The Conservation Agency

Exploration, Education, and Research

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

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

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Dr. Henry Jarecki
Timber Trail
Rye, NY 10580

Dear Henry:

Herewith a works and progress report for 1985.

Since volume makes this a bit cumbersome, I offer a reader's guide:

Progress continues on the book Island..., with an excellent and encouraging review received from Dan Simberloff. Michael Gibbons reports he will get the disks from Ms. Ayvazian, my office manager, and begin an editorial rewrite with an eye to coauthoring the whole. I believe a coauthored work may prove stronger and more acceptable to publishers. I have approached Smithsonian Institution Press about it. Continuing field work, especially Greg Mayer's studies, will greatly enhance the strength and value of the work.

We have several papers in press: one on reptiles and amphibians, the text of which was included in last year's report, but updated, and one on moths. Lots of others are in the nascent stage; some will be noted below and in the proposal for 1986 work.

Our most recent publication, on 'guana ticks, follows.

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AMBLYOMMA ANTILLORUM KOHLS, 1969 (ACARI: IXODIDAE): DESCRIPTION OF THE IMMATURE STAGES FROM THE ROCK IGUANA, *IGUANA PINGUIS* (SAURIA: IGUANIDAE) IN THE BRITISH VIRGIN ISLANDS

JAMES E. KEIRANS

Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Allergy and Infectious Diseases, Department of Entomology, Museum Support Center, Smithsonian Institution, Washington, D.C. 20560.

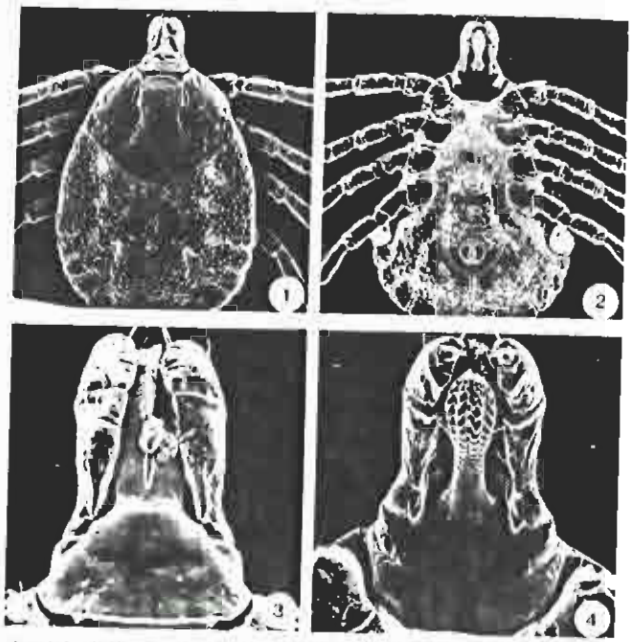
Abstract.—The nymph and larva of *Amblyomma antillorum* are described and illustrated for the first time from specimens collected on the endangered rock- or Anegada iguana, *Iguana pinguis* on Anegada Island, British Virgin Islands.

On Caribbean islands, iguana-feeding ticks of the genus *Amblyomma* comprise a small, relatively compact group of four species: *Amblyomma albopictum* Neumann, *A. antillorum* Kohls, *A. cruciferum* Neumann, and *A. torrei* Vigueras. *Amblyomma dissimile* Koch is only found occasionally on iguanas. It is primarily a parasite of snakes and also parasitizes Amphibia.

Herein are described the immature stages of *Amblyomma antillorum* Kohls, a parasite of the rock iguana, *Iguana pinguis* (Barbour). The descriptions are based on 2 nymphs and 3 larvae, the only specimens available. Measurements (mm) are given for all specimens. Preparation of immature stages for scanning electron microscopy follows the method of Corwin et al. (1979).

Amblyomma antillorum Kohls

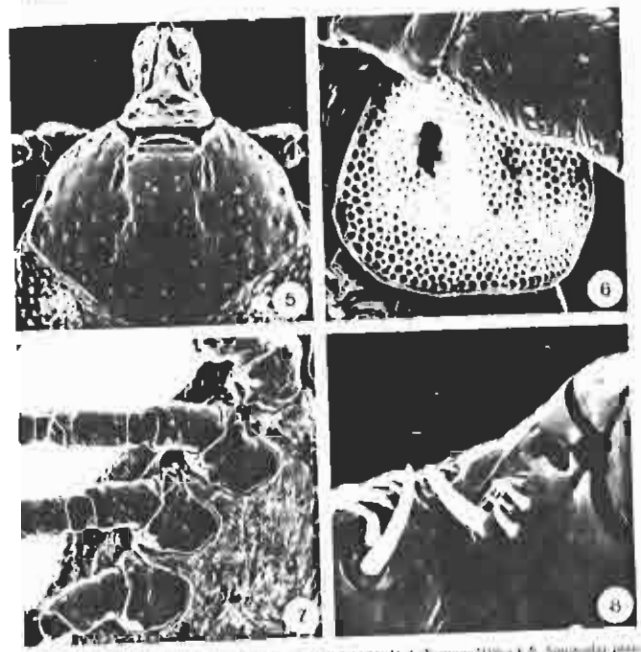
Nymph (Figs. 1–8).—*Body* (Figs. 1, 2): Length from scapular apices to posterior body margin 1.13, 1.64; width 0.86, 1.42; widest at level of spiracular plates. *Capitulum* (Figs. 3, 4): Length from posterior margin of cheliceral sheaths to posterior capitular margin 0.12, 0.11; width at level of scapulae 0.21, 0.20. *Basis capituli* dorsally (Fig. 3) ca. 2× as wide as long. Triangular, cornua absent. [The specimen illustrated in Fig. 3 shows the basis capituli with two surface indentations centrally. The other nymphal specimen does not show this artifact.] Basis capituli ventrally (Fig. 4) with posterior margin convex. *Palpi* (Figs. 3, 4) 0.25, 0.23 long; segment 2 ca. 2× as long as segment 3; segments decreasing in size in the order 2, 3, 1, 4; setae as illustrated. *Hypostome* bluntly rounded and bulbous anteriorly; dental formula 2/2 throughout with several minute denticles forming an apical corona; ca. 6 teeth in each file diminishing to crenulations basally. *Scutum* (Fig. 1, 5): Length 0.32, 0.33; width 0.41, 0.45; outline as illustrated; evenly distributed, *cervical grooves* short, deep, directed posteriorly; *eyes* at lateral scutal angle, not bulging to encircled by coloration. *Spiracular plate* (Fig. 6) subcircular with slight



Figs. 1–4.—*Amblyomma antillarum* nymph (RML 117481). 1, Dorsal view (64×). 2, Ventral view (64×). 3, Capitulum, dorsal view (318×). 4, Capitulum, ventral view (212×).

dorsal prolongation. *Eyes* (Figs. 7, 8): Coxa I–IV each with two spurs, the externals slightly bulbous, the internals more pointed and decreasing in size from I–IV. Trochanters lack spurs. Tarsus I 0.26, II 24 long, 0.07, 0.07 wide. Haller's organ (Fig. 8) with oval bifurcate, anterior pit setae number 6.

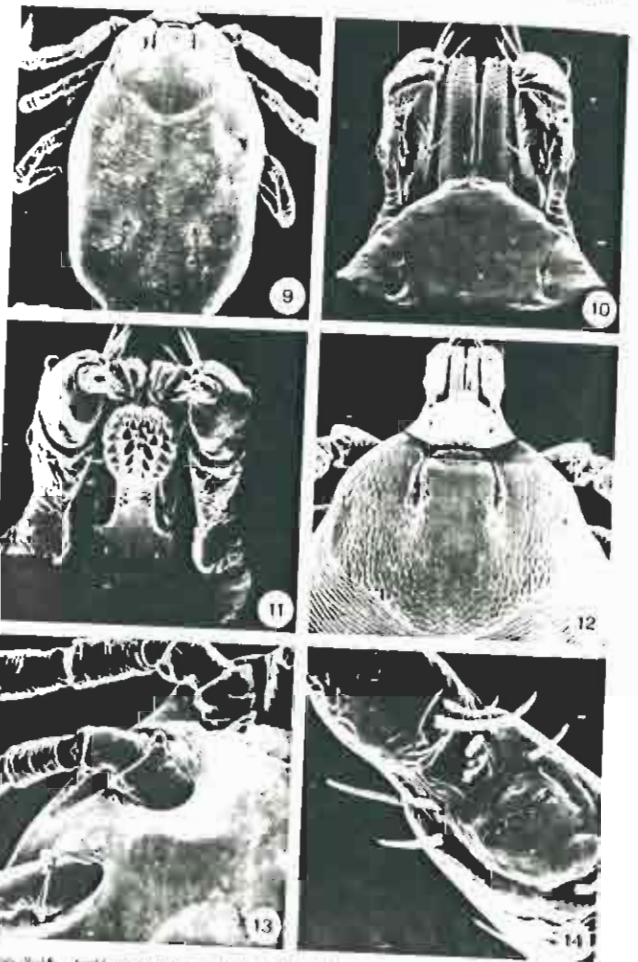
Larva (Figs. 9–14).—*Body* (Fig. 9) partially engorged; length from anterior scutal margin to posterior body margin 0.82–0.92, 1.05, width 0.55, 0.59, 0.67 widest at level of coxae IV. Dorsal body setae number 40 pairs, 2 pairs central dorsals, 8 pairs marginal dorsals. Ventral setae 12 pairs and 1 pair on anal valves, 3 pairs sternals, 2 pairs precoxals, 2 pairs premarginals and 5 pairs marginal ventrals. *Capitulum* (Figs. 10, 11): Length from posterior margin of cheliceral sheaths to posterior margin of basis capituli 0.65, 0.85, 0.85; width 0.12, 0.15, 0.14. *Basis capituli* dorsally (Fig. 10) with posterior margin straight medially then angling anterolaterally, cornua absent. Ventrally (Fig. 11) with posterior margin broadly



Figs. 5–8.—*Amblyomma antillarum* nymph (RML 117481). 5, Scutum (318×). 6, Spiracular plate (330×). 7, Coxae I–IV (212×). 8, Haller's organ (212×).

rounded. Basis pastoris setae 1 minute pair. *Palpi* 0.12, 0.15, 0.14 long, suture between segments 2 and 3 distinct; setae 0 on segment 1, 4 dorsally and 2 ventrally on 2, 5 dorsally and 3 ventrally on 3, ca 9 on segment 4. *Hypostome* (Fig. 11) bluntly rounded anteriorly with a cornua of four denticles; dentition 2/2 throughout length with serrulations extending posteriorly. *Scutum* (Figs. 9, 12) 0.30, 0.29, 0.39 long, 0.41, 0.40, 0.41 wide; setae 3 pairs. *Cervical grooves* short deep parallel troughs. *Legs* (Figs. 13, 14): Coxae I–III each with a single, small, truncate spur bearing a small to minute seta posteriorly [the seta is broken off on spur of coxa I in Fig. 13]. 8 coxal setae, 3 on I, 2 on II and III. Tarsus I 0.45, 0.46, 0.47 long, 0.05, 0.05, 0.06 wide. Haller's organ (Fig. 14) with 5 anterior pit setae.

Material examined.—26 ♂, 1 ♀, 2 N, 3 I. *Amblyomma undulatum* (RML 117481) ex *Iguana pinguis* (9) collected from dewlap, cloaca and hind axillary areas, Anegada Island (18°43'N, 64°30'W), British Virgin Islands, 16 Jul. 1984, James D. Lazell, Jr.



Figs. 9–14. *Amblyomma antillarum* larva (RMLH 74851). 9. Dorsal view (85×). 10. Capitulum, dorsal view (424×). 11. Capitulum, ventral view (458×). 12. Scutum (217×). 13. Coxae I (511×). 14. Haller's organ (1222×).

In addition to Anegada Island, *A. antillarum* is also found on *Iguana delicatissima* on the island of Dominica (Kohls, 1969). We have recently found a collection of 11 ♂ ♂ *A. antillarum* (RML H 5734) in the E. C. Bishopp tick collection (Bishopp 15182) from an iguana, East Caicos Island, Bahama Islands, 28 July 1930.

Species Relationships

Little is known about the immatures of Caribbean reptile-feeding *Amblyomma* species. The immature stages of *A. albopictum* are unknown and larvae of both *A. cruciferum* and *A. torrei* are undescribed. Thus, only the larva of *A. antillarum* is known for this group. The nymph of *A. antillarum* is inornate, which separates it from the ornate nymphs of *A. cruciferum* and *A. torrei*.

Remarks

The host of *Amblyomma antillarum*, *Iguana pinguis*, is found only on Anegada of the 46 named islands forming the artificial political entity of the British Virgin Islands. This saurian is a highly endangered species, a victim of competition with goats and other feral livestock, predation by dogs and cats, and habitat destruction and hunting by man. Because these iguanas receive no protection, a program was begun in July, 1984, to relocate them from Anegada to Guana Island, a privately owned wildlife sanctuary. *Iguana pinguis* was previously resident on Guana Island but was eradicated by agriculture prior to 1900 (Lazell, pers. comm.).

The host of *Amblyomma antillarum* on East Caicos Island is surely *Iguana iguana carinata carinata*. This iguana was listed in the genus *Cyclura* by Schwartz and Thomas (1975) as occurring on Big Iguana Cay off East Caicos Island.

Iguana pinguis is more commonly known as *Cyclura pinguis*, but I have followed Lazell (1983) who considered both the genera *Cyclura* and *Brachylophus* to be synonyms of *Iguana*.

Acknowledgments

I am most grateful to James D. Lazell, Jr., supported by the Mobatta Metals Corporation, for supplying me with specimens of *A. antillarum* and for information on *I. pinguis* and to Richard G. Robbins for the scanning electron photomicrographs.

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The Commonwealth of Massachusetts
University of Massachusetts-Boston
Harbor Campus
Boston, Massachusetts 02125-3393

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

Guana Island Letter
Gibbons: 1 November 1985.

Dear Skip,

Please accept my thanks, and extend them to Mocatta Metals for the opportunity of conducting field work on Guana Island. I have divided this letter into areas related to the kinds of investigations I have conducted on the Island: Historical Archeology, Prehistory, Sub-fossil and recent bony remains, and Overall Ecological Observations.

Historical Archeology.

Historical Archeology is the area of investigation that combines written records with what is found during the course of archeological excavation. Guana has a lot of potential in this area. It's occupation is documented since the 1600's. Archival material is scanty for the early period, but is better for more recent ones. The artifactual material is plentiful and obvious. There are some problems, however. The major one is that "pot hunters" have picked over the sites during the last fifty or sixty years. This fact lessens the reliability of archeological investigation and reconstruction. There are probably a large number of sites that a professional historical archeologist could uncover, and this kind of work would help reconstruct the Island's historic past. From the point of view of understanding the Island's natural history, this reconstruction is important in order to illuminate the history of habitat disruption over the last 400 years. The artifacts found in the caves this summer that fall into the historic time period indicate that they were used as animal shelters, store rooms, and lunching, if not living, spaces. From the remains of extensive terracing on the Island, agriculture was a major disruption to the natural succession of the Island.

Prehistory.

This archeology is that which uses excavation alone to reconstruct human occupation of the Island. This work relies on the discovery of artifacts and has no archival backup. Although it is tempting to think that prehistoric material on Guana is as plentiful as historic,

it is not. Only a couple of prehistoric artifacts were found in what was admittedly a casual investigation, but casual investigations of this sort have been going on on Guana for a long time now and very little has been found. I have searched for middens (old garbage heaps) the contents of which would be indicative of the Indians that lived there and have found none. The one arrowhead that I found this summer appears to be from a chert source in Florida. So, whatever else went on on Guana, like today people came from great distances to spend time there. What they did during this time is going to be hard to reconstruct, however.

Subfossil and Recent Bony Remains.

These come from the excavation (sampling) of three caves and two rock shelters on the Island. I would not, however, call these investigations paleontological. Most of what I sampled is recent material and represents modern fauna and flora. Thus far, the usefulness of this material has been to substantiate the ranges of certain extant forms. To date, we have not sampled any truly fossilized material. The oldest found is less than 1000 years old and is just beginning to be permineralized. The mineral replacement in our sample is from recent sediments. The question of whether there is true fossil material in the caves is difficult to answer without further digging. Some of the higher caves have surface configuations indicating underlying strata that may contain fossils. It is unlikely, however, that any material found will be as old as is the Island itself.

Some Ecological Observations.

Although the Island has a number of habitats that are pristine, it is not an ecology that is in equilibrium. This is probably due to agriculture, its termination and the vegetation's ongoing recovery. There are now more habitats on the Island that there would be if it had never been inhabited. This probably accounts for the more than expected number of species found.

There are some parts of the island that are stable from the point of an equilibrated ecology, but others are still recovering. This recovery is the subject of a different report, but preliminary calculations indicate that the eigen values for niches as abstractly inhabited hypervolumes (treating the niches as weighted Sobolev spaces) are such to expect recovery to take about 1500 years -- should the habitats be left alone. It is expected that animal and plant variety will decrease to a more balanced configuration over that period.

Further Investigation.

In all areas, with the exception of prehistory, further investigation is warranted. For the time being, however, my focus will be on the nature of the lower strata of the caves and rock shelters, accumulating further information toward the matematical modeling of the Island ecology, and enjoying a small portion of this planet that I am coming to know well.

HERPETOLOGY

This continues to be the most rewarding part of our work in terms of arcane theoretical testing and quantitative biology. Mayer spearheads this aspect of the project with me as an assistant. Without the long hours of work put in by Elayne Azevedo and Dale Ford in 1985, we would have accomplished only a fraction of the data collection. As these data accumulate, our notions, hypotheses, and validity of product get better and better.

