamsi were similar to what would be predicted for A. cristatellus living in the same habitat. The Guana Island population of A. cristatellus was significantly different from all other populations. We believe two processes are responsible; phenotypic plasticity explains most of the observed variability, but genetic differentiation may be responsible for the distinction of lizards from Guana.

room air and prevent the formation of temperature and humidity gradients. Lizards were provided with moistened paper and were kept in the boxes without food for 8-12 hours before the experiments commenced.

On each lizard we performed two experiments that were carried out on two successive days. During the first day, we measured the evaporative water loss (EWL) over a period of 6-8 hours. It was calculated from the mass change of the lizards (measured to the nearest mg using a Precisa balance, model 800M). At the same time we also measured room relative humidity (using a Psychro-Dyne psychrometer, Environmental Tectonics Corporation; average and SD 75.8±2.20%); and skin temperature (29.8±0.61°C). The temperature inside the box and in the room (measured using a Wescor TH-65 electronic thermometer) were identical (29.7±0.46°C). All measurements were taken at 30 min intervals.

Measurements of respiratory (Er) and cutaneous (Ec) water loss were conducted on the following day. In each box we inserted a known quantity of Drierite (anhydrous $CaSO_4$). The lizards were placed above the Drierite and, using a polyethylene bag, enclosed each lizard in a box with its head extruded. We assumed that all body Ec was taken up by the Drierite and that any change in box mass (measured every 30 min for 5-6 hours) was therefore due to loss (respiratory and cutaneous) from the head. To correct for possible leakage of water vapor into the bags we employed an additional box (control) which was prepared as above but did not contain a lizard. Dividing body Ec by surface area (see below) provided us with EWL per unit surface (CWL). We then multiplied

this value by the surface area of the head and obtained head Ec. Er was then calculated as total loss from the head minus head Ec. R, the integument resistance, incorporates the resistances of the skin and of the air boundary layer surrounding it; we calculated it using the equation given by Lillywhite and Sanmartino (1993).

In cross-section, the body of Anolis cristatellus can be viewed as a triangle, with the venter at its base and the sides of the body forming the two sides. We therefore calculated lizard body surface by pressing each lizard onto graph paper and tracing its ventral side and its flank. These tracings were then cut out and weighed; finally, we used the mass of a 100 cm^2 piece of the same graph paper to calculate the surface area of each lizard.

There are no rainfall records for most of the islands in the BVI. Average rainfall at Tortola in the years 1960-1991 was 1200 mm/year (range 790-1840; A. Swain, pers. com.). In the absence of a quantitative measure of aridity we attempted to produce a qualitative one. Two of us (GP and JL) who have been to all the study sites independently ranked them on a scale of 1 (wet) to 10 (dry). The two ranking systems were highly similar. We then asked three additional biologists who have worked in the BVI for several years to rank the same sites using the same scale. We then averaged all five values to produce a single index, which was also very similar to our original estimates. The averaged value of this aridity index is presented for each site in Table 1.

Whenever possible, individuals were released at the end of the study at the site of capture. Other specimens were deposited in the

Texas Memorial Museum at the University of Texas at Austin and in the Museum of Comparative Zoology at Harvard University.

Results

We found strong relationships between aridity and all physiological characteristics measured (Table 1). Lizards from Guana were consistently more resistant to water loss than expected from the island's aridity index. Because Guana values were well outside the 99% confidence limits we omitted them and recalculated correlation coefficients between aridity and water loss values. The adjusted correlation coefficients were higher; the correlations were statistically significant for all physiological indices ($p<0.05$ in all cases) but not for mass ($p=0.3$). Values for A. ernestwilliamsi, on the other hand, could be predicted with great accuracy from the relationship between aridity and water loss in A. cristatellus (Table 1, Fig. 2).

Cutaneous water loss comprised on average 75.3% (range 71.0-78.5%) of EWL. Differences between populations in the importance of Ec relative to that of Er were not statistically significant ($p>0.05$, Kruskal-Wallis non-parametric ANOVA), nor were they correlated with habitat aridity.

Discussion

With the exception of lizards from Guana, A. cristatellus EWL was strongly negatively correlated with environmental aridity. This

supports our initial prediction and agrees with the findings of studies on lizards in other locations (Hillman et al., 1979; Kattan and Lillywhite, 1989; Eynan and Dmi'el, 1993). Anolis ernestwilliamsi were nearly twice as large as the largest A. cristatellus we collected, and their total water loss values were the highest. Once corrected for size, however, in terms of water loss, A. ernestwilliamsi conforms to the trend indicated by its parent species; its EWL values were very similar to what we would predict for A. cristatellus in the same environment.

Our findings could be due to genetic differentiation between populations, but are also consistent with a phenotypic plasticity explanation (Hillman et al., 1979; Kobayashi et al., 1983). In the first case, we may be seeing the beginning of a multiple speciation event; if the second explanation is true, however, then no such event is indicated. Hertz et al. (1979) reported an EWL value of 8.3 mg/g/h from a Puerto Rican population of A. cristatellus, and our data suggest this is a reasonable value for a population dwelling in a moist habitat. Hillman and Gorman (1977), however, reported considerably lower values (1.9 and 1.8 mg/g/hr) in two other Puerto Rican populations, one of them geographically close to that studied by Hertz et al. (1979). Because lizards from virtually the same site were so different but lizards from two distant and climatically different sites were very similar, we suspect the disparity might be due to differences in methodology. This, and the findings of Hillman et al. (1979) and Kobayashi et al. (1983), support the phenotypic plasticity explanation for the differences

we found between populations. The lack of significant differences in mass between islands also supports this interpretation.

The consistent deviation of Guana lizards from predicted values is difficult to explain. Though our evaluation of the island's aridity may have been erroneous, Guana was the only island for which all evaluators assigned the same rank, suggesting that this is unlikely. Nor is a biogeographic explanation plausible: no relation between geography and EWL was evident (Fig. 1). Why then are Guana lizards so different? We suspect that the Guana population may represent a diverging lineage, and that the basis for these differences might be genetic. If so, special attention should be paid to its conservation. With an underlying phenotypic plasticity enabling rapid adjustment to local conditions, selection is only likely to induce genetic differentiation under extreme conditions. This is not the case at Guana. Genetic drift appears to be a more likely explanation, especially when the small size of Guana (340 ha) is taken into account.

MacLean (1985) found scale size to be inversely correlated with water loss rates in the gekkonid lizard genus Sphaerodactylus in the BVI. Malhotra and Thorpe (1991) similarly found that Anolis oculatus inhabiting the wettest habitats in Dominica had the largest scales, whereas the subspecies that inhabits arid areas had the smallest. Lazell (1994) similarly found a good correspondence between scale size and habitat aridity in the S. vincenti group in the Windward Islands, Lesser Antilles. Thus, the very small scales of A. ernestwilliamsi, which inhabits the most arid islet in the group, relative to that of A. cristatellus (Lazell, 1983) were

highly suggestive. This led us to hypothesize that scale size might be related to EWL in the A. cristatellus complex. However, no significant differences in scale size have been found among populations of A. cristatellus wilevae in the BVI (Lazell, 1983); this, and the similarity in EWL between A. cristatellus and A. ernestwilliamsi, suggest that scale size is not a good predictor of the resistance of lizard integument to water loss. Indeed, Malhotra and Thorpe (1991) noted some cases in which the correlation between scale size and aridity was opposite to their own findings. Kattan and Lillywhite (1989) have shown that lipids in the skin are responsible for reducing cutaneous EWL, and this remains the likely mechanism for the differences we observed between the these populations. Sheer mass may provide all the additional resistance to water loss A. ernestwilliamsi requires for survival.

Though A. cristatellus is clearly able to modify its EWL to local environmental conditions, the exact mechanism remains unclear. Cross-fostering experiments, in which animals of different populations are maintained under similar conditions for prolonged periods, are required. However, we believe that two mechanisms are involved: genetic differentiation appears to be occurring on Guana Island, and phenotypic plasticity is apparent in the differences between all other populations.

Acknowledgements. This project was funded by The Conservation Agency through a grant from the Falconwood Foundation. GP was financially assisted by a grant from the Institute of Latin

American Studies at the University of Texas. L. Jarecki, J. Overing and N. Goodyear assisted in producing the aridity index for the study sites and K. LeVering critically read the manuscript. We thank J. Conyers for assistance in collecting A. ernestwilliamsi and R. Rusher and the entire Guana staff for technical assistance with various aspects of this study.

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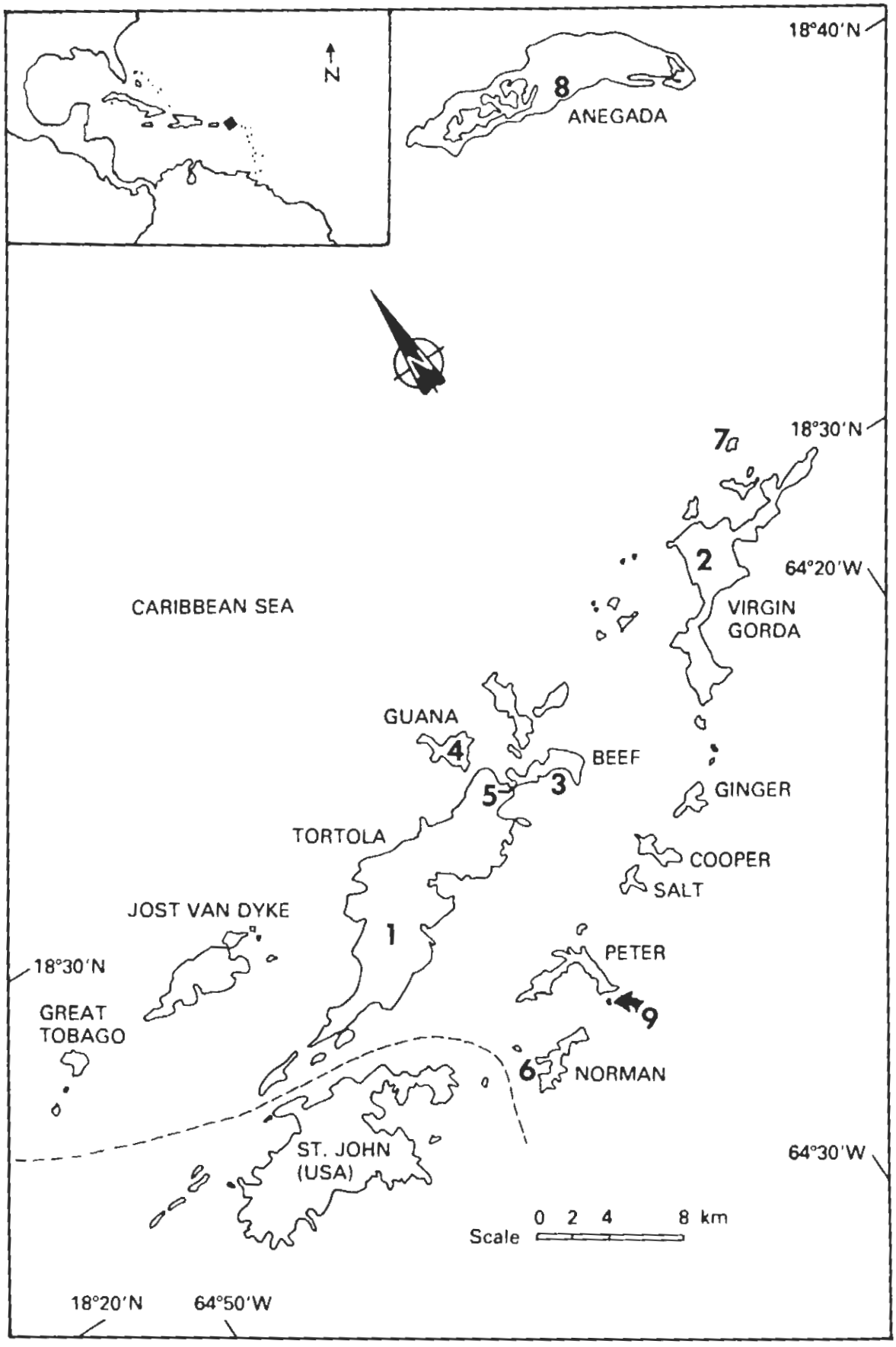
Authors addresses: Razi Dmi'el, Department of Zoology, Tel Aviv University, 69978 Tel Aviv, Israel; Gad Perry, Department of Zoology, University of Texas, Austin, TX 78712, USA; James Lazell, The Conservation Agency, 6 Swinburne St, Jamestown, RI 02835, USA. Address correspondence and offprint requests to Gad Perry.

Captions to figures

Fig. 1. Map of the British Virgin Islands. Study populations of Anolis cristatellus and A. ernestwilliamsi. 1- Sage Mt., Tortola; 2- Virgin Gorda; 3- Beef Island; 4- Guana Island; 5- Bridge, Tortola; 6- Norman Island; 7- Necker Island; 8- Anegada; 9- Carrot Rock. Insert shows the position of this island group in the Caribbean.