I have also considered several natural history topics. We got two fine, living amphisbaenas last July, which were maintained in captivity for feeding tests -- as proposed -- for a full month. They never ate anything at all. We tried them on Typhlops to test Bill MacLean's theory, but the Typhlops and Amphisbaena lived in seeming harmony. We tried them on ground geckos (Sphaerodactylus) with similar lack of result. We tried various insects: no luck. So, I still do not know what amphisbaenas eat. Pure serendipity: we collected several peculiar mites from the amphisbaenas. These went to Smithsonian, where they could not be identified. It is hypothesized that, if these parasites are as far out phylogenetically as their hosts, they will constitute a most remarkable new discovery. Scott Miller searched in vain for a mite expert willing to take on the task. Finally, a former professor of mine from U.R.I., Kerv Hyland, heard about them from me. He is a well-known parasitologist and was responsible for getting the 'guana ticks described and named by Kohls in 1969, five years after I discovered them the first time. I believe we can expect a good outcome if Hyland takes on this job.

The taxonomic status of BVI amphisbaenas remains undetermined, and awaits the slow accretion of more specimens of these creatures which are so difficult to find.

We got only one additional "slipperyback" skink, genus Mabuya, last July. I have not heard from Dr. Blackburn at Cornell since his enthusiastic correspondence a year ago. However, a perusal of MCZ specimens reveals over a hundred from the Puerto Rico and Mona Banks. These are spread through most months of the year. I believe dissection of these would provide the information to flesh out a life table for this species, which I argue is the most mammal-like reptile in reproductive physiology (more so than the other species studied by Blackburn). Given a good life table, we would know just when to concentrate our efforts on this very rare species. Nothing like that has ever been published.

I still have hopes that some clever programmer can work out a computer program for this species (and applicable to any other) so we can model its population biology. I believe the laboratory work and write-up for the life table would take one month of full-time work on my part. I would like to do it next fall at MCZ, Harvard.

Gibbons' point (above) about human disturbance increasing habitat types, and Mayer's evidence (below) that a small, artificial island has gained, not lost, species since becoming an island are fascinating. With respect to the reptiles and amphibians of Guana, all of which appear to be native, one has to wonder

where they were before disturbance provided new habitats? Gibbons' notion does not seem a plausible explanation for herpetological species diversity on Guana (nor for bats!), but it is the sort of idea we need to explore further.

Benes' evidence, combined with that generated quite independently by Mayer, that anoles move far more than the literature would have us believe requires further investigation. Both make their points in the reports below.

Our biggest problem in herpetological investigations is lack of assistants. The work is incredibly labor-intensive. Three people do not catch three times as many lizards as one, they catch ten times as many. The tightness of the math depends on big sample sizes. I propose adding several assistants to this field team. The benefits are potentially enormous.

Microevolution, speciation, and community assembly in anoles.

The goal of the studies which have been undertaken on Guana Island, and the continuation of them outlined below, is to understand how natural populations diverge in morphology and ecology, the processes by which new species are formed, and how new species are then combined into communities of increased ecological diversity. Archipelagos, such as the Virgin Islands, have long been recognized as favorable situations for the study of such processes; Darwin was greatly influenced by his experiences in the Galapagos, and Wallace, co-founder of the theory of evolution by natural selection, chose the Malay Archipelago as the site of studies which would be most instructive to him on the problem of the origin of species. The Virgin Islands also present many favorable opportunities and prospects for research on this problem.

The formation of species requires that two or more initially conspecific populations become isolated from one another; and that the separated populations evolve so that an initially geographic isolation becomes genetic. We can thus study species formation by studying those factors which control evolution within populations, and by then studying the results of evolution among an array of isolated populations. When one or more of these isolated populations differentiates ecologically, so that newly speciated forms are able to coexist, then diversity of the local community is increased. The following list of accomplishments and proposals for further study is arranged in an order roughly corresponding to the sequence of events outlined above. It begins with studies of the factors affecting the

evolutionary trajectory of individual populations, goes on to studies of the actual trajectory of a population, then the results of different trajectories among an array of populations, and finally community studies aimed at elucidating the origin of sympatric ecological diversity.

The primary subject of these studies has been the crested anole, Anolis cristatellus wileyae, the most widespread species of lizard in the Virgin Islands. It presents numerous advantages for the studies being carried out and proposed. Besides being widespread, it is very abundant, easily captured, marked, and observed, and has a number of differentiated geographically representative forms, including the Carrot Rock anole, Anolis ernestwilliamsi. These advantages have been born out by our field experience this past July, and confirm that the choice of study organism was a wise one. The saddlebacked anole, Anolis stratulus, and the grass anole, Anolis pulchellus, have also been studied to the extent that they present circumstances amenable to study. Among the findings of this past field season are a fairly sizeable population of the grass anole in the garden area of White Bay Flat, thus providing an opportunity for study of this species. Because of its usual rarity, we had feared that we would have little chance to study this species.

Factors affecting evolution within populations. Population structure, population dynamics, and ecological relationships are among the factors being studied here. We wish to determine the selective factors in the environment, and the properties of the population which determine response to such pressures

(genetic factors are considered below). The studies which are being carried out, all on Guana, are the following:

1) Diet. The food habits of the crested and saddlebacked anoles were to be determined by examination of stomach contents. Samples of both species for this purpose were collected in July. In addition, as mentioned above, the finding of a fairly dense grass anole population permitted collection of a series of this species for stomach content analysis. This is an important and unexpected benefit, since it allows us to make dietary comparisons among all members of the diurnal, arboreal lizard guild. Further work in this area that is required is the collection of larger samples for the assessment of size and sex variation in diet. Identification of stomach contents will be done with the aid of Scott Miller of the Smithsonian Institution.

2) Predation. The most interesting results to date in this portion of the study are observations of predation by anoles upon other lizards. The crested anole thus interacts with saddlebacked and grass anoles not just as a potential competitor, but as a predator as well. This was not anticipated, and knowledge of it will be important in interpreting the species interaction leading to observed community composition. Other species feeding upon the lizards will be determined by observation of avian predation, and stomach content analysis of snakes and Ameiva.

3)Structural habitat. The preferred perch sites and habitat occupation of the anoles has been determined by Rand-

Schoener census, a technique which has proven successful in studies of anoles on other islands. Several hundred observations were made this past July on Guana, and we are well on our way to understanding the habitat preferences and differences of the anoles. In addition, comparative observations were made on St. Thomas and Tortola. Together, thse observations show that the crested anole is a species of lower tree trunks, usually of considerable diameter, but also capable of climbing high into trees. The saddlebacked anole is also a tree species, but usually much higher than the crested anole, commonly occurring at heights over 3 meters. It will, however, descend to the lower parts of tree trunks and thus overlap with the crested anole. There seems to be especially great overlap in the forest along the trail up to Guana Peak; this situation calls for further study. The grass anole, as it name implies, is found in grassy and weedy areas, and on saplings of small diameter. Its habitat requirements explain its restricted distribution on Guana: it can live only in those areas protected from sheep, which consume all herbaceous vegetation outside the exclosures. The further requirements of this portion of the study are that the sample size of observations be increased.

4)Thermal habitat. The preferred body temperature of the anoles, which is an important part of their distribution within the habitat, will be determined by taking body temperatures of individuals. This part of the study is yet to be done; work on it is planned for 1986.

5)Population size. Studies of population size and density, using various methods of estimation, were carried out in 1982, 1984, and 1985. In 1985 triple-catch censuses were performed on the crested and saddleback anoles at the three established sites in White Bay Flat and Quail Dove Ghut. In addition, double-catch censuses of all three species were made in the garden on White Bay Flat. We are thus beginning to get a good picture of yearly variation in density and relative abundance of the species. These censuses will be continued at the three established sites on Guana, and perhaps the new garden site as well. At least three censuses of each site should be done each field period. An important new technique to be attempted in 1986 is a new method of individual marking allowing permanent, quick identification. This will not only make the census work easier, but, as will be seen below, it is necessary for study of selection.

6)Sex ratio. This has been determined during the course of population size studies, and will be studied during 1986.

7)Home range and territory size. These have been determined by mapping observations of marked individuals. This was begun in 1984 and expanded considerably in 1985. The study has been concentrated on the area around Anegada House. We now know that the home range of a male crested anole is from a few to ten meters along its longest dimension, and initial observations indicate considerable dynamism in territory occupancy over an interval of just one month. Study of movement and home range at this site will be continued.

8)Daily activity cycle. This has been determined by following the marked individuals from the study of home range and territory. This also provides many opportunities for observations of feeding, predation, courtship, etc. Results so far indicate that lizards spend most of their day doing nothing, or at least nothing in particular. There are however occasional episodes of interaction among individuals, and apparent attempted predation by birds. These studies will be continued in 1986.

9)Reproductive cycle. This will require collection of small samples in all seasons of the year. Information available from previously collected specimens needs to be supplemented by specimens collected during times of the year when scientific personnel have not visited Guana. A sample of females collected this past year showed that approximately 1/3 were gravid and ready or near ready to lay, and that most of the others had eggs in the yolk stage.

Microevolution in action. These studies will show the actual action of selection on the phenotype, and, if the genetic studies are successful, we will be able to predict the population's evolutionary response to observed selection differentials.

1)Heritability of meristic characters. The genetics of these characters will be studied by parent offspring regression. This will require the collection of substantial numbers of females, and the successful hatching of eggs laid in captivity. This is the technically most difficult part of the study.

Preliminary observations were made in 1984, and during a visit to Jamaica in September, 1984. We were able to obtain the first estimates of heritability of meristic characters this past July. However, the sample size obtained was the minmum necessary for a statistically valid estimate; much larger sample sizes are needed for us to have any confidence in our estimates. Discussions with the geneticists R.W. Marks of Villanova Univ., F. Arnason of the Univ. of Iceland, and R. Lande of the University of Chicago indicate that a variety of approaches to estimation of heritability will be needed to get a good estimate of what the heritability is in the population on Guana. Estimation by parent offspring regression should be carried out in three environments: in the laboratory, on "benchtops" on Guana, and in natural microhabitats on Guana. In addition, Lande emphasized the utility of half-sib analysis of heritability. It may be necessary to establish a breeding colony of lizards from Guana.

2)Cross-sectional selection. This is the measurement of phenotypic selection by comparison of juveniles to adults. This will require the collection of series of juveniles and adults. This was done in 1985, and should be repeated as often as possible, so as to become integrated with longer term studies of natural selection.

3)Within cohort selection. This is the measurement of phenotypic selection by comparison of same aged individuals at successive points in time. This study was begun in 1985. It is necessary that lizards for this study be individually marked. We

therefore need a means of marking which does not affect the characters being studied or the survivorship of marked animals. For this reason we will attempt a branding type of individual marking in 1986. Lande has pointed out to us that this way of looking at selection is burdened by the fewest assumptions.

4)Within population evolution. This is the measurement of phenotypic evolution by comparison of recent and old samples from the same population. C. Grant's collection should contain Guana specimens collected in th 1930's, and also older specimens for many other of the Virgin Islands. This study requires comparison of this older museum material with recently collected specimens. It will also be possible to observe short term changes by comparison of earlier and later samples within those recently collected. In order to compare old and recent samples and infer selection, we must assume that the genetic correlation matrix of the population is unchanged. We cannot, obviously show this to be true for populations from previous times. However, if we can show that the phenotypic correlations are the same in the old and recent samples is the same, the assumption about genetics is strengthened. We thus need to study patterns of morphological variation in Guana lizards, and in other populations (since older samples from Guana are small), to test our assumptions concerning the inference of evolution on Guana.

Any selection or evolution observed will be interpreted with respect to the factors listed above.

Evolution in action: geographic variation and speciation. These studies will examine the results of microevolution and

isolation among populations. The purpose will be to attempt to relate this larger scale evolution to what we know to be going on within populations.

1)Geographic variation- how do isolated and semi-isolated populations differ from one another? At a micro-scale, we want to know if phenotypic differences can occur within an island (e.g., Guana and Tortola), while more broadly we want to know in what way populations on different islands vary. In 1985 we began systematically collecting from as many islands as possible, to demonstrate geographic variation. Of special interest is our collection from Skipper Cay, which shows that the endemic Carrot Rock anole is limited to that island, and not found on the geographically similar Skipper Cay. In 1986 our major goal is to make simultaneous collections from several parts of Guana to see if the entire island population can be considered homogeneous with respect to morphology. This is similar in intent to MacLean's study of variation in physiology of geckos from different parts of Guana.

3)Speciation- how do closely related species differ, and what are their geographic distributions? In the BVI, the species to study is ernestwilliamsi, because it can be compared to the detailed data on cristatellus we will be gathering on Guana. Specifically, we want to make morphological comparisons, especially of those characters of selective and ecological significance, we want to know its karyotype (which we also need to know for Guana cristatellus for comparison), and we want to

determine its distribution. Specimens of the Carrot Rock anole collected this past July are now under karyotypic and mitochondrial DNA study with the assistance of Drs. R. Honeycutt and J. Blake of Harvard.

Community patterns. We are here concerned with how species fit together into communities, that is, how newly formed species acquire the ecological differences that allow them to coexist in the same habitat.

1)Other species' diets, structural and thermal habitats. These will be studied to determine what ecological factors separate the species, allowing them to coexist. These are the studies of the saddleback and grass anole discussed above and begun in 1985. They will be continued as indicated above.

2)Interspecific interaction. Direct confrontations between individuals are sometimes important in structuring communities, and we need to determine this for the anoles of Guana. This study was begun as part of the study of daily activity cycle in 1985. Other than predation, few instances of direct interaction have been observed, but we will remain alert to the opportunity of observing interactions as part of our study of daily activity.

3)Careful determination of what anoles occur on Monkey Point. As an essentially isolated patch of habitat detached from the main part of Guana, Monkey Point provides the best opportunity for studying a slightly different community, and can help in determining what factors limit the distribution and

abundance of the "mainland" anoles. Camping at Point Monkey for a few days may be the best way of realizing the potential of these opportunities. If it is possible, this can be done in 1986.

Much interpretation of community evolution depends on the extent to which competition is a structuring force. The three studies mentioned above will begin to give us some ideas, and might eventually lead to better, and perhaps experimental, tests of the extent of competition.

A related study of community dynamics was carried out on Hassel Island in the U.S. Virgins by Mayer and MacLean in June, 1985. This island was recently formed by dredging from the mainland of St Thomas. They found that despite the decrease in area of the island, no demonstrable extinctions have occurred in the 120 years since it was separated from St. Thomas, and that in fact new species have been introduced. This bodes well for the maintenance of species diversity on sanctuaries such as Guana.

Several new records from the British and American Virgins were also obtained during this year's field work. Most have been included in a MS accepted by Herpetological Review which also includes new records from previous years. (See attached MS.)*

The program outlined above is a multiyear project. Much of it can be accomplished in a single field season, but the truly important and unique studies of microevolution in action will require more than one season, for practical reasons, and because the studies are designed to be longer, and can only yield useful results if they are. We can as yet claim only to have scratched the surface of the mine of knowledge offered by Guana and its

* Not included. You've seen previous editions and the published work should be out in early 1986. Space-saving.... Shi

surrounding archipelago. The promise of Guana as a unique biological and scientific asset lies in its potential for long term studies of important ecological and evolutionary questions (which can only be addressed by such long term studies) in a stable and biotically rich environment, and the numerous opportunities for comparative study provided by the surrounding archipelago.

Greg Mayer

MUSEUM OF COMPARATIVE ZOOLOGY
The Agassiz Museum

HARVARD UNIVERSITY · CAMBRIDGE, MASSACHUSETTS 02138 · TEL. 617 495-2466

11 September, 1985

Dr. James D. Lazell, Jr.
The Conservation Agency
6 Swinburne St.
Jamestown, RI 02835

Dear Skip:

I'm writing to apprise you of the benefits which would accrue to the Guana Anolis microevolution project from a "midterm" visit. I believe that such a visit would produce important results, some not obtainable through our June-July visits.

The first part of the project which would benefit is that concerned with the population dynamics of the three species of Anolis. Three types of data can be gathered from our 8 marked populations. First, we can measure survivorship over a period of less than a full year. Our results from this past summer indicate that survival over a year (or at least survival + residency) is very low; thus we need to measure survivorship over a shorter time span. Second we can obtain data on individual growth rates. This is possible for the first time because of our introduction of individual marking. Because of the survivorship rate, measurement of these growth rates is only feasible for time periods less than a year. Lizards caught during the visit would be marked, thus allowing another measurement of growth and survivorship next summer. Thus two sets of measurements of these parameters would be made possible by a midterm visit; none without such a visit. Third, if time allows, we can recapture on some of our plots, thus obtaining some idea of seasonal variation in population size and age structure.

The second part of the project which would benefit is the study of the quantitative genetics of Anolis cristatellus. This is probably the most ambitious, and potentially most rewarding part of the entire project. It also requires much work, and the most technical innovation to be successful. This summer we were able to obtain the first estimates of heritabilities, but much larger sample sizes are needed to have reasonable standard errors of these estimates. A midterm visit presents three opportunities for this study. First, it allows us to increase the sample size. This is an obvious, but, given the large samples needed, important benefit. Second, it allows collection during a hopefully wetter period, when a greater proportion of females will be gravid. The proportion gravid is (along with hatch rate) an important determinant of how much data we can gather. Third, a trip of shorter duration allows us to transfer eggs for

incubation to the constant environment of the laboratory shortly after laying. During the Genetics Society of America meetings this past August I consulted with my colleagues Dr. Einar Arnason, chairman of the Dept. of Biology of the University of Iceland, and Dr. R.W. Marks of Villanova University regarding the measurement of heritability, and both agreed that laboratory incubation would be a necessary component of an overall effort to estimate heritability in this natural population.

I believe that an interim visit of short duration can provide a disproportionately beneficial amount of data, as outlined above.

With best wishes,

Gregory C. Mayer

California State University, Sacramento
6000 J STREET, SACRAMENTO, CALIFORNIA 95819-2694

DEPARTMENT OF BIOLOGICAL SCIENCES

October 20, 1985

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

Dear Dr. Lazell,

When we discussed the projects I might be able to attempt on Guana Is. this past summer, we thought it might be possible to do something with the range and behavior of the house gecko, Hemidactylus mabouia, a study of the sleeping habits of the Anolis cristatellus and the use made of human occupied structures by the anolids. Although I have a continuing interest in the least geckoes, Sphaerodactylus macrolepidus, it was not included in the animals specifically to be considered.

As regards the house gecko, it was soon apparent that any study of those animals while alive would take heroic measures for which I was not prepared. The behavior of the small colony I now have at home has just reinforced the impressions I formed last July. Even in limited quarters the lizards are so wary that observations are virtually impossible. I have considered installing an infra-red lighting system to see if this might be a way to see without intruding. They have largely rejected all foods with the exception of moths again supporting the opinion we discussed earlier, though it would take some stomach analyses to confirm this. With daily spraying the lizards are surviving though their tails are not as stuffed with fat as a healthy house gecko in the subtropics would have.

The least gecko has proved to be the most sensitive to humidity or moisture loss. The small group that traveled in the conventional reptile sack did not survive the trip while those in the small bottle came through in fine shape. Again, daily spraying and a colony of fruit flies in the cage has kept them in good condition although the animals have proved to be escape artists resulting in several disappearing before the problem was recognized and corrected. My hopes of being able to make observations in captivity which could then be confirmed and amplified in the field have been frustrated by the few number of animals remaining and again their extreme wariness and cryptic habits.

The reasons for these captive observations which seem rather far removed from the situation on Guana Island are to acquire some insight into approaches that might be applicable to but not immediately obvious in the natural situation. The Anolis cristatellus colony has proved the most useful in this. As regards the previously mentioned interest in their sleeping habits or, what I prefer, the sleep site fidelity study, the captive colony has disclosed what would have been difficult if not impossible to have determined in nature. That is that the lizards not only do not return to the same sleeping area more than two or three nights in succession, but they also change their sleeping location during the night. I can not give statistical frequencies since I have too few animals and too few observations, but there is no question of the validity of the observations in the captive condition and every reason to believe that it will be found to be true in the wild population since that is the situation in which the change of location to confound predators would be of more significance to the lizards. Although I have an ideal caging for the anoles, the small colony has diminished rapidly due to the unfortunate loss of several females because of accidents. One evidently fell to her death---after a fight with the male(???) The behavior of the male has been puzzling. He has been excessively wary compared with animals in the field. The only thing I can ascribe it to is that he lacks most of the crest on his tail. I noticed in Puerto Rico that a dominant male who lost a tail as a result of my efforts to capture him disappeared for some days from any of my observations. At least there is an observation here that is worth checking in the wild population. The lizard has begun sleeping lower in the cage recently could this be a behavioral change due to seasonal changes?

The portion of the summer's observatons concerning the use of buildings by the lizards had variable results. The problem I envisioned was the same that I had in Puerto Rico on a similar type study. That is of being able to recognize the anoles that used the terrace of 'C' cottage as they visited during the day. The method of marking by the use of the nylon tent-mending tape worked beautifully as long as the animal was one that had been marked and had not shed in the meantime. Although I have not developed an approach to the analysis of my observations statistically, the observations showed that there were constantly new lizards coming onto the terrace. My procedure was to mark all the lizards I could catch. Many of those marked never were seen on the terrace again, while some continued to appear at irregular intervals and others were daily visitors. Most of the daily visitors were Anolis stratulus males. I can't recall having any Anolis stratulus females. Anolis cristatellus females were second most frequent though they were wary and very observor-effected, i.e. they left when I appeared. Neither the A. stratulus or A. cristatellus males appeared inclined to leave unless I approached closely. Though not many A. cristatellus males came onto the terrace, the ones who did usually remained for a period of time on the one day at least. The lizards would hide in the cracks at the ceiling edge or along the gate post if threatened and drink from the base of the gutter after rains. Pearly-eyed thrashers drank and bathed in the top of the gutter.

Feeding was observed in both species of anole. A. cristatellus males were seen with sizable moths in their mouths, but, in the case of the A. stratulus, the prey items taken were so small that they could never be identified. Examination of stomach contents

of the lizards showed a similar pattern in that the A. cristatellus males had large prey items, i.e. cockroaches while those of A. stratulus were small and not readily recognizable.

Since it had occurred to me, prior to departure for the island that there might be a good opportunity for an auxiliary study of the blood cell characteristics of the endemic lizards, I consulted with our hematologist, Dr. RoseLeigh Vines, who furnished the necessary solutions for staining blood smears. As I was able to work alongside Greg Maver on his mark-recapture studies, there was indeed an opportunity to make many blood smears from clipped toes without further insult to the animals. These smears have been examined casually and appear to offer considerable information on blood characteristics. This study will take some time to develop due to the fact that neither of us are familiar with the literature nor specific characteristics for these species. But then, if we were, what would be the point of doing the study? Because of our heavy teaching schedules, it will be some time before we can devote such time to this fascinating study.

It will be apparent from the above paragraphs that most of what was accomplished during the month of July, 1985 was of a preliminary nature. There are wonderful opportunities for comparative observations on anole behavior in areas occupied by humans as compared to the areas around some of the ruins which are largely without human intrusion. The problem of marking for recognition can only be solved by constant capture and mark or remark although that does constitute an intrusion into the behavior regime. Were the animals I never saw a second time the victims of predation? Or did they appear when I was not observing? It almost seems as though a team of observers on duty in shifts from before dawn to dusk would be necessary to answer these types of questions. I would scarcely hazard a guess as to the approach to the study of the house geckoes and the lesser gecko without further captive studies to give some insight into the animals' reactions to different approaches although I know you have not much use for laboratory studies. The results of the terrace activity of the anoles and the blood studies will be sent when they can be completed, which may well take a year.

Despite the frustrations encountered and the unfortunate effect that the climate has upon me, I am very grateful to you and the Jareckis for the opportunity to work on Guana Island.

Sincerely,

Elinor S. Benes

Elinor S. Benes, Ph.D.
Professor of Biological Sciences

The Nature Conservancy

1800 North Kent Street, Arlington, Virginia 22209
(703) 841-5300

September 26, 1985

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

Dear Skip:

Thanks again to both you and the Jareckis for what has become one of the highlights of the year for me--the chance to come down to Guana and work on a real, functioning biological reserve.

I'm more certain than ever that the Bridled Quail Dove is a rare bird and definitely worth working on. Since coming back I've talked to John Faaborg of the University of Missouri; he's worked on several Lesser Antillean islands and found the bird's distribution spotty, and common only in a couple of places. Of the islands he's been on, he netted 4 on Montserrat, 6 on St. Kitts (where he found it most common, even in the rain forest, a fact he accounts for by the absence there of the Ruddy Quail Dove), 1 on Guadeloupe and none on Dominica, though he saw one in captivity there; on the latter island there is very little dry forest left, and lots of Ruddy Quail Dove.

The 1985 season was an excellent one, despite the failure of the radio transmitters to live up to expectations. They did, however, help me find a number of things out. For one, I now have a much better idea of the extent of suitable habitat on the island; I also gained some notion of the range of the individual within that habitat and made observations on the roosting sites. In addition to making various behavioral observations, I also now have a much better if not entirely satisfying estimate of the total population size on the island.

As to the extent of the habitat, instead of believing as I did last year that the birds occupy only about 15 hectares and are largely confined to the area of the main ghuts, radio-tracking and further observation lead me to the conclusion that 60 hectares is a much more accurate figure; this represents close to 20% of the island. In addition to Harris, Quail Dove, Palm and Grand Ghuts, the birds are found throughout the xeric woodland on the west-facing slope of the Sugarloaf, and, if anything, their distribution is even larger.

As to use of the habitat and daily movement patterns, the tracking data I was able to get (a total of about eight days' observations on four individuals) indicate that, rather than being sedentary, the birds apparently move freely throughout the habitat. I was unable to discern a daily activity pattern on the basis of the data I have.

Data on the roosting birds were definitely of interest and were possible largely because of the radio signals, though I did find two unmarked roosting birds in the course of tracking the signals. Roost sites were in trees at 3.5-7 m off the ground, at elevations on the slope of about 10 m to 120 m. The only bird for which I have two roosting observations roosted at sites about 35 m apart on consecutive nights. I think it's likely I am the first biologist to observe roosting quail doves.

The fact that the trapped birds were marked with colored bands helps us get some grasp of the population size. Working with the data I was able to get and not putting any great statistical reliability on the number, I'd place the population around 75; this is based on the fact that, after three birds had been marked, I kept track of my and others' observations where the observer had a clear look to see if bands were on the bird's legs. We made 50 such observations, of which two birds were marked. Incidental information includes some pair bonding observations and the fact that the crop and stomach contents of a bird killed in the net by thrashers should give us some data on diet. I also finally observed a calling bird and figured out how to tell it from that of a Red-necked Pigeon and Zenaida Dove.

I think we learned a lot this past summer that will help in further field studies. For one, the birds are just not that easy to catch. Faaborg found this too; he had the same problem of birds bouncing out of the nets before he could reach them. He was using small-mesh nets. Apparently the nets with the larger mesh (of which I left a couple on Guana) are more effective. If we only have the nets we had last summer, I'd suggest we place them more toward the bottom of the slope, so on any quail dove drives we haven't so far to go, since the birds so often wander off. It would be helpful if we could get ahold of more nets, too. I'm not sure how easy this is. I think high school students would be helpful in dove drives and in monitoring nets; a couple of birds were caught, after all, by just wandering into a net, but I suspect their life expectancy after being caught isn't long. We might also try baiting the area of the nets with cracked corn or whatever else might be available on Tortola. Of course, if we want to re-radio next year, which we may have the chance to do, we've got to catch them, and the earlier on, the better. Our success rate in netting on drives was about one in four, by the way.

Another way of marking birds, not involving nets, is definitely worth trying. You mentioned it to me last summer, and Faaborg brought it up when I talked to him. There is a spray gun

that foresters use to mark trees that has been used to mark Anolis lizards and might similarly be employed on quail doves. Apparently it's effective at 20-25 ft. One can often get that close to a quail dove (certainly more often than one can catch one in a net). Different colors, if that's possible, at different locations on the island would be useful, and the more birds marked, the more reliable the population estimate. Of course it's only short-term, and color-banding of captured birds is still highly desirable. At any rate, I'll look into it.

I think a fuller discussion of the problems of radio tracking is merited. As you probably remember, the signal on the first bird disappeared overnight. On the second, I was able to get four days' observations before the signal appeared to weaken and definitely got slower before disappearing altogether. On the third, the transmitter fell off the bird after three days and was recovered; it failed to give a signal when I tested it after a few days. The fourth bird was trapped and the radio attached only a day and a half before my departure, but by the morning I left, this signal had disappeared also.

Judging by the fact that one transmitter began sending a slower signal and another, the one I retrieved, stopped working, I feel the disappearance of the signals came from transmitter failure rather than the birds leaving the island. I spent some time talking to Dr. Bill Seegar, who lent me the tracking equipment. He found the account of the diminishing signal hard to explain; if the batteries fail, he says the signal remains the same to the end and then just plain stops. He also praised Paul Howey, who built the transmitters, to the skies. He's used Paul for years and even used his influence to get Paul over from England to work at the Hopkins Physics lab. I've since met with Paul to give back the equipment and retrieved transmitter for his analysis. He was very upset to hear what had happened and says he'll replace them. He's an honest fellow with a Ph.D. in biology from an English university. I've even thought of inviting him along as the field assistant you suggested I look for--more as a colleague, really--as he's apparently done lots of radio-tracking and is good at interpreting what's going on, besides being a technical whiz. Besides, if he's there and nothing works, we could all jump on him.

I don't rule out altogether, however, the possibility that at least some of the radioed birds left Guana. For one, John Faaborg thinks the birds move around from island to island. For another, the only marked bird we saw again for sure (each bird with a radio got a yellow band on the left leg and a band of a different color on the right, allowing individual identification) was the one the transmitter had fallen off; the others, though I looked for them for 10 days, never showed up again. In the future, should we get a good number of birds marked, I think it would be worth checking out ghuts on some of the nearby islands, especially those right across from White Bay, on Tortola.

This leads me into what my plans would be for 1986. I think they are reflected largely in what I've written above. If possible, I'd like to do some more radio tracking, only have it work more smoothly. I'd like to mark more birds, so I can get a better estimate of the population size. It would be useful to find any of the four birds marked last summer. I'd like, once more birds are marked, to check the nearby ghuts on Tortola, even though they don't look too promising, or maybe even spend one day on another island. And observation, pure and simple, has put me onto something every year. Eventually, it would be great to make observations during the nesting season, which is probably April or May. We don't know how many pairs breed on the island, how the nests are spaced, where in the habitat the bird nests, what nesting success is or how much nesting is synchronized.

By the way, I certainly applaud the efforts to cut down on and (I hope) eventually eliminate the sheep. There's still quite a bit of damage going on. The most severe I saw was to the south of Harris Ghut, where I saw several animals and some of the ground was virtually denuded. I hope the control efforts will go on.

Last, thanks for thinking up and coordinating these expeditions, which I think are proving more valuable each year.

Best regards,

Chip

Robert M. Chipley, Ph.D.
Director, Preserve Selection
and Design

National Museum of Natural History • Smithsonian Institution
WASHINGTON, D.C. 20560 • TEL. 202 357-2107

Dept. of Entomology, NHB 127
19 September 1985

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

Dear Skip:

Here is my 1985 Guana Island entomology progress report. In our three weeks on Guana this year, we collected probably over 5000 insect and related arthropod specimens. The catch was similar to last year's, but differing in composition of species, as well as abundance of those species collected. We did not see some species that were common last year, and collected some that we did not see last year, which points out the value of continued survey. Since this was the second very dry year in a row, the insect abundance was quite depressed relative to what I assume is "normal". We had very little success with rearing of immature stages, due to the effects of dryness on the insects and ther hostplants. We concentrated survey efforts on groups of special interest to us and our collaborators, especially several families of moths and beetles.

Completion of mounting, labelling, and processing these specimens will (as before) take some time. Preliminary processing should be finished by the end of the year, at which time the material will (depending on the group to which it belongs) either go directly to specialists or into the main research collection here.

Specimens from last year (and to a much lesser extent, this year) are already in the hands of the following specialists. [This includes only transactions that I have been personally involved in, material in the main collection is seen by many additional persons by visit or loan. The Entomology Department here sends out over 500 loans a year, which include over 100,000 specimens!]

Drs. D.R. Davis, M. Collins, T.L. Erwin and collaborators, P. Mundel, and J. Coddington of the Smithsonian Institution
Dr. J. Keirans of the National Institutes of Health tick unit
Dr. R. Wenzel of the Field Museum, Chicago
Mr. R.R. Snelling and C.D. Nagano of the Los Angeles County Museum
Dr. M. Ivie of Ohio State University
Dr. E. S. Ross of the California Academy of Sciences, San Francisco
Dr. J. B. Heppner of the University of Florida
Dr. F. Thompson of the Florida State Museum [snails]
Dr. D. Schwert of North Dakota State University [earthworms]
Drs. L. Roth and A.F. Newton of Harvard University

Drs.R.W. Hodges, R. Poole, and D. Ferguson of the U.S. Dept. of Agriculture
Mr. M.G. Pogue of the University of Minnesota
Dr. Barry Roth of the Santa Barbara Museum of Natural History [snails]

I might also add that several of the live arthropods we brought back are now "stars" in the Smithsonian's "Insect Zoo", a very popular exhibit here.

We still need more general survey work on Guana -- to sample summer in a moist year, as well as the other seasons; to sample specific habitats some of which [e.g. soil arthropods] have been impossible to sample due to dryness; to gather more specimens of a variety of species which are represented only by enticing, but inadequate samples.

An example of the last item is the tiny moth whose larvae mine the leaves of sea grape trees. This summer up to half the leaves of individual sea grape trees were damaged by this insect, but I could not locate any live mines. The same mines were found in sea grape leaves on Puerto Rico by a Smithsonian entomologist in 1898, and they are commonly seen in the Puerto Rican bank, but we still do not know the identity of the insect! The answer is to locate live mines with the larvae still inside and rear them [although I am not sure what season to look for them in, it does not seem to be summer].

Comparative work on nearby islands should continue as well. We do not know the similarities and differences [and most importantly, the underlying reasons] of the insect faunas of Guana, Tortola, and Puerto Rico, for example.

I think our general survey work has shown excellent opportunities for also undertaking more specialized projects in areas such as the following:
--Termites, their biology, and their associates [=nest cohabitants]
--Arachnids and myriopods, and their biology
--Embioptera [web spinners], their biology and biogeography
--Ants [perhaps in combination with a termite project]
--Soil arthropods

As we have discussed previously, support for illustrations, especially those necessary for the proper description of new species, would be very help in supporting our survey efforts and promoting the prompt production of high quality publications on the Guana fauna.

Two general items that I feel would be very useful in supporting the general program of field biology on Guana are having a good botanist in the field with the zoologists, and developing a well balanced reference library of field guides and introductory texts. I think the library would be wlecomed by regular hotel guests as well, who frequently have nature questions but no one to ask.