Fig. 2. The relationship between habitat aridity and skin resistance in Anolis cristatellus (squares) and A. ernestwilliamsi (circle). Guana is represented by an empty square.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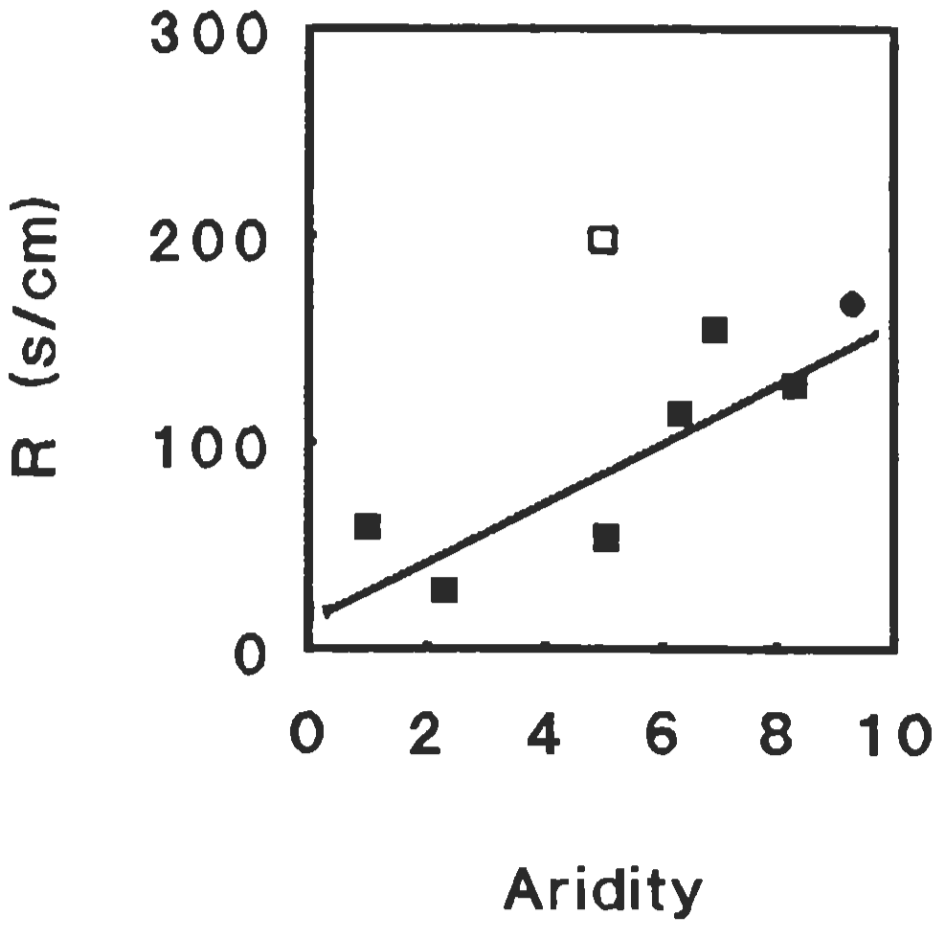

Fig 2

Table 1. Locations, sample sizes and average mass and water loss characteristics for Anolis cristatellus from eight insular populations; n is the number of specimens examined from each. Data from Carrot Rock are for A. ernestwilliamsi only, and were therefore excluded when calculating correlation coefficients with aridity (r^2). Low numbers for aridity index denote wet habitats.

Island	n	aridity index	mass	Evaporative water loss		Integumentary resistance
			(g)	(mg/g/h)	(mg/cm^2/h)	(s/cm)
Sage Mt, Tortola	6	1.0	5.94	4.83	0.54	59.10
Virgin Gorda	6	2.3	4.11	10.28	0.98	28.53
Beef	6	5.0	7.67	4.00	0.49	53.61
Guana	12	5.0	7.63	1.49	0.18	198.95
Bridge, Tortola	6	5.0	7.85	3.39	0.43	55.22
Norman	6	6.3	5.27	2.73	0.25	114.17
Necker	6	6.9	8.27	1.94	0.23	155.13
Anegada	6	8.3	6.40	2.44	0.25	128.15
Carrot Rock	5	9.3	13.19	1.16	0.19	167.69
r^2 (Guana included)			.177	.443	.514	.332
r^2 (without Guana)			.190	.502	.591	.611

Status of a Relocated Population of Endangered *Iguana pinguis* on Guana Island, British Virgin Islands

Numi C. Goodyear[1,2]
James Lazell[1]

Abstract

Eight individual rock iguanas (*Iguana pinguis*) from Anegada Island were relocated to Guana Island by Lazell, 1984–1987, in order to establish a second population reservoir for this endangered species. The species may have originally occupied the entire Puerto Rico Bank. The relocation has been successful and, in the area currently providing the best habitat, we estimate a density of 9 or 12 animals of various age classes per 19 ha. The optimal area contains a sheep exclosure with relatively dense understory vegetation and numerous exotic as well as native species of plants. Iguana activity is concentrated on east-facing slopes and ridge-tops that get morning sun. Outside the exclosure most edible ground cover and shrubs have been eaten by sheep, leaving toxic or noxious species, such as *Croton* or *Lantana*, in the understory where *I. pinguis* adults generally forage. Removal of sheep may be critical to continued population growth of these reptiles. Views on relocation or repatriation of other endangered Antillean *Iguana* species are advanced, with some ideas on minimum viable population sizes and a possible explanation for the extirpation of *I. pinguis* from much of its former range.

Three species of iguanas occupy the northeastern quadrant of the West Indies: *Iguana iguana*, *I. delicatissima*, and *I. pinguis* (Figure 1). Dodd and Seigel (1991) point out that while numerous attempts to reestablish reptile populations have ostensibly been made, few have been documented to have succeeded. The most critically endangered of these three, *I. pinguis*, has been successfully established on Guana Island (300 ha), part of its former range dominated by a dry tropical forest.

Iguana iguana is the most gracile and cristate of the three species (Lazell 1973). It is frequently stated that this species is arboreal, but it is often densely abundant on small islets without trees and is thus quite terrestrial locally; these are not marginal habitats for the species (Roze 1956; Lazell 1973). It is widespread both within the northeastern quadrant of the Antilles and southward in the Lesser Antilles, and throughout tropical South and Central America. Lazell (1973) has suggested, however, that some populations in the northeastern West Indies were endangered.

Iguana delicatissima has reduced crests and undistinguished proportions. This species climbs well and often occurs where trees are available, but the densest known populations are largely terrestrial and occur where there are no trees to climb (Lazell 1973). *Iguana delicatissima* extends beyond the northeast quadrant of the Antilles only southward to the Dominica and Martinique Banks of the Lesser Antilles. Since Lazell's work 30 years ago, no updates on the status of this species have been published.

Iguana pinguis has the most-reduced crest scales in the genus and, as its name implies, the stoutest proportions. The species is often claimed to be terrestrial (see de Queiroz 1987), but young individuals climb frequently, and even large adults climb well (Figure 2). It is entirely confined to the Greater Puerto Rico Bank (land area continuous with Puerto Rico during the last glacial maximum) but has been extirpated from Puerto Rico and the United States Virgin Islands (Pregill 1981). Until 1984, the only known surviving population was on Anegada in the British Virgin Islands (Barbour 1917; Carey 1972, 1975).

The Anegada population has been declining since 1968, when a foreign firm, the Development Corporation of Anegada, Ltd., began an abortive attempt to lease and develop the cay. Stock retaining walls were bulldozed and previously-penned exotic ungulates (goats, sheep, cattle, burros, and swine) were released to roam the island at large. Based on work completed just after the signing of the lease, Carey (1975) warned that free-ranging ungulates might compete with the iguanas. Lazell (1980) reported the desertification of Anegada a decade after the stock release. Goodyear (1988, 1991) found both numbers and area occupied on Anegada had dwindled dramatically since Carey's 1968 prerelease estimate of two per hectare.

[1]The Conservation Agency, 6 Swinburne Street, Jamestown, RI 02835, U.S.A.
[2]Address for correspondence: The Conservation Agency, Branch Office: 97B Howland Avenue, Jamestown, RI 02835, U.S.A.