Again, I thank you for including me in this project and I look forward to an exciting future for Guana Island research!

Best Regards,

Scott E. Miller

National Museum of Natural History · Smithsonian Institution
WASHINGTON, D.C. 20560 · TEL. 202-

Dept. of Entomology, NHB 127, 15 November 1985

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

Dear Skip:

Thanks for your recent letter. I am sorry to hear of Henry's refusal to let Guana room and board costs cover our stay on Anegada. While I cannot comment on your main project (restocking of Guana iguanas), Pam and my trip to Anegada was very productive for insects.

One of the wonderful features of the Guana project is the opportunity to understand the fauna of a small island (Guana), and then compare it to the faunas of nearby islands which vary in climate, geology, and history. It is the comparison that will allow us to address underlying questions such as "Why is the Guana fauna the way it is? Why are there so few (or so many) species of (whatever)? How has the geologic and human history of Guana effected its fauna?"

This comparsion between Guana (hilly with no limestone), Anegada (low limestone), and the "aridulate rain forests" of Tortola and Virgin Gorda (high and moist), will provide the data for "real science" in the long run. For insects, we must do the survey work ourselves, since it has not been previously done in an adequate way (using the "high tech" traps, etc., for efficient sampling).

Although the sorting and labeling of the Anegada samples is not yet finished, preliminary sorting shows that although many of the same species were collected on both Guana and Anegada, the abundance was quite different on the different islands. Also, some species were taken on each island that were not collected on the other, but our samples are not yet complete enough to rule-out having missed the species involved on the other island.

One interesting example is the embiids just identified by Ed Ross of the California Academy of Sciences. The fact that we collected the same species on Guana, Tortola and Anegada, shows that it is probably a remarkable native [the females cannot fly] and not just a chance introduction (in lumber, for example). The species, the first recorded from the BVI, is very close to Oligembia brevicauda Ross, but study of more specimens is necessary for positive identification in this difficult group.

I have attached a xerox of the redescription of the Anegada Iguana Tick, which just appeared. Collecting the first adequate sample of this rare tick was indeed a good by-product of your iguana work! *

Looking forward to next season!

Scott

Scott E. Miller

encl.

* included up front.

National Museum of Natural History · Smithsonian Institution
WASHINGTON, D.C. 20560 · TEL. 202357-2637

368204R

December 13, 1985

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

Dear Dr. Lazell:

The decapod crustaceans that you left here on November 21 have finally been identified as follows:

Atyidae
  Atya innocous (Herbst, 1792)
    Z-19902: 1♂
Coenobitidae
  Coenobita clypeatus (Fabricius, 1787)
    Z-19869: 1 large ♂
    Z-19874: 1 large ♂
    Z-19913: 1♂
    Z-19914: 1♀
    Z-19936: 1 large ♂
Pseudothelphusidae
  Epilobocera sinuatifrons (A. Milne-Edwards, 1866)
    Brown Gut, ca 140 m, Tortola; 7.vii.85; N. Clarke and G. Mayer coll.: 1♀ 2? (dry fragments)
Grapsidae
  Grapsus grapsus (Linnaeus, 1758)
    Z-19906: 1♀ (dry molt)
    Z-19912: 1♀
    Z-19926: 1♀
Gecarcinidae
  Cardisoma guanhumi Latreille, 1828
    Z-19873: 1 large ♂
  Gecarcinus lateralis (Freminville, 1835)
    Z-19875-6: 2♀
    Z-19925: 1♀
  Gecarcinus ruricola (Linnaeus, 1753)
    J. Lazell notes, cat. p. 94; Guana; 19.vii.85; D. Ford & E. Azavedo coll.: 1♀ (dry fragments).
Ocypodidae
  Ocypode quadrata (Fabricius, 1787)
    Z-19867: 1 young ♀
    Z-19878: 1♂
    Z-19927-8: 1♂ 1♀
  Uca burgersi Holthuis, 1967
    Z-19871-2: 2♂
    Z-19881-97: 17♂

To the best of my knowledge, the lots represented by the following numbers in the list that you left with me were not included in the material delivered: Z-19920-3, Z-19924, and Z-19929-35.

The rather small male identified as Atya innocous is somewhat atypical of that species. The determination is probably correct, but I would be interested in seeing any other specimens of Atya that you may obtain on Tortola.

The fiddler crabs from Beef and Guana islands seem to be near, if not identical with, Uca burgersi. All that I would swear to is that they all seem to belong to a single species.

The most interesting lot in the collection consists of the dry fragments from Tortola of Epilobocera sinuatifrons, a species known previously only from Puerto Rico and St. Croix. As noted in your letter of November 2, the freshwater fauna of Tortola probably deserves further investigation.

When you let us know which of the specimens you wish to deposit in the MCZ, we will take care of that commitment before accessioning the remainder as a welcome gift from The Conservation Agency.

Sincerely yours,

Fenner A. Chace, Jr.

Fenner A. Chace, Jr.
Zoologist Emeritus
Department of Invertebrate Zoology

FOR LAZELL

GEOLOGY DEPARTMENT
STEVENS HALL
NORTH DAKOTA STATE UNIVERSITY
FARGO, NORTH DAKOTA 58105

TELEPHONE (701) 237-8455

31

3 April 1985

Scott E. Miller
Department of Entomology, NHB 127
National Museum of Natural History
Smithsonian Institution
Washington, D.C. 20560

Dear Scott:

Aside from now being able to place Skip Lazell's earthworms into a family (Acanthodrilidae), I can do nothing more with them. Would he like them returned?

Glad to hear that progress is being made on the dissertation. All's, of course, hectic here. Best regards to all of the "beetle people".

Sincerely,

Donald P. Schwert, Ph.D.
Assistant Professor

DPS:sk

Addendum to Invertebrate Section

The earthworm results are most disappointing. We need rainy weather to get more and better specimens. Apparently we have something remarkable here, but cannot yet prove it.

I got very interested in land crabs and fresh water decapods last year. None had been collected, apparently, from the B.V.I. We generated a collection of a dozen species and several dozen specimens. I delivered these to Dr. Chace at Smithsonian on 21 November, as per his report. [redacted] We must get many more species and better coverage of other islands before we can hope to generate an important publication.

I hope Dr. Margaret Collins, Smithsonian, will join us in 1986 for termite work, and Dr. Ed Ross, of California Academy of Sciences, with come to work on the Oligembia. Both are noted in the Proposal, below.

S.L.

* His report, here paginated as pp. 30 ; 30E, came in while this was being typed.

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.

A PROPOSAL FOR

THE GUANA MARINE SANCTUARY,

BRITISH VIRGIN ISLANDS

This Agency has sponsored three separate investigations of the marine environment of Guana Island. Immediately following Tropical Storm Klaus in November 1984, Dr. A. H. Weiner studied the reefs in White, North, and Muskmelon Bays. His report to the owner of Guana Island included stringent recommendations for control of erosion and concommitant siltation of the reefs -- especially highlighting removal of livestock (sheep) from the island. This proposal was accepted and is being carried out.

In June 1985, Weiner, assisted by A. Hooten and J. Damron, inventoried the reef ecosystems. They found these ecosystems to be remarkably diverse. Their report is appended.

In July 1985, Joseph and Charlotte Stokes, assisted by Nolan Stokes and others, inventoried fishes on the White and Muskmelon Bay reefs. They tallied more than 125 species. Their report is appended. Joseph and Charlotte Stokes are authors of the Collins Handguide to marine tropical fishes. They have travelled and observed fishes widely in the Caribbean, so their comparative assessment of Guana's high diversity is particularly significant.

We propose that White and Muskmelon Bays be declared a Marine Sanctuary by the Government of the British Virgin Islands. We propose the following boundaries:

1. Due south (180°) from the tip of Long Man's Point (NW extreme of Guana Island) to a point due west of, and ca 100 meters from, the Guana Head (between Muskmelon and White Bays).

2. Southeast at 140° from the point west of, and ca 100 m off, Guana Head to Monkey Point (the SW extreme of Guana Island); and

3. The high tide line along Guana Island from Long Man's Point to Monkey Point.

We suggest the following regulations within the designated Sanctuary:

1. No dropping of anchors. All vessels must tie to carefully set moorings. When the available moorings are full, the Sanctuary is simply Closed -- until a mooring again becomes available. We recommend no more than ten moorings in addition to those already established.

2. Fish pots and traps may be present by permit of the BVI Government only. An effort should be made to ascertain the number (about three in July 1985) of fish pots within the area and their ownership. A permit should be issued to the owner(s) for the number of pots they have regularly placed within the area, but no more. Thus, no disruption of existing uses for local livelihood would occur, but no additional exploitation would be permitted.

3. Traditional uses of the area not involving pots or traps would continue unimpaired. These include some welk, conch, and lobster collection for food; hook-and-line fishing for food; and snorkelling and SCUBA diving for sport. Fish spearing by divers would be prohibited.

While we believe activities within the proposed Sanctuary can be easily monitored by Guana Club and Wildlife Sanctuary personnel, we do not believe the Guana Island staff should be involved in enforcement activities. Enforcement of regulations within Marine Sanctuaries should be conducted only by duly authorized officers of the BVI Government.

We believe that responsibility for the moorings within a Marine Sanctuary should lie with the Government. We would be eager to contribute advice as to siting and acquisition of the moorings. These moorings would represent the only major expense in establishing the Sanctuary.

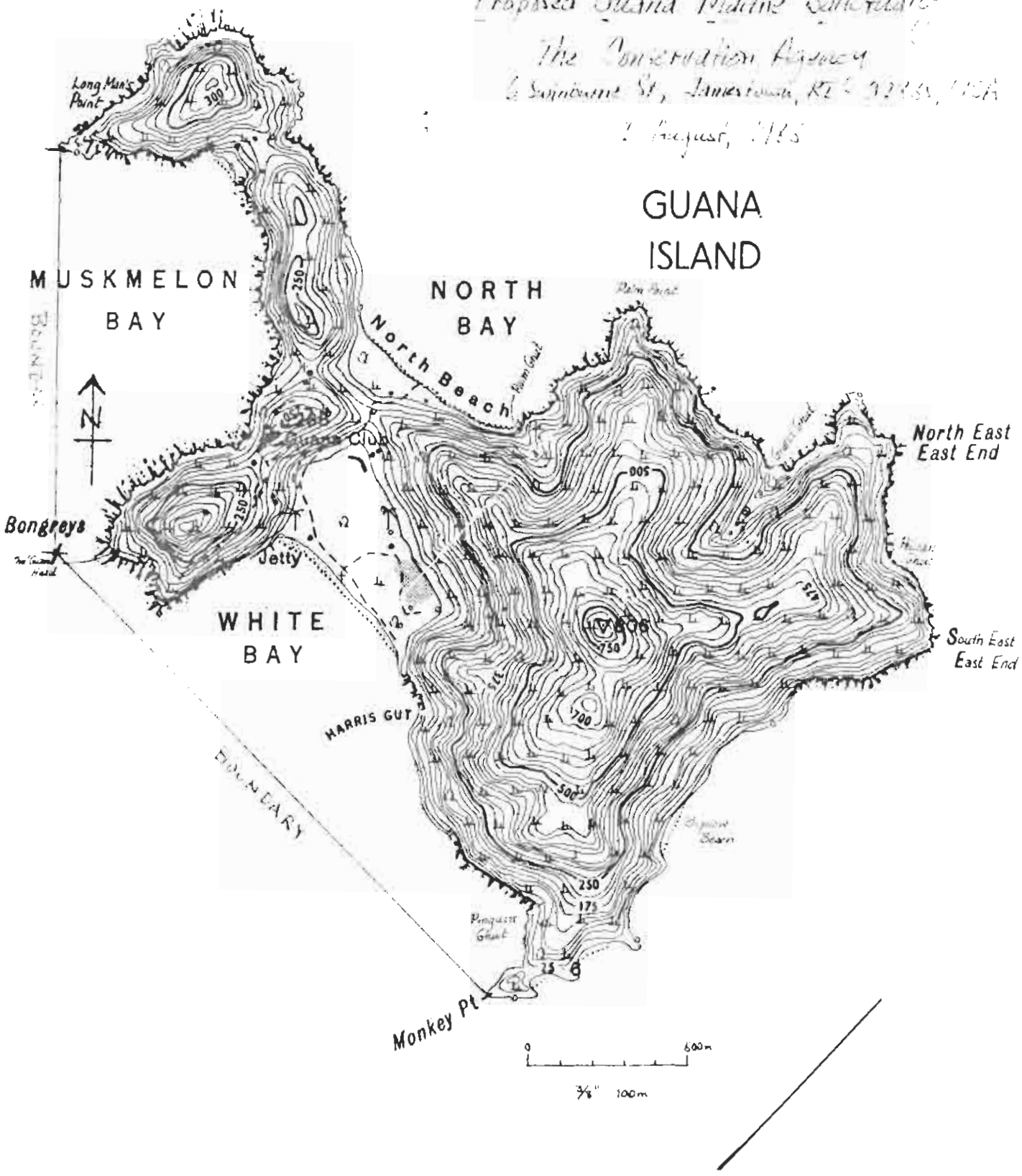
Our work was supported in large part through a grant from the Mocatta Metals Corporation, and a contribution from The Stokeses.

Prepared by: J. D. Lazell, Ph.D.

30 November, 1985.

TOP

Proposed Guana Marine Sanctuary
The Conservation Agency
6 Spinnaker St, Jamestown, RI 02835, USA
1 August, 1995



Arthur H. Weiner, Ph.D.
Office: 618 Whitehead St., Key West, FL 33040
305-294-4103
Lab: Rt. 4, Box 310, Summerland Key, FL 33042
305-872-9073

June 19, 1985

James D. Lazell, Jr., Ph.D
The Conservation Agency
8 Swinburne Street
Conanicut Island
Rhode Island, 02835

Dear Skip:

Andy Hooten and I have just returned from Guana Island after having spent five days surveying the island's nearshore marine areas. We are planning to submit a report on our findings to the Conservation Agency this fall. I would like to take this opportunity to convey our basic impressions of the surveyed area.

Both Andy and I would like to thank the owner's for their support of this endeavor. The Guana Island Club staff was most cooperative and helpful in expediting our field work and in making our stay most comfortable. Our special thanks go to John Damron who provided logistics support for our boating operations and directed us to the areas which most deserved our attention. His knowledge of the island and its environs and his demonstrated expertise in organizing and running a diving operation was critical to the success of our field work.

Collectively speaking, Andy and I have considerable familiarity with coral reef areas in the Caribbean and eastern tropical Pacific. We have carried out ecological survey work in the Florida Keys, American Virgin Islands, Puerto Rico, Vieques, Culebra, Jamaica, Panama and the Galapagos Islands. It is our considered opinion that the reef areas which border Guana Island are comparable or actually surpass, in species diversity, community structure and accessibility any that we are familiar with. The following is a generalized list of attributes that pertain to the Guana Island reef areas:

1. There is a wide diversity of marine community types within easy access of the island. These include: fringing reefs, tongue and groove reefs, hard bottom communites, seagrass communities, sand bottom communities, sunken wrecks and sea caves.

2. The fringing reef areas contain a very high diversity of hard corals, soft corals and finfish with an exceptionally high percentage of living bottom cover in the fringing reef areas.

3. Nearshore areas can be easily accessed by small boat, and the most diverse and aesthetically pleasing areas occur in water depths of less than 50 feet. For the diver, this means a maximum of bottom time and a minimum of time spent in a boat or required for decompression. This also makes excellent diving areas accessible to the novice.

4. Because of the geography/topography of the island, excellent snorkeling or diving opportunities are available regardless of wind and swell conditions. The proximity of the reefs to Guana's protected beaches would allow for mixed use recreational opportunites. In other words, members of the same party could dive, snorkel, beachcomb or sunbathe at the same time.

5. Based on our observations and discussions with John Damron, it appears that underwater visibility would range from good to excellent for about six months of the year, i.e. the May through October period.

6. The combination of proximity to the land base and shallow depth means that diving operations can be carried out with a minimum of risk and financial cost.

7. The fact that these extraordinarily beautiful reefs occur at shallow depths in clear water means that underwater photography, nature study and scientific research opportunities occur under optimal conditions.

We will be elaborating on all of these points in our report. If you have any questions please give either Andy or myself a call. Again, thank you for the opportunity of visiting Guana Island.

Sincerely,

Art Weiner

Arthur H. Weiner, Ph.D

cc: Andy Hooten

Figure 1. Locations of sites inventoried during June, 1981.

Arthur H. Weiner, Ph.D.
Office: 618 Whitehead St., Key West, FL 33040
305-294-4103
Lab: Rt. 4, Box 310, Summerland Key, FL 33042
305-872-0072

October 12, 1985

James D. Lazell, Jr., Ph.D
The Conservation Agency
8 Swinburne Street
Conanicut Island
Rhode Island, 02835

Dear Skip:

Enclosed is our report from the spring trip to Guana. We included the negatives from the photographs in case you wanted more prints or blowups. We also have a number of slides which can be reproduced. It would probably be a good idea to put together a slide show of the natural history of the island, both marine and terrestrial. The report is on a computer so can easily be amended if more information or a slightly different type of delivery is needed for a different readership. Needless to say, a great deal more field work would be necessary to prepare for a serious submittal for a marine sanctuary designation. We would like a copy of the report prepared by the fish people, or any other reports dealing with the marine environment adjacent to Guana.

It doesn't look like I will be able to get to Guana in November. I am an expert witness, for the state, in a case involving the clearing of a hammock on Key Largo which contained wood rats. I expect to spend early November with the lawyers preparing for the case which will be heard later in the month. I am also planting over a thousand mangroves on Grassy Key. Carol and I are doing the work ourselves and must get it completed by the end of November.

I have an excellent replacement for me, who is a botanist and a landscape architect, who could help with plant identifications and would be perfect for designing the tropical garden. He designed a large one in Gainesville.
Don Goodman, Ph.D
Kanapala Botanical Gardens
4625 Southwest 63rd Boulevard
Gainesville, Florida, 32618 904/372-4981

I worked with Don on the county's land use plan as part of Tom Patton's consulting team. I highly recommend him for the Guana effort.

I will be at home in the evenings if you need to get in touch.

Best regards,

Art

MARINE RESOURCE INVENTORY

GUANA ISLAND

BRITISH VIRGIN ISLANDS

Submitted TO: The Conservation Agency

Submitted By: Andy Hooten, M.S.
Art Weiner, Ph.D

Submitted On: October 23, 1985

GUANA ISLAND, B.V.I. MARINE RESOURCE INVENTORY

The following report is a physical description, biological inventory, and discussion of eight subtidal marine communities surrounding Guana Island, B.V.I. Surveys were conducted during the third week in June, 1985 by Arthur H. Weiner, Ph.D. and Anthony J. Hooten, M.S.

This report will be divided according to three main

A): A physical description of all sites visited accompanied by listings of observed biota.

B): A discussion of these areas as related to marine resource management, and;

C): The use of Guana Island as a potential research and facility for environmental education.

Section (A) of this report presents these descriptions under four geographic categories. These categories are as follows:

White Bay Complex
Muskmelon Bay Complex
Bigelow Beach
North Bay

Refer to Figure 1 for an illustration of these locations.

A(1)(a) White Bay Complex

The White Bay Complex includes three sites on the southern, southeastern and eastern sides of Guana. The first site inventoried lies directly offshore from the largest beach on the island. This area, referred to as "South Beach" is a fringing coral reef with approximately seven well developed spur and groove formations oriented or [illegible] in a northwest to southeast direction (Fig 2). Total area coverage of this reef is roughly 10 hectares with spurs [illegible] in lengths of 20 to 35 m. Water depths are shallow ([illegible] depth range), with the spurs terminating in only 3-4 m of water. The sand channels between these spurs are widely separated, approximately 7 to 10 m.

Previous observations by Weiner (1984) noted that this area was affected by wave energy and concomitant turbidity as tropical storm Klaus. The observations made for this report noted that much of this community had suffered recent mortality, presumably due to wave damage and sedimentation as a result of the tropical storm. Large colonies of

[illegible] Acropora palmata were dead and broken and [illegible] and [illegible] a large percentage of the coral rubble substrate in the area. In fact, coral skeletons were often encrusted by sponge, indicating death due to excess sedimentation. However, numerous observations of new coral growth indicate that this area is recolonizing coral settlement. Presently, the top of the spurs are largely composed of live coral, Millepora spp. and filamentous algae.

[illegible] sites are abundant here in the densest [illegible] Fomacentrid damselfish being part of the impressive abundance. These fishes demonstrated well established territories along the spur formations.

The deeper reef area (6-9 m) at the terminus of the spurs is lower in percent cover of benthos. Massive rounded [illegible] corals interspersed between siliceous reef corals and sea whips.

[illegible] species observed throughout the reef community [illegible]

A(1)(b)

The second site, identified as the Ha[illegible] Complex, is a deeper water [illegible] northeast of Molasses Reef (Fig. 1). This community is [illegible] on the only [illegible] major sand channel bisecting the area (unlike the numerous sand channels associated with South Beach). The area is a mixture of soft and stony corals, with massive stony coral morphologies most common. This community is found [illegible] a slight drop off. Total depth is 12 m into the main channel between Ha[illegible] and Tortola. Where reef growth [illegible] sites into the sandy substrate, it is in these sites that impressive numbers of the queen conch Strombus gigas were observed. Many of the individuals examined were large with very thick margins on the shell. To the authors, this condition indicates old and mature animals. Even though few juvenile conch were observed, animals of this size and apparent age suggest a well established reproductive [illegible]

[illegible] species observed in this area were [illegible] [illegible] [illegible]

[illegible] species observed in this community [illegible] [illegible]

A(1)(c)

The third site in the Ha[illegible] Complex is [illegible] on the eastern end of the reef beneath the large [illegible] formations. Quite near, the reef line [illegible] and

A(2)(a) Muskmelon Bay Complex

observed in 1-2 meters of water. Of particular note are large mats of the colonial anemone *Palythoa mammillosa* colonized as a kind of "connective tissue" between colonies of hard corals and gorgonians. Waterward from this area, large colonies of elkhorn corals *Acropora palmata* are settled upon and between large rock boulders. Also observed within this varying subtidal topography were numerous other species of corals, resident reef fishes and pelagic fishes such as herring, anchovy, jacks and tuna.

Waterward of this zone, the sand channel interrupts benthic colonization as it curves around the cove. Beyond this interruption, water depth increases and the bottom supports colonies of large *A. palmata*, smaller massive corals and many soft corals and sea fans. Proceeding further, water depth gradually increases as do the abundance and cover of stony corals. Figure 6 (a) shows a colony of pillar coral, *Dendrogyra cylindrus*. While uncommon in many areas of the Caribbean and western Atlantic, this coral was frequently observed at this site. At approximately 10 m, the reef crest and fore reef slope (shelf break) occur. At this point, percent cover and apparent species richness and diversity of corals appear to be highest. The fore reef slope continues down approximately 30 to 45 degrees and terminates in 18-24 m of water.

In the southeastern section of this reef, the sand channel also breaks with the reef crest and fore reef slope. Change in reef topography is most evident in this area.

Species observed at Crab Cove are listed in Tab

A(2)(b)

The second site within the Muskmelon Bay Complex is known as "Muskmelon Beach". This area lies directly offshore from Muskmelon Beach, a beach composed of coarser particles (i.e., coral and shell fragments) than the fine siliceous and calcium carbonate particles found on "South Beach". This community is not far from the Crab Cove area and species composition observed at the Muskmelon site was similar. However, this area exhibits stress from wave energy and turbidity and the benthic organisms have appeared damaged. The site does not support a structured coral reef, rather a patchwork of soft and stony corals. Refer to Table 4 for a list of species observed. One animal, seen only at this site was the reef squid, *Sepioteuthis sepioidea*.

A(2)(c)

The third site within this comp
northwestern face of [illegible]

referred to as "D and Central Station", is a habitat type similar to the one described at "Shark Head", but with regard to topography, that is the most impressive of all sites visited. This area possesses large rock walls, as well as slabs and boulders that support a variety of encrusting forms. Hard corals occur in massive and plating morphology. Also, one coral species was found only on this and the "Shark Head" site, the orange cup coral, Tubastrea tenuilamellosa. The rock walls are colonized by tunicates, hydroids, gorgonians and sponges. In fact, more sponges were observed at this site than any other visited. Water depth varied from 6 to 18 meters.

Two submerged caves are along the north face of Long Marine Point. These two caves are located in shallow water approx. 2-3 m and were apparently carved into the point of the island by waves. One cave in particular extends into the rock approximately 50 m and terminates with a small above-sea level pocket within which one can stand up and breath trapped air. This pocket is apparently a site where changes in pressure from oncoming wave surges can be felt. With the use of dive lights in this pocket, one can observe very interesting rock patterns carved by the erosional forces of wave surges.

The second cave area possesses two or three passages which also reach back into the island; however, as one progresses into these areas, spaces tend to narrow quickly, resulting in limited room for exploration. No air pockets comparable to the one described above were observed in this second cave.

Sessile organisms were not present in these caves, presumably due to the high wave energy which created these features. However, if they were relatively abundant outside of the cave openings and small fish species, such as glass-eye snappers, squirrel fishes and wrasses, could be observed further in the caves. Two invertebrates were observed in the caves, Panulirus interruptus, the rock lobster, and the small unidentified Paramuricea sp. hiding within the smooth pebbles on the cave floor.

A second visit to this site in the late afternoon found the area to be very active in fish and invertebrate feeding behavior. Fish species observed were diverse and abundant, particularly pelagic species cruising back and forth across the large rock slabs.

A list of species observed at "D" and Central Station is provided in Table 2.

A(3)

Ar41

C. Marine Resource Management

The marine ecosystems described in this report are among the most productive natural systems that represent a range of values to the British Virgin Islands with a central and geographical location. These systems, in themselves, and in man's activities, represent a natural resource that is of immeasurable value to the residents and visitors of the British Virgin Islands.

However, as human populations increase, and uses of natural resources increase for the B.V.I., these systems could become easily stressed or destroyed. Land use and pollution problems are easily observed in island ecosystems, where natural resources are physically limited by the boundaries of the sea.

It therefore becomes important to recognize early the resources such as these valuable marine systems will become increasingly valuable as human activity increases in the area. If these and other natural systems are not protected and properly managed, their degradation or loss could hurt key elements of the economic and recreational life of the area.

Such key economic elements are (1) commercial fisheries, (2) recreational diving, and (3) valuable aesthetic and educational tools for the B.V.I. government and its people.

Identification of potential threats to these natural systems is the basis for protection and proper management.

As the human population continues to increase in the B.V.I., the mismanagement of wastes and poor land use practices could quickly result in detrimental impacts to these marine communities. Poor sewage disposal will become increasingly more severe and short term solutions to the problems are sought. Poorly designed and located solid and liquid waste disposal sites will leach harmful nutrients and other pollutants into adjacent waters, resulting in degradation of water quality and nutrients, negative impacts to the marine environment.

Additional pollution sources can presently be observed in the form of sediments clearing of land where soils are not shielded from erosion. Poor farming and other land use activities have been well documented in other areas and known to have direct effects on the health and productivity of adjacent marine systems.

[illegible] Guana Island does not appear to be [illegible] the trends of the declining fishery. [illegible] management of [illegible] the nation's nearshore waters and adjacent waters

[illegible]

[illegible] Presently, the commercial fishing practices [illegible] B.V.I. probably do not pose a threat to commercially desirable fish and invertebrates. Current observed practices do not appear to enter advanced technologies for increasing harvests. Therefore, fishermen appear to be harvesting well under the natural carrying capacity of the area. However, as new technology and fishing practices become available the annual percent harvest is increased, potential to exceed the natural carrying capacity also increases. Now is an opportune time to recognize what potential private or unregulated industry may pose for the B.V.I. It is recommended that regulation be adopted early enough so that both the resources and the industry are adequately protected.

2). Recreational Use

Scuba diving and snorkeling are sports that have established themselves as important activities in the tourist industry. The B.V.I. as fortold surrounds diving operations that [illegible] depend [illegible] around the islands.

While current dive operations appear to have little impact upon the marine communities around B.V.I., as the tourist industry continues to increase, so does the interest for associated sport activities, such as glass bottoming, spearfishing, and shell and coral collecting. Observations by Antonius and Ilan (1982) have noted that coral reef ecosystem health can be adversely impacted by increased diving pressure.

By recognizing potential problems, such as the ones listed above, steps can be taken to prevent conflicts from becoming problems. Protective measures, such as objectively promulgated and enforceable laws, management zones and park and sanctuary designations are steps that can be taken to ensure the stability of marine ecosystems and, in turn, the stability of the commercial fishery, tourism and the quality of life for B.V.I.'s residents.

It is the opinion of the authors that the marine communities surrounding Guana Island represent some of the finest examples in the western Atlantic and Caribbean and are deserving of the utmost protection that could possibly be afforded them. We strongly recommend that these areas b

incorporated as part of a larger marine sanctuary program for the B.V.I. government. Such a designation would properly establish and manage, in perpetuity, the continued existence of these natural systems through time, and protect resources, educate, and provide for the people of the B.V.I.

The authors are familiar with the procedures of marine sanctuary designation in other areas, although detailed procedures are beyond the scope of this report. We offer the following as a general outline towards sanctuary designation:

a). An exhaustive inventory of marine communities surrounding Guana.

b). The establishment of management objectives and policies based on the inventory and the following:

1.). Assessment of commercially exploitable fisheries resources.

2.). Mapping of nearshore coral reef communities and other significant features, i.e. underwater camera, scanning sonar, areas of high and shallow concentrations, location of threatened/endangered species, etc.

3). Design and implementation of a training educational program for user groups.

4.) Use of a land-based interpretive center for users

c). Creation of detailed outlines stating procedures and mechanisms for implementing this

C. Potential Uses of Guana Island

The natural area and natural environments of Guana Island represent a unique opportunity for recreation and education. Given the accessibility to marine habitats, the close proximity, access of those resources, and protected nature, Guana is an ideal site on which to use as a marine oriented outdoor school and educational facility.

Because diving related activities have increased in popularity with the tourist industry, many educational groups and photographic and conservation objectives are also beginning to include snorkeling and diving field trips in their yearly itineraries. Guana Island could represent an ideal location for small community and educational workshops emphasizing awareness of the fragile marine environment. In this location one of the world's most diverse marine environments be experienced with minimal costs and travel effort.

Generally, such activities are most desirable during the months when Guana Club is least active. Therefore, the establishment of such a program could be an economic asset for Guana Club.

During our work at Guana, we identified ways in which the island would be physically ideal for educational workshops. We wish to itemize those ways with the following:

1. The meeting room adjacent to the dining area could be a significant location to hold lectures, photographic presentations and preparatory sessions for field work.

2. The small library could be modified to include research books and scientific literature as well as being a working area for a small museum of natural history on the island.

3. The beach cabana could serve as a wet laboratory and classroom to observe live specimens.

Given the differing marine habitats, classes could be broken into small enough groups visiting different areas so that a high ratio of student-to-teacher interaction could be maintained. This is an important selling point for many educational groups.

While Guana Club is equipped with many features to readily host such programs, we have identified some additional items that would be necessary to make such a concept

Table 1 A List of Fauna Observed at the "South Beach" site

Scleractinian corals:

Acropora cervicornis	staghorn coral
Acropora palmata	elkhorn coral
Agaricia agaricites	lettuce coral
Agaricia fragilis	lettuce coral
Colpophyllia natans	
Dendrogyra cylindrus	pillar coral
Diploria clivosa	brain coral
Diploria labyrinthiformes	brain coral
Diploria strigosa	brain coral
Porites astreoides	yellow porites
Porites porites	clubbed finger
Montastrea annularis	star coral
Montastrea cavernosa	large star coral
Siderastrea radians	starlet coral
Siderastrea siderea	
Stephanocoenia michellini	

Hermatypic Hydrocorals:

Millepora alcicornis
Millepora complanata

Alcyonaria:

Briareum asbestinum	corky sea fingers
Eunicea calyculata	warty eunicea
Eunicea mammosa	mammillated eunicea
Gorgonia flabellum	
Muricea muricata	
Plexaurella sp.	
Pseudopterogorgia bipinnata	

Sponges:

Anthosigmella varians
Haliclona rubens
Ircinia strobilina

Miscellaneous Invertebrates:

Antipathes sp.	[illegible] shes
Aurelia sp.	moon jelly
Bartholomea sp.	sea anemone
Condylactis gigantea	[illegible] anemone
Diadema antillarum	long spined sea

Algae:

Fishes:

Table 2 Species Observed at [illegible] Point

Scleractinian corals:

Acropora cervicornis	staghorn coral
Agaricia agaricites	lettuce coral
Agaricia fragilis	lettuce coral
Colpophyllia natans	
Diploria clivosa	brain coral
Diploria labyrinthiformes	brain coral
Diploria strigosa	brain coral
Porites astreoides	yellow porites
Porites porites	clubbed finger
Montastrea annularis	star coral
Montastrea cavernosa	large star cor
Siderastrea radians	starlet coral
Siderastrea siderea	
Stephanocenia michelinii	

Hermatypic Hydrocorals:

Millepora alcicornis	
Millepora complanata	

Alcyonaria:

Briareum asbestinum	corky sea [illegible]
Eunicea calyculata	warty eunicea
Eunicea mammosa	mammillated eunicea
Gorgonia flabellum	
Muricea muricata	
Plexaurella sp.	
Pseudopterogorgia bipinnata	

Miscellaneous Invertebrates

Condylactis gigantea	sea anemone
Diadema antillarum	long spined
Echinometra lucunter	
Eupolymnia nebulosa	
Lebrunia danae	
Ricordea florida	
Sabellastarte magnifica	feathered polychaete
Spirobranchus giganteus	christmas tree worm
Strombus gigas	queen conch
Tripneustes esculentus	
[illegible]	

Fishes:

Abudefduf saxatilis	sergeant major
Acanthurus coeruleus	blue tang
Acanthurus chirurgus	doctorfish
Aulostomus maculatus	trumpetfish
Canthigaster rostrata	sharpnose puffer
Chaetodon capistratus	foureyed butterfl
Chaetodon ocellatus	spotfin butterfl
Chaetodon striatus	banded butterfly f
Epinephelus guttatus	red hind
Eupomacentrus dorsopunicans	dusky damsel fi
Eupomacentrus partitus	bicolor damsel f
Eupomacentrus variabilis	cocoa damsel fish
Gobiosoma genie	cleaner gobies
Haemulon flavolineatum	french grunt
Haemulon sciurus	bluestriped grunt
Halichoeres bivittatus	slippery dick
Holocentrus rufus	squirrel fish
Hypoplectrus unicolor	butter hamlet
Kyphosus sectatrix	bermuda chub
Lutjanus apodus	schoolmaster
Microspathodon chrysurus	yellow tail damsel
Mulloidichthys martinicus	yellow goatfish
Ocyurus chrysurus	yellowtail snapper
Pempheris schomburgki	glassy sweeper
Scarus coeruleus	blue parrotfish
Scarus croicensis	striped parrotfish
Scarus guacamaia	parrotfish
Synodus intermedius	sandiver
Thalassoma bifasciatum	bluehead wrasse