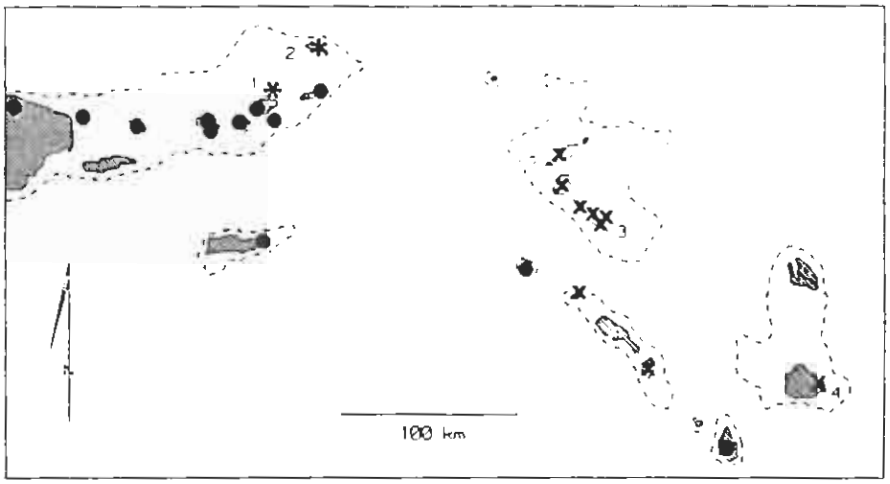

Figure 1. Northeastern West Indies showing known populations of *Iguana*: *I. pinguis*, asterisks. *I. iguana*, dots. *I. delicatissima*, crosses, (1) Guana, (2) Anegada, British Virgin Islands; (3) St. Barts and satellite cays Ile Forchue, Ile Chevreau, and Ile Fregate; (4) Gaynor's Gut, Antigua. Islands are hatched. Dashed lines indicate bank edges, land limits at glacial maximum.

Goodyear's current work on diet and population status provides several lines of evidence that cement the relationship between the stock animal release and the decline of *I. pinguis*. Other threats are posed by dogs, which are known to kill adults, cats, which kill juveniles, and humans, who historically have killed all age classes.

In July 1984, concerned that the iguana was jeopardized on Anegada and that no measures were planned to protect it, J. Lazell, W. MacLean, G. Mayer, and H. Jarecki decided to transport several pairs of *I. pinguis* to the Guana Island Wildlife Sanctuary in an attempt to create a subpopulation there. Chapman Grant (1932) had reported iguanas on Guana Island, but he identified the species as *I. iguana*. Oscar Chalwell, however, who has worked on the island since 1928 and was burning charcoal on the island in Grant's time, never saw any iguana on the island or neighboring islands prior to the 1984 relocation (personal communication, October 8, 1992). The conflicting accounts indicate Grant's report may have been based on hearsay. No *I. iguana* fossils or subfossils have been found on the Puerto Rico Bank (MacLean 1982), suggesting that it is a relatively recent, possibly post-glacial, arrival. While we do not believe that *I. pinguis* occurred on Guana in modern times, fossils found on St. Thomas and Puerto Rico indicate that this species' distribution encompassed most of the Greater Puerto Rico Bank (including Guana) at glacial maximum, about 10,000 years B.P.

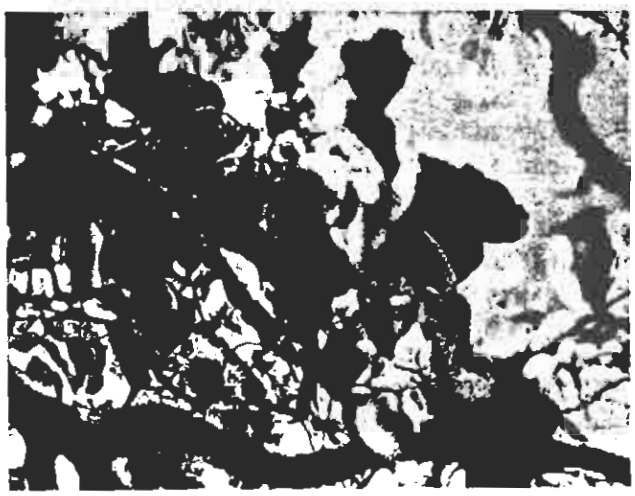

Figure 2. Male *Iguana pinguis* in a *Pisonia subcordata* (loblolly) tree on Guana Island at sunrise.

Between 1984 and 1986, eight individuals were caught on Anegada and relocated to Guana Island. For five females released, snout-vent length (SVL) in cm (followed by release date and reproductive status, if detectable) was as follows: 46.0 (July 29, 1984; palpably gravid), 44.0 (July 19, 1986), 22.4 (July 27, 1986), 33.5 and 43.0 (July 31, 1986; the larger was gravid). For three males, SVL in cm (and release date) was as follows: 41.0 (July 19, 1985), 50.4 and 50.9 (July 31, 1986).

If the 1984 gravid female successfully nested, that might explain several subadults seen by Lazell on Guana in July 1987. Hatchlings were observed by October 1987, as they have been each year since. Several of these are believed to have grown to be the adults studied in 1991 and 1992.

Methods

This study was prepared for in 1990 and 1991 by the location and taming (using fruit rewards) of four wild adult iguanas (SVL > 40 cm) (Carey 1975). Tamed iguanas, and young individuals, did not flee when approached, which allowed us to mark them, "recapture" them (visually), and determine portions of their home ranges by locating identifiable individuals in various parts of the study area. Study animals had por-

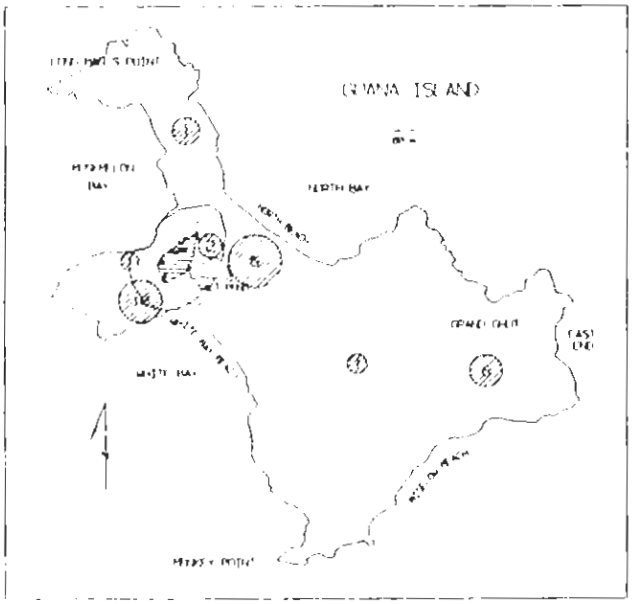

Figure 3. Guana Island. The study area (horizontal lines), its associated boundary strip, and seven areas (diagonal lines) outside the study area in which adult iguanas have been observed. Numbers in circles are numbers of sightings. Black polygons are Club buildings.

tions of their home ranges in an area centered about the Guana Island Club (Figure 3). The approximately 3-ha study area supports a mixture of native and exotic plants and has a relatively dense understory. A sheep-exclosing fence encircles much of the area.

Home Range. Outermost positions occupied by identified iguanas between October 1990 and November 1992 were mapped using a combination of techniques. If the iguanas' positions could be recognized, they were plotted directly on 1 : 3000 maps of the site; otherwise, we determined positions by telemetry of transmitters carried by iguanas or placed at the iguanas' former locations. In 1992, four tame iguanas were fed 2-by-4-cm radiotags wrapped in a blanket of chicken skin; two knots secured the skin on either side of the tag. To minimize impact on the iguana, we used as little thread as possible. The tags contained L. L. Electronics one-stage transmitters (with collapsed loop antennae) potted in a wax slug coated with dental acrylic. Finished tags were dipped in brightly-colored latex tool-coating material so the tag could be more readily recovered after it had passed through the animal's digestive tract (usually in 4–7 days). Tagged animals were not provided with food supplements while they carried the tag. Bearings to transmitters were recorded from nine mapped telemetry stations. Generally we took readings every two hours from at least two stations. Readings were usually not more than 5 minutes apart, but were accepted if they were as much as 10 minutes apart. No locations were made using angles less than 30°. To make sure telemetered positions were accurate, direct approaches to the animals were made after each remote determination. Generally, radiotagged iguanas were approached at dusk, after dark, and at dawn to confirm their night locations.

Density Determinations. From October 3 through 30, 1992, we conducted a mark-recapture study of *I. pinguis* on Guana Island. We modified standard techniques by avoiding actual capture of individuals. Experience with *I. pinguis* on Anegada indicates that capture and handling make individuals wary and unapproachable. Because an ancillary study involved observations of feeding behavior and food selection experiments, it was important that iguanas be traumatized as little as possible.

Iguanas were approached within 3 meters and marked with oil-based paint fired from a disposable 3-cc syringe. A single dot of red paint used to mark the lumbar region of the first and most approachable female appeared to excite her. She peered over her shoulder to investigate it. Although this lasted only a few minutes, we switched to white paint for all subsequent individuals. None responded in any visible way to white, either when it hit them or later in the study. The paint splatter patterns and drips were distinctive on each specimen; there was no confusion of marked individuals seen in good light. (It was sometimes difficult to identify some individuals only partially visible in dens or burrows.) Population estimates were made using the Schnabel (1938) method and the computer programs of Krebs (1989). Because of the increased likelihood of "recapture" of tame iguanas, we believed that inclusion of all sightings might artificially decrease the point estimator and constrict the confidence interval. We therefore used two data sets in all population estimates: one in which all recapture data were included, and another in which recaptures counted only when new ones were marked that same day.

Our study area included regions of relatively high iguana and observer density. We calculated the perimeter of the study area (our equivalent of a "trapping grid") by mapping a polygon of the outermost points of "captures" and "recaptures"—sightings of identified individuals not carrying radiotags. For density estimates, we added a boundary strip to the study area equal to the average home-range radius of radiotagged individuals, since, because of the animals' movements, the sampling area is larger than the actual study area (Dice 1938). As is customary, we have interpreted "maximum diameter" to mean "maximum dimension" (Otis et al. 1978). Because some study animals, like our male iguana, have elongate rather than

roughly circular home ranges, we believe this practice makes the sampling area artificially large, which lowers density estimates. Perhaps a better estimate of average movements would be a literal interpretation of the word "diameter"—twice the radius of a circle with an area equal to that of the home range. This would average the effect of animals whose longest home-range dimension is perpendicular to the study area and those that are parallel, as well as all options in between. Water (ocean, salt pond) overlapped by the boundary strip was subtracted, leaving a total sampling area of 18.8 ha.

In 1992, in addition to the two authors, two assistants were dedicated to the project, and two club staff who would spot and identify iguanas in the course of their work. As many as 15 other club staff and eight scientists working in the study area would notify us if iguanas were seen. We did not consider sightings as "recaptures" unless they were confirmed by at least two of the six people (including us) who recognized the marks.

Minimum convex polygon, 95% ellipse, and harmonic mean home ranges were calculated using TELEM.88 (Coleman & Jones 1988). To check the accuracy of our telemetry readings and relate the movement data to topographic features of the study site, we transferred the information to a GIS database (PC ARC/INFO, ESRI, Redlands, California), using a DIGI-PAD 5 (GTCO Corp., Rockville, Maryland).

Results

Ten individuals were marked during October 1992: one adult male, three adult females, and six juveniles. Radiotelemetry locations were made for each of the four adults for 3 to 7 days ($\bar{x} = 5$). Visually-determined locations of individuals at the outermost points of movement between 1990 and 1992 were included in the home-range data set. The male's minimum convex polygon estimate of 7.3 ha was larger than that of all females ($\bar{x} = 1.7$ ha; Table 1, Figure 4). Intensively-used areas (50% probability of occurrence contour, harmonic mean estimates) were smaller still (Table 1, Figure 5), and they all encompassed areas within the sheep exclosure. The average home-range radius of the four adults was 175 meters.

It did not appear that iguanas moved between checks that occurred at night. Night locations varied: iguana 1 retreated to two different excavated burrows, iguana 2 to three excavated burrows and one tree, and iguana 3 to two excavated burrows and one tree; iguana 4 slept semi-exposed in a crack between two rocks.

The population in the area sampled was estimated to

Table 1. Home ranges in hectares of three adult female and one adult male *Iguana pinguis* on Guana Island, British Virgin Islands.

		Home Range (ha)		
Iguana	*Sex*	*Minimum Convex Polygon*	*95% Ellipse (noncircular method)*	*50% Contour Harmonic Mean*
1	female	0.9	1.2	0.1
2	male	7.3	21.5	1.5
3	female	3.5	4.2	0.4
4	female	0.7	1.9	0.1

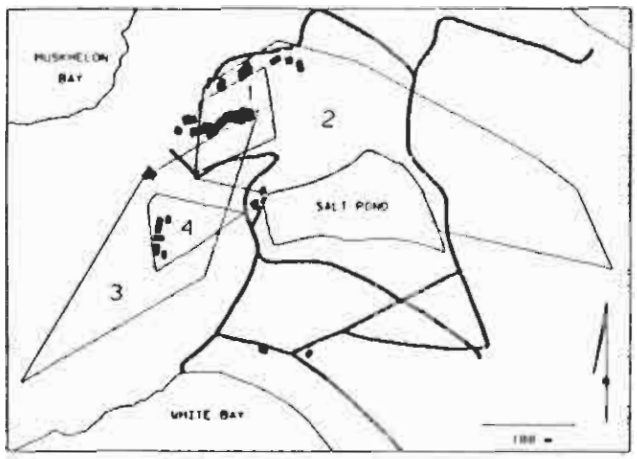

Figure 4. Minimum convex polygon home ranges of four adult *Iguana pinguis* on Guana Island. Iguanas 1, 3 and 4 are female; Iguana 2 is male. Black polygons are Club buildings; road pattern also shown.