Table 3. Species observed at [illegible] Reef

Scleractinian corals:

Acropora palmata	elkhorn coral
Agaricia agaricites	lettuce coral
Agaricia fragilis	lettuce coral
Colpophyllia natans	
Dendrogyra cylindrus	pillar coral
Diploria clivosa	brain coral
Diploria labyrinthiformis	brain coral
Diploria strigosa	brain coral
Porites astreoides	yellow porites
Porites porites	clubbed finger coral
Montastrea annularis	star coral
Montastrea cavernosa	large star coral
Mycetophyllia lamarckiana	
Siderastrea radians	starlet coral
Siderastrea siderea	
Stephanocoenia michelinii	
Tubastrea tenuilamellosa	

Hermatypic Hydrocorals:

Millepora alcicornis
Millepora complanata

Alcyonaria:

Briareum asbestinum	corky sea fingers
Eunicea calyculata	warty eunicea
Eunicea mammosa	mammillated eunicea
Gorgonia flabellum	
Muricea muricata	
Plexaurella sp.	
Pseudopterogorgia bipinnata	
Unidentified antipatharian	black coral

Miscellaneous Invertebrates:

Anilocra sp.	isopod parasite of fishes
Aurelia sp.	moon jelly
Bartholomea sp.	sea anemone
Condylactis gigantea	sea anemone
Diadema antillarum	long spined sea urchin
Echinometra lucunter	
Eupolymnia nebulosa	
Lebrunia danae	
Palythoa mammillosa	
Ricordea florida	

Pacific staghorn sculpin	Leptocottus armatus
Tidepool sculpin	Oligocottus maculosus
Tidepool stickleback	Gasterosteus aculeatus
Threespine stickleback	Gasterosteus aculeatus
Starry flounder	Platichthys stellatus

Algae:

Acmaea mitra	whitecap limpet
Calliarthron tuberculosum	articulated coralline
Corallina vancouveriensis	articulated coralline
Cryptopleura violacea	violet encrusting red
Endocladia muricata	endocladia
Fucus gardneri	rockweed
Gigartina papillata	papillate gigartina
Gigartina spinosa	spinose gigartina
Gloiopeltis furcata	jania
Hedophyllum sessile	sea cabbage
Iridaea cornucopiae	dusky iridaea
Laminaria setchellii	Setchell's laminaria
Laminaria sinclairii	Sinclair's kelp
Lithothamnium californicum	California lithothamnium
Lithothamnium pacificum	Pacific lithothamnium
Mastocarpus papillatus	papillate mastocarpus
Mastocarpus pacificus	Pacific mastocarpus
Microcladia borealis	northern microcladia
Neorhodomela oregona	Oregon neorhodomela
Nereocystis luetkeana	bull kelp
Odonthalia floccosa	fleshy odonthalia
Pelvetiopsis limitata	false kelp
Petrocelis franciscana	St. Francis petrocelis
Plocamium cartilagineum	plocamium
Polysiphonia hendryi	Hendry's polysiphonia
Porphyra perforata	laver
Postelsia palmaeformis	sea palm
Prionitis lanceolata	prionitis
Pterocladia capillacea	pterocladia
Ptilota filicina	fern ptilota
Rhodoglossum affine	rhodoglossum
Rhodomela larix	rhodomela
Smithora naiadum	smithora
Ulva fenestrata	sea lettuce
Ulva lobata	sea lettuce
Zostera marina	eelgrass

Fishes:

Cottidae (sculpins)	
Artedius harringtoni	Scalyhead sculpin
Clinidae (clinids)	
Alloclinus holderi	whitespotted rockskipper
Anoplarchus purpurescens	high cockscomb
Apodichthys flavidus	penpoint gunnel
Cebidichthys violaceus	monkeyface prickleback
Clinocottus acuticeps	sharpnose sculpin
Clinocottus analis	wooly sculpin
Clinocottus embryum	calico sculpin
Clinocottus globiceps	mosshead sculpin
Gibbonsia elegans	spotted kelpfish
Gibbonsia metzi	striped kelpfish
Heterostichus rostratus	giant kelpfish
Labrisomus nuchipinnis	hairy blenny
Oligocottus maculosus	tidepool sculpin
Oligocottus snyderi	fluffy sculpin
Ophiodon elongatus	lingcod
Paralabrax clathratus	kelp bass
Paralabrax nebulifer	barred sand bass
Scorpaenichthys marmoratus	cabezon
Semicossyphus pulcher	California sheephead
Stichaeidae (pricklebacks)	
Cebidichthys violaceus	monkeyface prickleback
Xiphister atropurpureus	black prickleback
Xiphister mucosus	rock prickleback
Xiphister rupestris	rock prickleback
Embiotocidae (surfperches)	
Amphistichus argenteus	barred surfperch
Amphistichus rhodoterus	redtail surfperch
Brachyistius frenatus	kelp perch
Cymatogaster aggregata	shiner perch
Embiotoca jacksoni	black perch
Hyperprosopon anale	spotfin surfperch
Hyperprosopon argenteum	walleye surfperch
Hyperprosopon ellipticum	silver surfperch
Hyperprosopon rosenblatti	pile perch
Rhacochilus toxotes	rubberlip surfperch
Rhacochilus vacca	pile perch
Zalembius rosaceus	pink surfperch
Gobiidae (gobies)	
Lepidogobius lepidus	bay goby
Gobiesocidae (clingfishes)	
Gobiesox rhessodon	California clingfish
Gobiesox rhessodon	California clingfish
Pholidae (gunnels)	
Apodichthys flavidus	penpoint gunnel
Pholis ornata	saddleback gunnel
Pleuronectidae (flatfishes)	
Citharichthys sordidus	Pacific sanddab
Citharichthys stigmaeus	speckled sanddab
Hippoglossina stomata	spotfin flounder
Parophrys vetulus	English sole
Platichthys stellatus	starry flounder
Psettichthys melanostictus	sand sole
Rhacochilus toxotes	rubberlip surfperch
Rhacochilus vacca	pile perch
Rhinogobiops nicholsii	blackeye goby
Scorpaenidae (rockfishes)	
Sebastes atrovirens	kelp rockfish
Sebastes auriculatus	brown rockfish
Sebastes carnatus	gopher rockfish
Sebastes caurinus	copper rockfish
Sebastes chrysomelas	black-and-yellow rockfish
Sebastes dalli	calico rockfish
Sebastes elongatus	greenstriped rockfish
Sebastes entomelas	widow rockfish
Sebastes flavidus	yellowtail rockfish
Sebastes maliger	quillback rockfish
Sebastes melanops	black rockfish
Sebastes miniatus	vermilion rockfish
Sebastes mystinus	blue rockfish
Sebastes nebulosus	china rockfish
Sebastes ovalis	speckled rockfish
Sebastes paucispinis	bocaccio
Sebastes pinniger	canary rockfish
Sebastes rastrelliger	grass rockfish
Sebastes rosaceus	rosy rockfish
Sebastes rosenblatti	greenblotched rockfish
Sebastes ruberrimus	yelloweye rockfish
Sebastes serranoides	olive rockfish
Sebastes umbrosus	honeycomb rockfish
Sebastes vexillaris	pygmy rockfish
Sebastes wilsoni	pygmy rockfish
Sebastes zacentrus	sharpchin rockfish
Sebastolobus alascanus	shortspine thornyhead
Stichaeidae (pricklebacks)	
Cebidichthys violaceus	monkeyface prickleback
Xiphister atropurpureus	black prickleback
Xiphister mucosus	rock prickleback
Xiphister rupestris	rock prickleback
Zaproridae (prowfishes)	
Zaprora silenus	prowfish
Zoarcidae (eelpouts)	
Lycodapus fierasfer	blackmouth eelpout
Lycodes pacificus	blackbelly eelpout

Table 4. Fauna observed [illegible]

Scleractinian corals:

Acropora cervicornis	staghorn coral
Acropora palmata	elkhorn coral
Agaricia agaricites	lettuce coral
Agaricia fragilis	lettuce coral
Colpophyllia natans	
Dendrogyra cylindrus	pillar coral
Dichocoenia stokesi	star coral
Diploria clivosa	brain coral
Diploria labyrinthiformis	brain coral
Diploria strigosa	brain coral
Eusmilia fastigiata	flower coral
Favia fragum	
Isophyllastrea rigida	
Porites astreoides	yellow or tan
Porites porites	clubbed finger
Madracis decactis	
Madracis mirabilis	
Meandrina meandrites	
Meandrina meandrites	
Montastrea annularis	star coral
Montastrea cavernosa	large star co
Mussa angulosa	large flower
Mycetophyllia lamarckiana	
Scolymia cubensis	starlet coral
Scolymia lacera	
Stephanocoenia michelini	

Hermatypic Hydrocorals:

Millepora alcicornis	
Millepora complanata	

Alcyonaria:

Briareum asbestinum	corky sea finger
Eunicea calyculata	warty sea rod
Eunicea mammosa	tattletale gorgo
Gorgonia flabellum	
Muricea muricata	
Plexaura sp.	
Pseudopterogorgia bipinnata	

Sponges:

Aplysina cauliformis	[illegible]
Callyspongia vaginalis	
Ircinia strobilina	

Miscellaneous Invertebrates:

Anilocra sp.	isopod para
Aurelia sp.	moon jelly
Bartholomea sp.	sea anemone
Condylactis gigantea	sea anemone
Diadema antillarum	long-spined s
Echinometra lucunter	
Eupolymnia nebulosa	
Lebrunia danae	
Palythoa mammillosa	colonial anemones
Panulirus argus	spiny lobster
Ricordea florida	
Sabellastarte magnifica	feathered polychae
Spirobranchus giganteus	christmas tree wor
Tripneustes esculentus	
Zoanthus pulchellus	

Algae:

Amphiroa fragilissima
Caulerpa racemosa
Dictyota sp.
Laurencia poitei
Padina sp.
Valonia ventricosa

Fishes:

Abudefduf saxatilis	sergeant major
Acanthurus coeruleus	blue tang
Acanthurus chirurgus	doctorfish
Aulostomus maculatus	trumpetfish
Anisotremus surinamensis	margate
Canthigaster rostrata	sharpnose puffer
Caranx fusus	blue runner
Chaetodon capistratus	four-eyed butterf
Chaetodon ocellatus	spotfin butterfl
Chaetodon striatus	banded butterfly
Epinephelus guttatus	red hind
Eupomacentrus dorsopunicans	dusky damself
Eupomacentrus partitus	bicolor damsel f
Eupomacentrus variabilis	cocoa damself
Gobiosoma genie	cleaner gobies
Haemulon flavolineatum	french grunt
Haemulon sciurus	bluestriped grun
Halichoeres bivittatus	slippery dick
Holocentrus rufus	squirrelfish
Hypoplectrus indigo	indigo hamlet
Hypoplectrus unicolor	butter hamlet

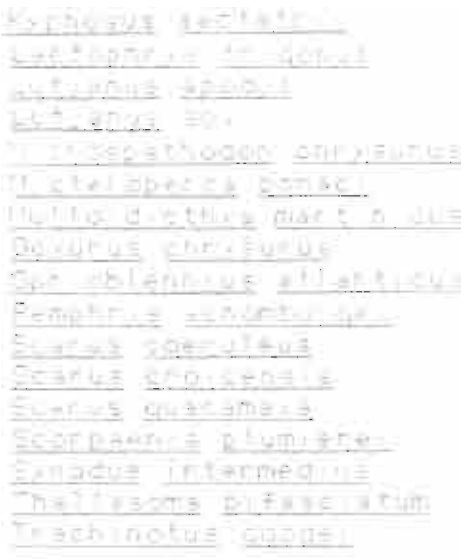


Table 5 Species observed at "Grave Central Station"

Scleractinian corals:

Madracis pharensis	elkhorn coral
Meandrina meandrites	"lettuce coral"
Agaricia agaricites	"lettuce coral"
Agaricia fragilis	
Colpophyllia natans	
Dendrogyra cylindrus	pillar coral
Diploria clivosa	brain coral
Diploria labyrinthiformis	brain coral
Diploria strigosa	brain coral
Eusmilia fastigiata	yellow pox tee
Favia fragum	clubbed finger cor
Manicina areolata	star coral
Montastrea annularis	star co
Montastrea cavernosa	
Mycetophyllia lamarckiana	
Porites astreoides	r coral
Siderastrea radians	
Siderastrea siderea	
Stephanocoenia michelinii	
Tubastrea tenuilamellosa	

Hermatypic Hydrocorals:

Millepora alcicornis	ora l
Millepora complanata	oral

Alcyonaria:

Briareum asbestinum	corky sea f nger
Eunicea calyculata	warty eunicea
Eunicea mammosa	mammillary eu
Gorgonia flabellum	
Muricea muricata	
Pseudopterogorgia acerosa	
Pseudopterogorgia bipinnata	
Plexaurella sp.	
Pseudoplexaura porosa	sea rod
Pseudoplexaura wagenaari	
Antillogorgia sp.	

Miscellaneous Invertebrates:

Ascidian sp.	round parasitic ti f ire
Bunodosoma sp.	mesh ell
Condylactis gigantea	sea anemone
Lebrunia danae	sea anemone
Ricordea florida	ong horned sea urchin
Zoanthus sp.	
Palythoa caribaeorum	colonial anemones
Palythoa mammillosa	
Zoanthus pulchellus	
Isostichopus badionotus	tethered co"-cruc

Algae:

Fishes:

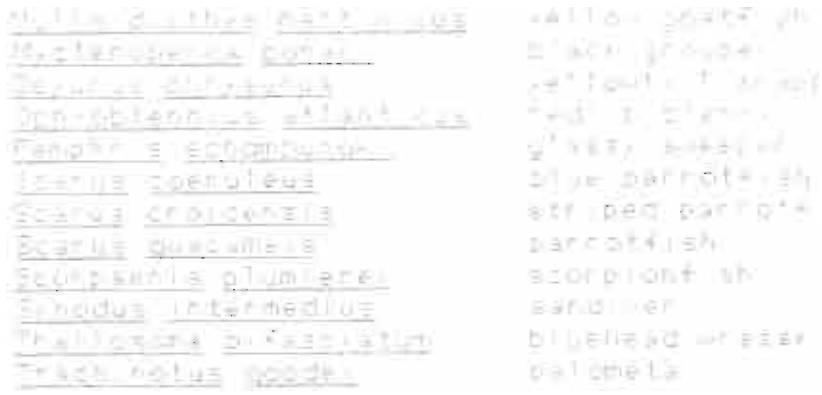


Table 6. [illegible]

Scleractinian corals:

Acropora cervicornis	staghorn coral
Acropora palmata	elkhorn coral
Agaricia agaricites	lettuce coral
Colpophyllia natans	brain coral
Diploria labyrinthiformis	brain coral
Leptoseris cucullata	[illegible]
Porites astreoides	[illegible]
Montastrea annularis	star coral
Montastrea cavernosa	large star coral
Siderastrea radians	starlet coral
Siderastrea siderea	

Hermatypic Hydrocorals:

Millepora alcicornis	fire coral
Millepora complanata	fire coral

Alcyonaria:

Briareum asbestinum	corky sea finger
Eunicea calyculata	warty sea rod
Eunicea mammosa	mammillated sea rod
Gorgonia ventalina	
Eunicea succinea	
Pseudopterogorgia acerosa	
Pseudopterogorgia bipinnata	

Sponges:

Aplysina cauliformis	[illegible]
Haliclona tubifera	
Ircinia strobilina	

Miscellaneous Invertebrates:

Bunodosoma granulifera	sea anemone
Eunicea tourneforti	
Eupolymnia nebulosa	
Palythoa caribaeorum	colonial anemones
Ricordea florida	
Sabellastarte magnifica	feathered polychaete
Spirobranchus giganteus	christmas tree worms
Zoanthus pulchellus	

Algae:

Fish:

Class Chondrichthyes

Dasyatis sabina	Atlantic stingray
Dasyatis americana	southern stingray
Dasyatis centroura	roughtail stingray
Gymnura micrura	smooth butterfly ray
Rhinoptera bonasus	cownose ray
Rhinobatos lentiginosus	atlantic guitarfish
Rhinobatos percellens	chola guitarfish
Narcine brasiliensis	lesser electric ray
Aetobatus narinari	spotted eagle ray
Manta birostris	giant manta ray
Carcharhinus leucas	bull shark
Carcharhinus limbatus	blacktip shark
Carcharhinus perezi	caribbean reef shark
Carcharhinus plumbeus	sandbar shark
Carcharhinus porosus	smalltail shark
Carcharhinus acronotus	blacknose shark
Carcharhinus isodon	finetooth shark
Carcharhinus brevipinna	spinner shark
Carcharhinus falciformis	silky shark
Carcharhinus obscurus	dusky shark
Carcharhinus signatus	night shark
Carcharhinus limbatus	blacktip shark
Carcharhinus leucas	bull shark
Carcharhinus perezi	caribbean reef shark
Carcharhinus plumbeus	sandbar shark
Carcharhinus porosus	smalltail shark
Carcharhinus acronotus	blacknose shark
Carcharhinus isodon	finetooth shark
Carcharhinus brevipinna	spinner shark
Carcharhinus falciformis	silky shark
Carcharhinus obscurus	dusky shark
Carcharhinus signatus	night shark

Class Osteichthyes

Abudefduf saxatilis	sergeant major
Acanthurus coeruleus	blue tang
Acanthurus chirurgus	doctorfish
Canthigaster rostrata	sharpnose puffer
Cephalopholis fulva	blue runner
Chaetodon capistratus	four-eyed butterfly
Chaetodon ocellatus	spotfin butterfly
Chaetodon striatus	banded butterfly
Epinephelus guttatus	red hind
Eupomacentrus dorsopunicans	dusky damselfish
Eupomacentrus partitus	bicolor damselfish
Eupomacentrus variabilis	longfin damselfish
Gobiosoma genie	cleaner goby
Haemulon flavolineatum	french grunt
Haemulon sciurus	bluestriped grunt
Halichoeres bivittatus	slippery dick
Holocentrus rufus	squirrelfish
Kyphosus sectatrix	bermuda chub
Lachnolaimus maximus	hogfish
Lutjanus apodus	schoolmaster
Lutjanus griseus	mangrove snapper
Lutjanus synagris	lane snapper
Malacanthus plumieri	sand tilefish
Microspathodon chrysurus	yellowtail damselfish
Mycteroperca bonaci	black grouper
Mycteroperca interstitialis	yellowmouth grouper
Ocyurus chrysurus	yellowtail snapper
Pomacanthus arcuatus	gray angelfish
Pomacanthus paru	french angelfish
Scarus coelestinus	midnight parrotfish
Scarus coeruleus	blue parrotfish
Scarus guacamaia	rainbow parrotfish
Scarus taeniopterus	princess parrotfish
Scarus vetula	queen parrotfish
Sparisoma aurofrenatum	redband parrotfish
Sparisoma chrysopterum	redtail parrotfish
Sparisoma viride	stoplight parrotfish

Table 7. Species observed at Bigelow Beach.