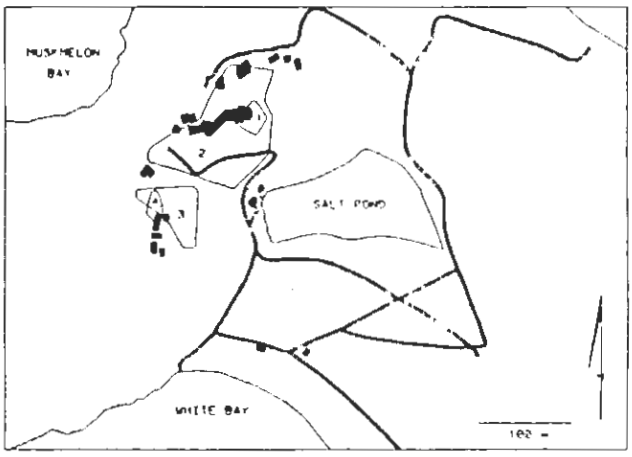

Figure 5. Centers of activity of four adult *Iguana pinguis* on Guana Island as shown by 50% contours of harmonic mean home ranges. Iguanas 1, 3, and 4 are female; Iguana 2 is male. Buildings and roads as in Figure 4.

be 9.0 individuals (95% CI, 6.5–12.9) when all recaptures were included and 12.2 individuals (95% CI, 6.2–28.0) when capture sessions were considered as only those days on which new iguanas were marked. In the 18.8-ha sampling area, the density was 0.5 to 0.7 iguanas (all age classes) per hectare.

Young iguanas, smaller than the original colonists, were first observed in 1987, and hatchlings have been observed each year in late summer and early fall. On September 12, 1991, a clutch of 10 eggs was accidentally unearthed in a sand pit during road work midway along the road paralleling North Beach. One egg was destroyed, but the clutch was reinterred; the rest apparently hatched on September 17. Two hatchlings located measured 9.5 and 10 cm SVL.

Discussion

Home-range sizes for the four *I. pinguis* on Guana were considerably larger than previously published estimates for West Indian iguanas. Iverson's (1979) work with *Iguana carinata* and Carey's (1975) work with *Iguana pinguis* home ranges on Anegada showed that all males and females had home ranges less than 0.1 ha in size, more comparable to the size of the Guana iguanas' centers of activity (Table 1). The first author found home-range sizes on Anegada similar to those reported here for Guana. Because animals on Guana were directly approached after each telemetry-determined location check, we know that the size differences were real, not due to telemetry error.

Field evidence indicates that *I. pinguis* distribution is patchy on Guana Island. Certain areas appear to have no iguanas at all. From 1990 through 1992, approximately 3350 hours of island exploration off the study area by capable observers yielded only 27 sightings of unmarked iguanas in seven areas (Figure 5). Individuals may have been counted more than once or, prior to October 1992, may have been animals we later marked. Five of the areas are within normal travel distance or within home ranges of iguanas inhabitating the study area (Figure 4). An isolated individual was seen on one occasion at the center of the island, but apparently the only discrete subgroup inhabits the extreme east end of the island (Figure 3).

Based on individual recognition, we estimate the total adult iguana population at 20 animals. There are doubtless individuals we have not seen, but very few at this point. Two that we never saw were reported on the study site: a large male and a subadult (1–2 years old). In late August through October, flushes of hatchlings are regularly observed. Dispersal outward and upward from their natal beach in response to early-morning insolation might explain the numbers of hatchlings seen along the Club's east slope and ridge top. We see few subadults and much unoccupied habitat. In one case we observed an adult female iguana chase a hatchling away from an area in which she was being fed. Adult territoriality may decrease recruitment of hatchlings in prime areas of habitat.

For adults, three factors seem to influence habitat quality and determine the distribution and abundance of *I. pinguis* on Guana: vegetation, aspect, and shelter. The most striking difference between the relatively densely populated iguana habitat associated with the Club and the rest of the island involves the understory vegetation as it is affected by sheep. Sheep have been present on Guana since at least the 1930s, when the Bigelows acquired the island. Shortly after, the Club area was fenced and the roads into it were pipe-grated to form a sheep exclosure. Since 1980, continual efforts have decreased sheep numbers from about 100 (Lazell 1980) to less than 50 (personal observation), but reproduction still occurs. Though the fence is now deteriorating, sheep rarely enter the exclosure, and vegetation around the Club is notably different from that of the surrounding area.

Outside, sheep have browsed desirable understory vegetation (nontoxic, palatable, nutritious species) up to a height just under 2 meters and have left a sparse covering of toxic and noxious plants (such as *Lantana* spp. and *Croton* spp.). *I. pinguis* adults generally forage on or within a meter of the ground, and we expect that either the low quantity or the quality of the ground cover is preventing their establishment on most of the cay. We do not know if the success of the iguanas within the environs of the Club's sheep exclosure is due to the presence of an ungrazed understory of native plants or the suite of edible exotic species there (such as *Hibiscus* spp. and *Ixora* spp.). Species composition aside, Lazell points out that Guana appears more verdant than many islands where iguanas are abundant. To date however, iguanas have failed to evenly populate the cay. The relationships of sheep to suppression of the iguana population may be clarified if iguana distribution and numbers increase once sheep are extirpated from the cay and the natural understory recovers across the island.

Topographically and geologically, Guana and Anegada are dissimilar: Guana is largely rugged igneous rock hills with some sandy lowlands (maximum elevation, 246 meters), while Anegada is an old reef tract, half limestone, half sand (maximum elevation, 7 meters). On Guana, because of its relief, aspect may be important to iguanas and influence their distribution. While Guana has east-facing slopes that do not seem to support iguanas, these are generally shaded in early morning by relief to the east. All sleeping sites ($n = 7$) except one occupied by the male were on ridge tops or had eastern exposure. As Carey (1975) reported for

iguanas on Anegada, and as Goodyear has frequently observed, iguanas bask near sleeping sites prior to foraging in morning hours. It may be advantageous for cold, sluggish iguanas to bask near burrows to facilitate escape from predators. We found they frequently retreat into burrows when approached just after sunrise.

Geological differences between Anegada and Guana also may affect the quality and number of shelter sites. Central regions of Anegada have thousands of naturally occurring limestone cavities that are used as refuge and sleeping sites by iguanas. Iguanas excavate burrows there in sandy areas only. On Guana, all refugia are excavated from hard-packed soil with associated rock outcrops. This requires greater energy expenditure than do the alternatives on Anegada (no digging, or digging in sand), which may explain why refugia are less densely spaced on Guana. Decreased burrow density on Guana may result in the arboreal tendencies we noted there. In a similar study on Anegada (four one-month sessions from 1988 to 1991), Goodyear and three assistants never observed an iguana sleeping in a tree.