Scleractinian corals:

Acropora cervicornis	staghorn coral
Acropora palmata	elkhorn coral
Agaricia agaricites	lettuce coral
Agaricia fragilis	lettuce coral
Colpophyllia natans	
Dendrogyra cylindrus	pillar coral
Dichocoenia stokesii	star coral
Diploria clivosa	brain coral
Diploria labyrinthiformis	brain coral
Diploria strigosa	brain coral
Favia fragum	
Isophyllastrea rigida	
Porites astreoides	yellow porites
Porites porites	clubbed finger
Montastrea annularis	star coral
Montastrea cavernosa	large star coral
Siderastrea radians	starlet coral
Siderastrea siderea	
Stephanocoenia michelinii	

Hermatypic Hydrocorals:

Millepora alcicornis	fire coral
Millepora complanata	fire coral

Alcyonaria:

Briareum asbestinum	corky sea fingers
Eunicea calyculata	warty sea rod
Eunicea mammosa	mammillated eunicea
Gorgonia flabellum	
Muricea muricata	
Plexaurella sp.	
Pseudopterogorgia bipinnata	

Sponges:

Anthosigmella varians
Haliclona rubens
Ircinia strobilina

Miscellaneous Invertebrates:

Anilocra sp.	(isopod parasite of fishes
Aurelia sp.	moon jelly
Bartholomea sp.	sea anemone
Condylactis gigantea	

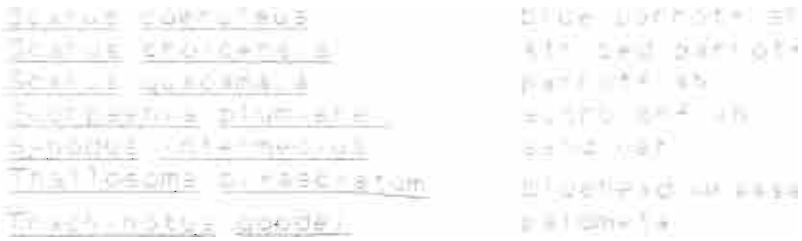
Diadema antillarum	long spined sea
Echinometra lucunter	
Eucidaris tribuloides	
Lebrunia danae	
Palythoa mammillosa	colonial anemone
Ricordea florida	
Sabellastarte magnifica	feathered po
Spirobranchus giganteus	christmas tree worms
Tripneustes esculentus	
Zoanthus pulchellus	

Algae:

Amphiroa fragilissima
Caulerpa racemosa
Dictyota sp.
Laurencia papillosa
Padina sp.
Valonia ventricosa

Fishes:

Abudefduf saxatilis	sergeant ma
Acanthurus coeruleus	blue tang
Acanthurus chirurgus	doctorfish
Aulostomus maculatus	trumpetfish
Anisotremus surinamensis	margate
Canthigaster rostrata	sharpnose puffer
Caranx fusus	blue runner
Chaetodon capistratus	four-eyed butterf
Chaetodon ocellatus	spotfin butterfl
Chaetodon striatus	banded butterfl
Epinephelus guttatus	red hind
Eupomacentrus dorsopunicans	dusky damsel fi
Eupomacentrus partitus	bicolor damsel f
Eupomacentrus variabilis	cocoa damsel fi
Gobiosoma genie	cleaner goby
Haemulon flavolineatum	french grunt
Haemulon sciurus	bluestriped grunt
Halichoeres bivittatus	slippery dick
Holocentrus rufus	squirrel fish
Hypoplectrus indigo	indigo hamlet
Hypoplectrus unicolor	butter hamlet
Kyphosus sectatrix	bermuda chub
Lactophrys triqueter	spotted trunkfi
Microspathodon chrysurus	yellowtail damse
Mycteroperca bonaci	black grouper
Mulloidichthys martinicus	yellow goatfish
Ocyurus chrysurus	yellowtail snapp
Ophioblennius atlanticus	redlip blenny
Pempheris schomburgki	glassy sweeper



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FIGURES

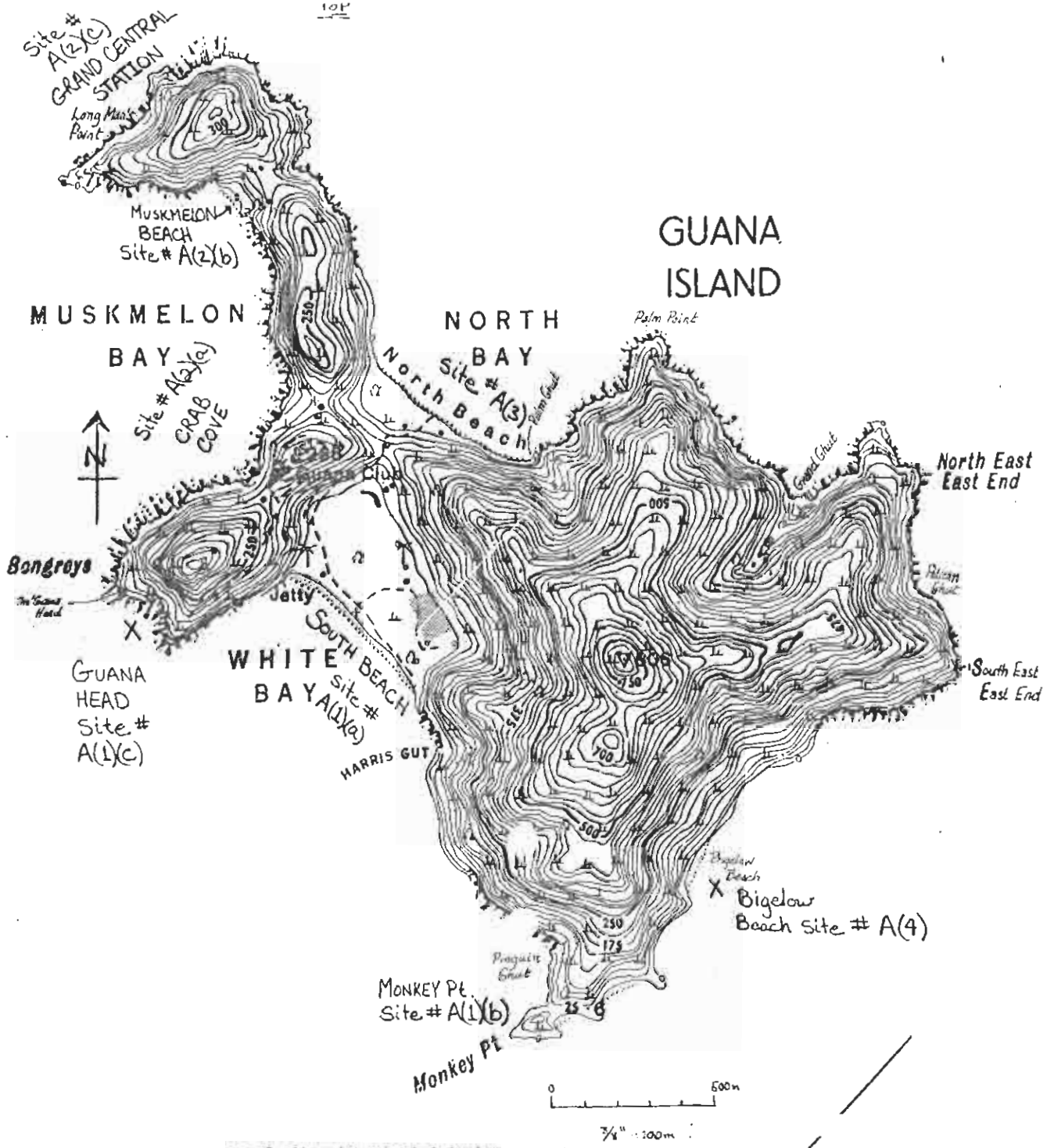


Figure 1. Locations of sites inventoried during June, 1985.

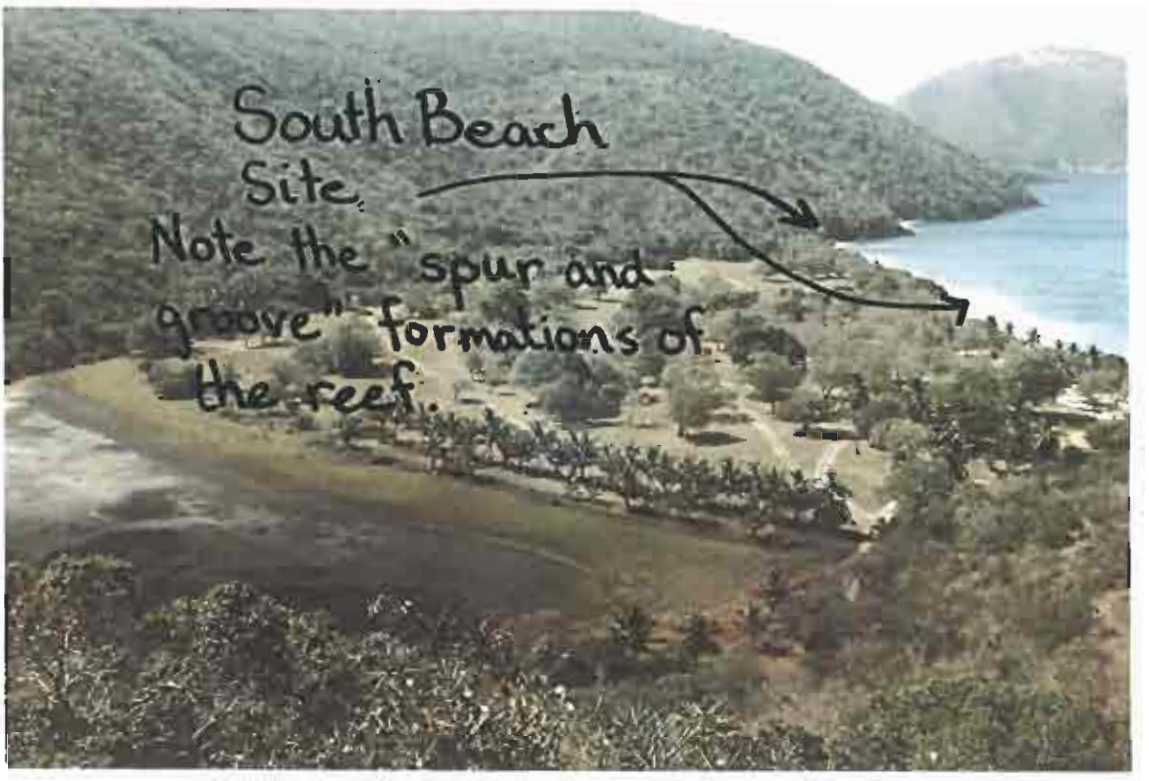


Figure 2. Spur and Groove formations of South Beach.

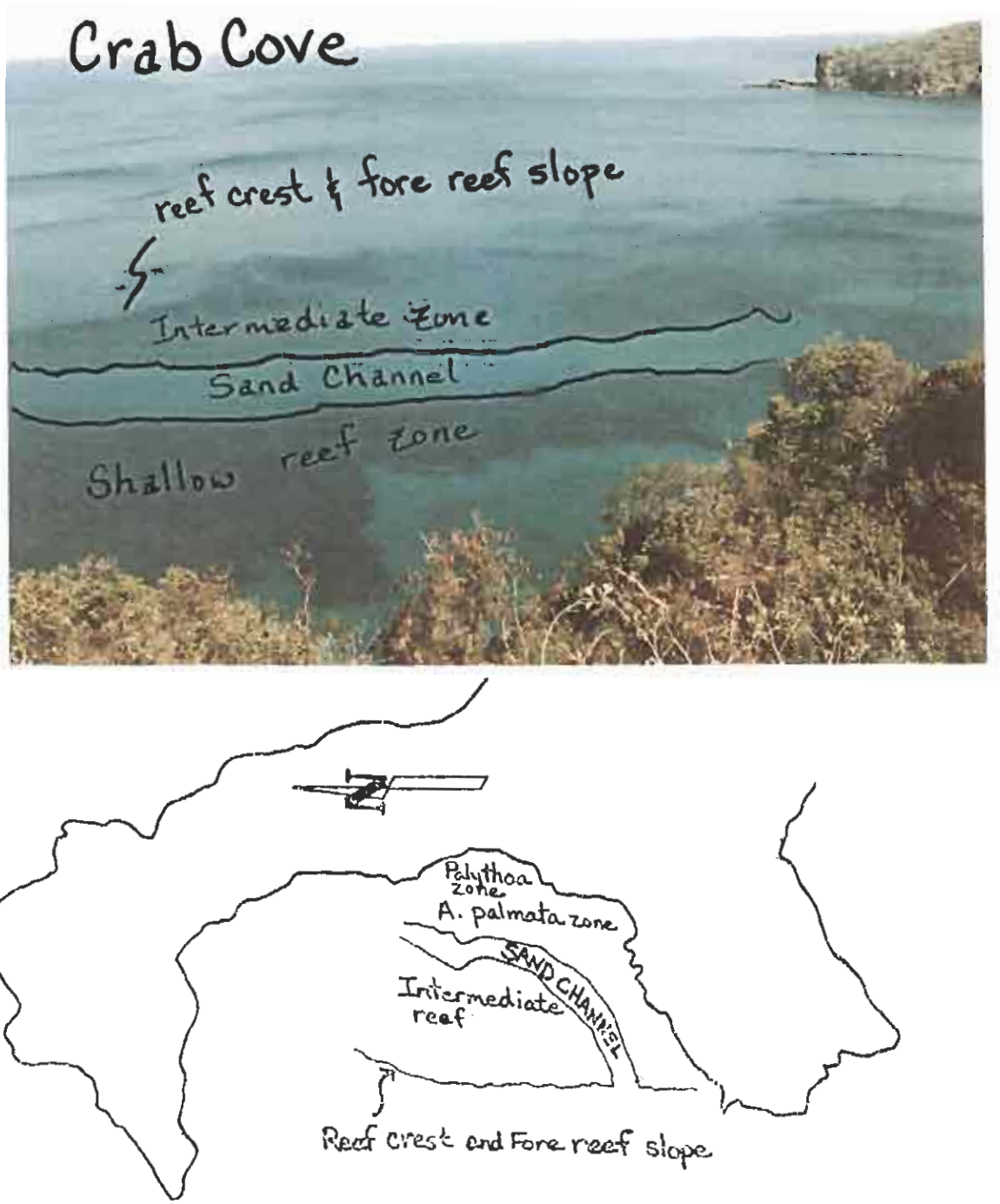


Figure 3. Detailed photo and diagram of Crab Cove illustrating zones.

Figure 4(a). Pillar Coral(Dendrogyra cylindris) at Crab Cove. This coral species was frequently observed at five of the seven sites inventoried.
(b). North Beach

Figure 5(a). Encrusted anchor at North Beach. Note the scoured condition of the substrate.

(b). Elkhorn coral (Acropora palmata). Large colonies of this species were observed further waterward from North Beach.

F. JOSEPH STOKES, JR.
1012 Westview Street
Philadelphia, PA 19119

August 1, 1985

Dear Dr. Jarecki:

We recently spent an enjoyable 11 days on Guana Island collaborating with Skip Lazell. Our particular interest was a survey of the fish life.

In preparation to writing our Divers and Snorkelers Guide to the Fishes we made similar surveys of nearly 30 islands in the Caribbean. In our opinion the reefs in White and Muskmelon Bays are outstanding for their variety of fish life. During the limited hours we spent in the water we observed a total of 124 species -- an impressive number in comparison to other islands. White Bay has these additional features:

1. -- The reefs are near the surface and the fish easily seen; reefs are often too deep for snorkelers.
2. -- The water is usually calm and relatively clear. Many reefs are exposed to rough weather and cannot be enjoyed during a limited vacation.
3. -- Access is near perfect from the beautiful beach or from a boat moored outside the reefs. No rocks or urchins.
4. -- The reefs are close to the shore and right at the Club's facilities. Many reefs are far off-shore and some distance from a resort.
5. -- There is a wide variety of corals, both hard and soft. Frequently reefs are largely just a few varieties.