Decreased burrow density may also increase vulnerability to predation. On Anegada and Guana, frightened iguanas flee towards burrows. On Anegada, shelter sites are always within 30 meters. On Guana, iguanas have been found 250 meters from their closest known burrow, considerably increasing their exposure during flight. Red-Tailed Hawks (*Buteo jamaicensis*), or perhaps now-extinct nesophontid insectivores, are likely to have been the only native predators, but they must have preyed largely on hatchlings or eggs. Humans and their associated cats and dogs prey on both juveniles and adults. At the advent of human colonization, iguanas that inhabited islands with volcanic terrain may have suffered a new and unacceptable level of predation. Low density of shelter sites may have been critical if it hindered escape, and may explain the recession of *I. pinguis* from most of its former distribution on the Puerto Rico Bank. In concert, the porous limestone habitats on Anegada and the relatively small human population may have provided a critical refuge for *I. pinguis*, perhaps its last natural stronghold.

Many would argue that Guana's population is too small to be called a success, far lower than the "minimum viable population" of 500 individuals commonly used as a guideline (Grumbine 1990; Dodd & Seigel 1991). We believe Guana's *I. pinguis* population to be both normal and viable. Populations descended from a few individuals are the norm on oceanic islands: we believe the entire present West Indian herpetofauna must have arisen from a small number of founders. It is difficult to envision multiple scenarios in which 500 individuals of each ancestral species arrive. More plausibly, offspring from single gravid females or the occasional pair underwent the process of natural selection in each novel environment. If high fecundity characterized colonizers, evolution and adaptation to local conditions could sweep small gene pools. Further, small populations (less than 500 individuals) are persistent in the West Indies. Many islands presently populated by endemic species are so small that they cannot support 500 individuals. Carrot Rock, southeast of Peter Island, British Virgin Islands, is a 1.3-ha protrusion from the sea supporting the spectacularly distinct, undescribed species *Mabuya* (Lazell & Mayer 1992). The speciation that has occurred is testament to both the persistence in isolation and the viability of the small populations that occur on that rock. Other examples are given by Craig (1991) and Simberloff et al. (1992). Certainly many West Indian cays support tiny but tenacious populations of sheep and goats, Guana being no exception. We suspect that minimum viable population size may have to be assessed on a case-by-case basis. On Guana, the small population of *I. pinguis* could be called inviable only if it failed to respond to local selection pressures or to expand when given the opportunity.

Conclusions

A reproducing population of *Iguana pinguis* is now established on Guana Island, where it had certainly been absent for more than half a century prior to 1984. A population of 9 to 12 occupies 19 ha, 3 ha of which are apparently optimal habitat. All 10 marked individuals were hatched on Guana; six appear to be young of the year. On the rest of the 300 ha of Guana Island, iguana distribution is patchy and sparse. We estimate that 20 adults inhabit the cay. If predation and foraging competition by humans and their domestic animals are curtailed, *I. pinguis* may be capable of expanding its population. The experiment on Guana continues: predation by non-native animals has been almost eliminated on the Guana Island Wildlife Sanctuary (and will be with the demise of the last cat), and we hope the last sheep will not be far behind.

The conservation status of the other iguanas of the northeastern Antilles, *I. iguana* and *I. delicatissima*, has not been assessed since 1963–1964 (Lazell 1973). Lazell (1973) pointed out population declines and island extirpations, but he complained that ". . . there is no evidence that man, mongooses, dogs, cats, goats, or pigs—singly or in combination—have affected them." In Lazell's field notes are frequent comments that iguanas were "very common" at many sites, including St. Barts and Gaynor's Gut, Antigua, where man and associated exotic animals were also dense.

Carey's (1975) descriptions of population structure

on Anegada indicate a sort of false prosperity: adults represent close to 90% of the population six months after the hatching period. Adults appeared numerous and demonstrably breeding, but there was low recruitment. We have noticed the same trends in age structure on Anegada, and Lazell observes that the population as a whole appears to have decreased since his first visit in 1980. Low numbers of subadults may be due to the predation of young by cats and dogs (Carey, 1975) or after young have passed their more carnivorous juvenile phase, to competition with feral livestock and adult iguanas for quality mast and foliage.

With these scenarios in mind, it is now important to revisit such sites as Ile Forchue, northwest of St. Barts, where in 1963 Lazell recorded "at least 40" individuals and noted: "Huge colonies swarm. . . ." (Lazell 1973). Ile Forchue is larger than Guana Island, about 535 ha, as is Ile Chevreau, about 448 ha, also said to have a large population of *I. delicatissima* (Lazell 1973).

The Goat Islands, off the south-central coast of Jamaica, formerly had a large population of *I. collei* (Grant 1940). After introduction of mongooses, it was assumed that iguanas were extirpated there. They may not have been so drastically affected. Seemingly prosperous populations of iguanas occur in many places where mongooses are abundant, such as Hispaniola, St. John, and St. Thomas (Schwartz & Henderson 1991). If iguanas persist on the Goat Islands, removal of mongoose and goat (and other exotic species) might restore these islands to excellent habitat. If iguanas have been extirpated, then elimination of exotica might be easy, because a poisoning campaign could be carried out without risk to iguanas. Captive stock of *I. collei* (Ehrig 1990) could be reestablished. Great Goat Island, about 230 ha, is certainly large enough to support a population; Little Goat, about 100 ha, may well be too.

We believe that relatively small islands may be the key to the long-term prosperity of many species of iguanas.

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Diversity or Proliferation?

I am a field biologist principally involved in site inventories for purposes of prioritizing conservation action. I work largely with terrestrial vertebrates and discover new species very frequently. Most of my non-field time is consumed describing new species, many of them of quite extraordinary evolutionary or biogeographic interest.[1,2]. My productions are the norm; biological surveys and inventories produce a steady stream of new and truly wonderful animals, exemplified in the batch of incoming reprints nearest at hand as I write[3,4]. The magnitude of the task of cataloging this planet's life forms is truly staggering. Some of the least conspicuous organisms turn out to be among the most important indicators of environmental health and impinge forcefully on the most critical conservation action decisions; consider the Tomah mayfly[5]. I find the views expressed by Renner and Rickles[6] disheartening and even appalling.

While I agree that a good deal of ecosystem preservation can – indeed must – proceed without exhaustive inventories, I cannot accept the view that ignorance is good or the putative "intellectual development" of systematists is benefitted by not knowing what lives where. I am mightily impressed by the surprises. No one known to me guessed a decade ago that Hong Kong retained some of the richest remaining ecosystems on the continental shelf of Asia between Korea and Vietnam[7,8]. Inventory processes there are still so far from complete that the few of us who know about the special places are still faced with disbelief and denial[9]. Only good inventories convince policymakers (and not always even then).

I found Renner and Ricklef's[6] positive view of cladistics especially galling. In the subject areas I know most about, mammology and herpetology, cladistics has provided no conservation-oriented benefits and, indeed, siphons considerable resources away from much needed field studies. The cladistic studies I see are carried out by the desk-sessile who simply proliferate Latinized names, especially

for higher taxa (genera, families, etc.). The "diversity" they generate is one of words, not organisms. Generating names is not science, and cladistics as I see it practiced is not even scientific.

The exemplar of the cladogram of the lizard family Chamaeleonidae and other iguanian lizards presented by de Queiroz and Gauthier[10] is especially appropriate. This depiction is based on a cladistic revision[11] that has been vigorously criticized[12,13]. The revision was based entirely on morphological characters garnered from the literature and obviously not checked for accuracy. Many trenchant characters, almost certainly apomorphic, were discounted and not used in the revision. Character weighting was wholly subjective and – I submit – irrational.

For example, enlarged middorsal scales were weighted as a character precisely equal to zygodactyl foot. The presence and degree of middorsal scale enlargement is enormously variable within species. It is prone to sexual dimorphism and both ontogenic and geographic variation. In the revision cited[11], the presence of enlarged middorsal scales in any member of any species in a predetermined group of species up for family status was scored as simple presence. The zygodactyl foot of chamaeleonids, by contrast, is a complex suite of apomorphies involving bones, muscles, vascularization, enervation, and scales. It is utterly unique in all Reptilia and sets Chamaeleonidae instantly apart.

I reject the notion that any sort of intellectual development has gone into cladogram production and resultant name proliferation. Cladograms are generated in computers, not in brains. The sole purpose of the human cladist is to cull and rig the data fed into the computer.

The attempt to put a veneer of evolutionary respectability onto cladograms by inserting little character bars[10] on their lines is concessionary but inadequate. The basic and sole mensurable parameter of a cladogram remains time, on the y-

axis. There is nothing at all on the x-axis. Thus, cladistic analysis provides almost the opposite of evolutionary assessment: the inverse; the flip side of the coin. In evaluating "relationship," the cladist really will never be dissuaded from the belief that only the temporal sequence of events matters. The magnitude and significance of evolutionary changes forged by natural selection – at dramatically different rates in different lineages – is claimed too subjective to ponder (but devaluation of the chamaeleonid foot was judged "objective," one must suppose).

If "relationship" is, as cladists believe, a property of lineages precisely equal to the inverse of their independent length in time, then cladists must necessarily believe at least one of the following: a, evolutionary rates are constant; or b, evolution does not affect relationship. This latter is implicit in an attempt at conciliation[10] of cladistics with the categorical hierarchies of Linnaean nomenclature.

Cladograms can be extremely useful in pondering real, evolutionary relationship, but they do not depict it. The only reliable cladograms would be based on precisely accurate molecular clocks (should such ever be found). Molecular clocks only function to the extent that they are sequestered from and immune to natural selection – the motive force of evolution. A molecular "clock" subject to evolution by means of natural selection is worthless. Time is not a selection pressure.

Many systematists today merely proliferate names in higher taxonomic categories. These are just words, not organisms. They are artificially invented, not "discovered." Insofar as they are simply and unequivocally defined, these word names can be useful in communication, but not if there are too many of them (nine unrecognizable "families" where one easily-recognized one existed before[11]). Only inventories document diversity, and we have far too few of them. Despite pedantic debate, the correlation of diversity to stability is obvious to me

from field experience on the tundra and in the tropics. I do not need Popper[14] or Hurlbert[15] to "prove" the diversity-stability relationship for high-level consumers (like me), any more than I need them to prove this planet is subspherical. However, it does take good inventories – and long-term studies – to demonstrate it. Systematics could provide a solid, communicable framework for inventories; monographs are inventories, after all.

Systematics could be a valid, but minimally intellectual, enterprise that if regulated, policed, weeded, and cleaned up would be a useful servant to biological science. But at this time systematics is just a childish game. Trading cladograms for inventories is like trading horoscopes for encyclopedias.

James Lazell

The Conservation Agency, 6 Swinburne Street, Jamestown, RI 02835, USA

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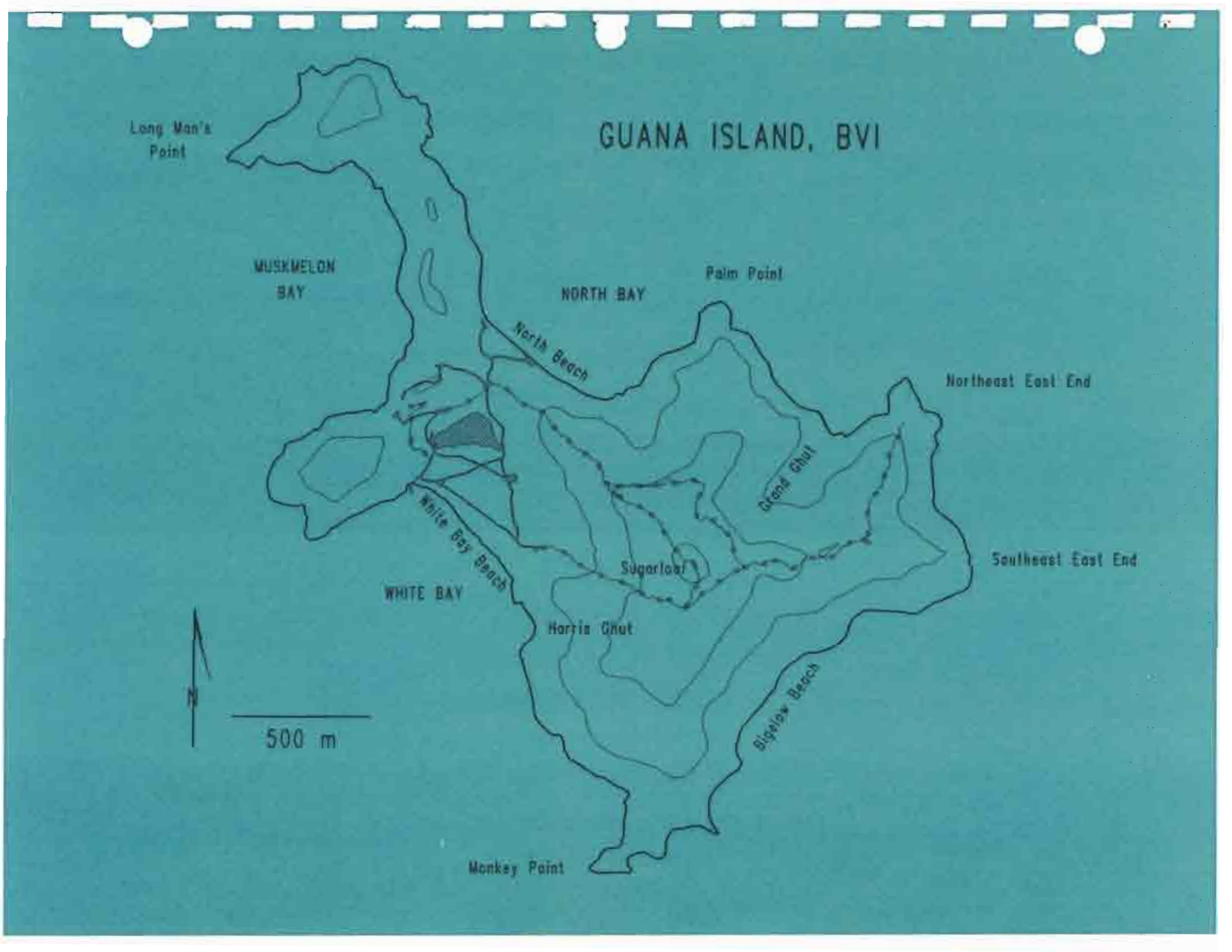
This will help clarify my views on the pseudoscience of cladistics.

Slip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