We would strongly recommend that steps be taken to establish White and Muskmelon Bays as a marine preserve with a ban on spear fishing, fish traps, souvenir hunting, and anchoring: activities that have a deleterious effect on marine life and if allowed to go on can be the death of any reef. It is only recently that studies have shown that reefs are not as once thought virtually indestructible, but rather are highly sensitive ecosystems that react unfavorably to any sort of abuse. Unfortunately the ever increasing pressures put upon reefs by their exploitation by tourists, developers,

and natives have already destroyed countless reefs throughout the Caribbean and Bahamas. The time to establish protective restrictions is before these pressures build up. Once they have it becomes politically almost impossible to impose restrictions.

The reasons for banning spear-fishing, fish traps, souvenir hunting and anchoring are these:

1. -- The spear fisherman is too selective -- he removes the larger, breeding individuals as well as the colorful species a fish watcher most enjoys. An even more serious effect of spear fishing is in the behaviour of the fish. The fish quickly come to fear people in the water and move out of sight, much to the disappointment of the fish watcher.
2. -- Fish traps also selectively catch the large individuals (the small fish swim through the mesh). Invariably buoys are lost and the traps remain on the bottom where they continue for years to lure fish into them where they die and are eaten by small fish and crustaceans.
3. -- Souvenir hunters indiscriminately break off coral and gather up gastropods. It takes years for these things to grow back and the reef gradually loses much of its beauty.
4. -- Anchors often scrape and break the coral as they settle and almost invariably break the coral when pulled up. The yachtsman doesn't realize what is happening at the end of the line. Probably at least 3 anchors are lowered into White Bay each day -- 1000 per year -- the effects can be devastating!

We were among the large group of marine experts invited to Jamaica several years ago to advise their Department of Tourism how they might restore

their reefs. The reefs had once been an important tourist attraction but as a result of various sorts of over-exploitation they became relatively barren and their tourist industry was suffering the results. The establishment of marine preserves was discussed at length. From these the following points emerged:

1. -- Coastal waters are considered part of the national domain; therefore any steps to establish a marine preserve must carry the full sanction of the government.
2. -- Every citizen considers he is entitled, under regulation, to catch fish. A government must have strong reasons for curtailing fishing areas (in your case tourism) or provide substitute areas such as artificial reefs. Artificial reefs are inexpensive to create and experience has demonstrated that within weeks they develop a large and readily catchable fish population that is supplemental to any surrounding area.
3. -- The restrictions applying to a marine preserve must be policed and enforced. This means that boundaries are clearly marked, are easily determined from the water, that those who enter the preserve can be readily observed and that the government is prepared to take action against violators.

White and Muskmelon Bays would appear to be ideal as a prototype marine park. Their shallow water corals and marine life are outstanding. Their headlands clearly define its boundaries. The access is excellent from either the shore or the bay. Moorings could be installed in the shallow water beyond the reef line to avoid anchor abuse, or marker floats set up to indicate anchor limits. Finally, the preserve could be easily patrolled by the staff of the Club and if some were deputized then violators could be apprehended.

We believe your proposal would be welcomed by the government of the British Virgin Islands. The preserve at Guana could well serve as a prototype for additional preserves to follow such as one at Little Dix Bay and other suitable sites. Your cooperation in this would be a very real service to the islands and a great credit to you personally. If we can be of help in any further way please call on us.

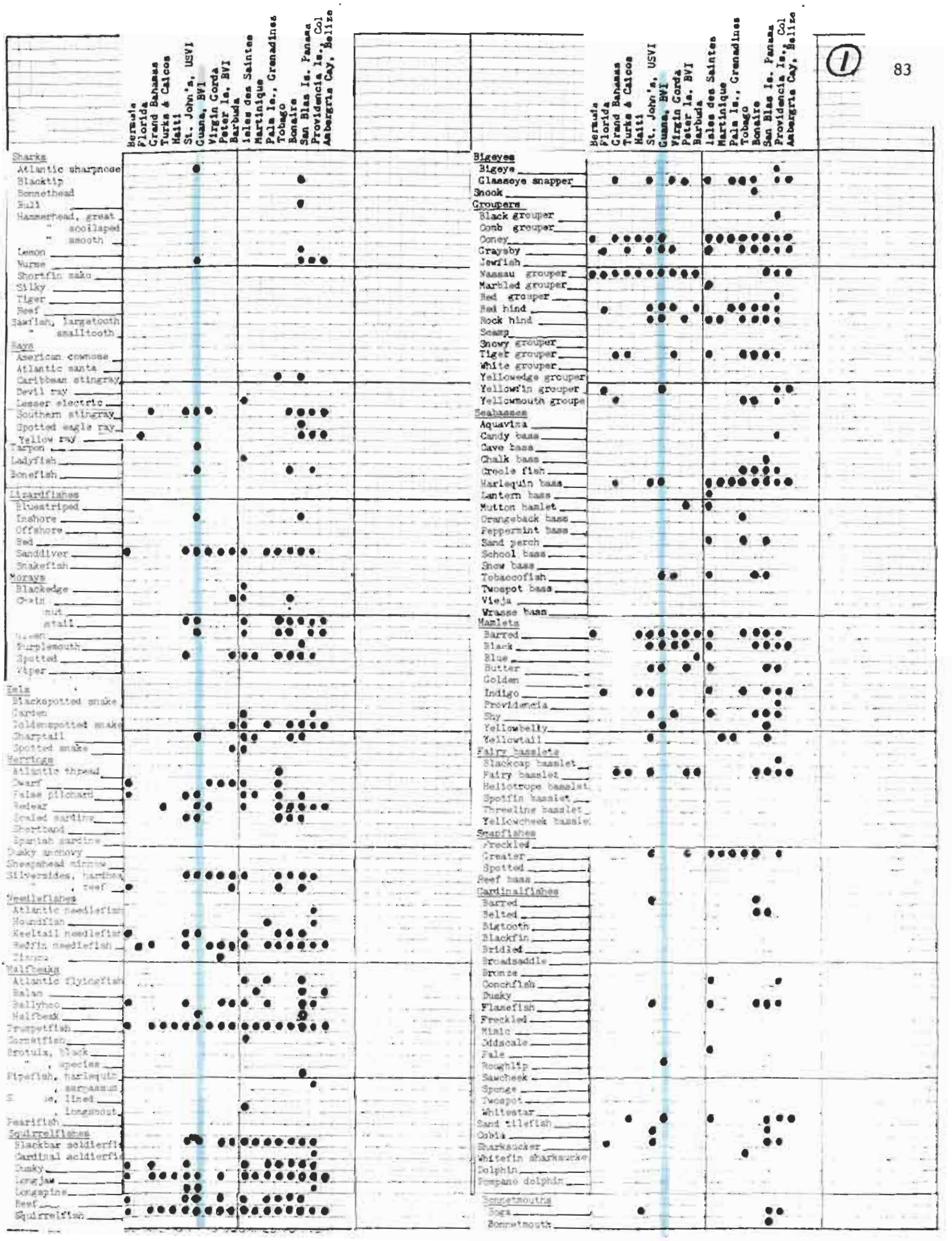
With best wishes,

F. Joseph Stokes, Jr.

Charlotte C. Stokes

P.S. We attach a connotated listing of the fish species we observed during the relatively few hours we snorkeled in White Bay. There are undoubtedly many other species that escaped our attention, especially species we have seen on nearby islands during other trips.

Paula Selby is now offering our Fish Guide for sale in the office.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Guana, BVI
Virgin Gorda
Peter Is. BVI
Barbuda
Isles des Saintes
Martinique
Pale Is., Grenadines
Tobago
Bonaire
San Blas Is. Panama
Providencia Is., Col
Ambergris Cay, Belize
Sharks
Atlantic sharpnose
Blacktip
Bonnethead
Bull
Hammerhead, great
" scoilaped
" smooth
Lemon
Nurse
Shortfin mako
Silky
Tiger
Reef
Sawfish, largetooth
" smalltooth
Rays
American cownose
Atlantic manta
Caribbean stingray
Devil ray
Lesser electric
Southern stingray
Spotted eagle ray
Yellow ray
Tarpon
Ladyfish
Bonefish
Lizardfishes
Bluestriped
Inshore
Offshore
Red
Sanddiver
Snakefish
Morays
Blackedge
Chain
" mut
" stail
Green
Purplemouth
Spotted
Viper
Eels
Blackspotted snake
Garden
Goldenspotted snake
Sharptail
Spotted snake
Herrings
Atlantic thread
Dwarf
False pilchard
Redear
Scaled sardine
Shortnose
Spanish sardine
Dusky anchovy
Sheepshead minnow
Silversides, hardhead
" reef
Needlefishes
Atlantic needlefish
Houndfish
Keeltail needlefish
Redfin needlefish
Flyings
Halfbeaks
Atlantic flyingfish
Balao
Ballyhoo
Halfbeak
Trumpetfish
Cornetfish
Brotula, black
" , speckled
Pipefish, harlequin
" , sargassum
S e, lined
" , longsnout
Pearlfish
Squirrelfishes
Blackbar soldierfish
Cardinal soldierfish
Dusky
Longjaw
Longspine
Reef
Squirrelfish
Bigeyes
Bigeye
Glasseye snapper
Snook
Groupers
Black grouper
Comb grouper
Coney
Graysby
Jewfish
Nassau grouper
Marbled grouper
Red grouper
Red hind
Rock hind
Scamp
Snowy grouper
Tiger grouper
White grouper
Yellowedge grouper
Yellowfin grouper
Yellowmouth grouper
Seabasses
Aquavina
Candy bass
Cave bass
Chalk bass
Creole fish
Harlequin bass
Lantern bass
Mutton hamlet
Orangeback bass
Peppermint bass
Sand perch
School bass
Snow bass
Tobaccofish
Twospot bass
Vieja
Wrasse bass
Hamlets
Barred
Black
Blue
Butter
Golden
Indigo
Providencia
Shy
Yellowbelly
Yellowtail
Fairy basslets
Blackcap basslet
Fairy basslet
Heliotrope basslet
Spotfin basslet
Threeline basslet
Yellowcheek basslet
Soapfishes
Freckled
Greater
Spotted
Reef bass
Cardinalfishes
Barred
Belted
Bigtooth
Blackfin
Bridled
Broadsaddle
Bronze
Conchfish
Dusky
Flamefish
Freckled
Mimic
Oddscale
Pale
Roughlip
Sawcheek
Sponge
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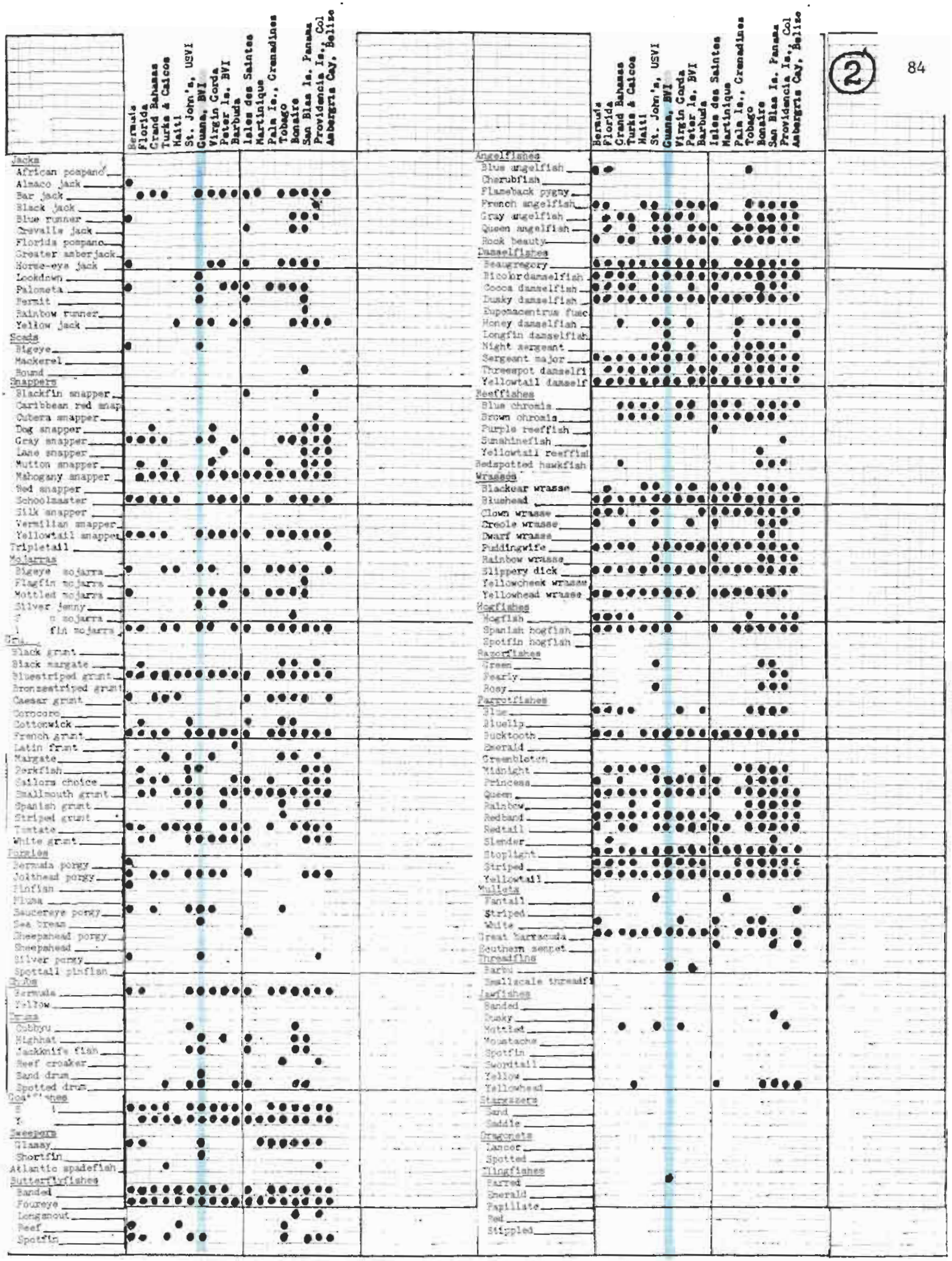
Cobia
Sharksucker
Whitefin sharksucker
Dolphin
Pompano dolphin
Sergeantmouths
Soga
Bonnetmouth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Isles des Saintes
Martinique
Pain Is., Grenadines
Tobago
Bonaire
San Blas Is. Panama
Providencia Is., Col
Ambergris Cay, Belize
Jacks
African pompano
Almaco jack
Bar jack
Black jack
Blue runner
Crevalle jack
Florida pompano
Greater amberjack
Horse-eye jack
Lookdown
Palometa
Permit
Rainbow runner
Yellow jack
Scads
Bigeye
Mackerel
Round
Snappers
Blackfin snapper
Caribbean red snap
Cubera snapper
Dog snapper
Gray snapper
Lane snapper
Mutton snapper
Mahogany snapper
Red snapper
Schoolmaster
Silk snapper
Vermilion snapper
Yellowtail snapper
Tripletail
Mojarras
Bigeye mojarra
Flagfin mojarra
Mottled mojarra
Silver jenny
n mojarra
fin mojarra
Grunts
Black grunt
Black margate
Bluestriped grunt
Bronzestriped grunt
Caesar grunt
Corocoro
Cottonwick
French grunt
Latin grunt
Margate
Porkfish
Sailors choice
Smallmouth grunt
Spanish grunt
Striped grunt
Tomtate
White grunt
Porgies
Bermuda porgy
Jolthead porgy
Pinfish
Pluma
Saucereye porgy
Sea bream
Sheepshead porgy
Sheepshead
Silver porgy
Spottail pinfish
Tilefishes
Bermuda
Yellow
Drums
Cubbyu
Highhat
Jackknife fish
Reef croaker
Sand drum
Spotted drum
Goatfishes
Sweepers
Glasseye
Shortfin
Atlantic spadefish
Butterflyfishes
Banded
Foureye
Longsnout
Reef
Spotfin
Angelfishes
Blue angelfish
Cherubfish
Flamefback pygmy
French angelfish
Gray angelfish
Queen angelfish
Rock beauty
Damselfishes
Beaugregory
Bicolor damselfish
Cocoa damselfish
Dusky damselfish
Dupomacentrus fusc
Honey damselfish
Longfin damselfish
Night sergeant
Sergeant major
Threespot damselfi
Yellowtail damself
Reeffishes
Blue chromis
Brown chromis
Purple reeffish
Sunshinefish
Yellowtail reeffish
Redspotted hawkfish
Wrasses
Blackear wrasse
Bluehead
Clown wrasse
Creole wrasse
Dwarf wrasse
Puddingwife
Rainbow wrasse
Slippery dick
Yellowcheek wrasse
Yellowhead wrasse
Hogfishes
Hogfish
Spanish hogfish
Spotfin hogfish
Razorfishes
Green
Pearly
Rosy
Parrotfishes
Blue
Bluelip
Bucktooth
Emerald
Creambleach
Midnight
Princess
Queen
Rainbow
Redband
Redtail
Slender
Stoplight
Striped
Yellowtail
Mullets
Fantail
Striped
White
Great barracuda
Southern sennet
Threadfins
Barbu
Smallscale threadfi
Jawfishes
Banded
Dusky
Mottled
Moustache
Spotfin
Swordtail
Yellow
Yellowhead
Stargazers
Sand
Saddle
Dragonets
Lancer
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Clingfishes
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Red
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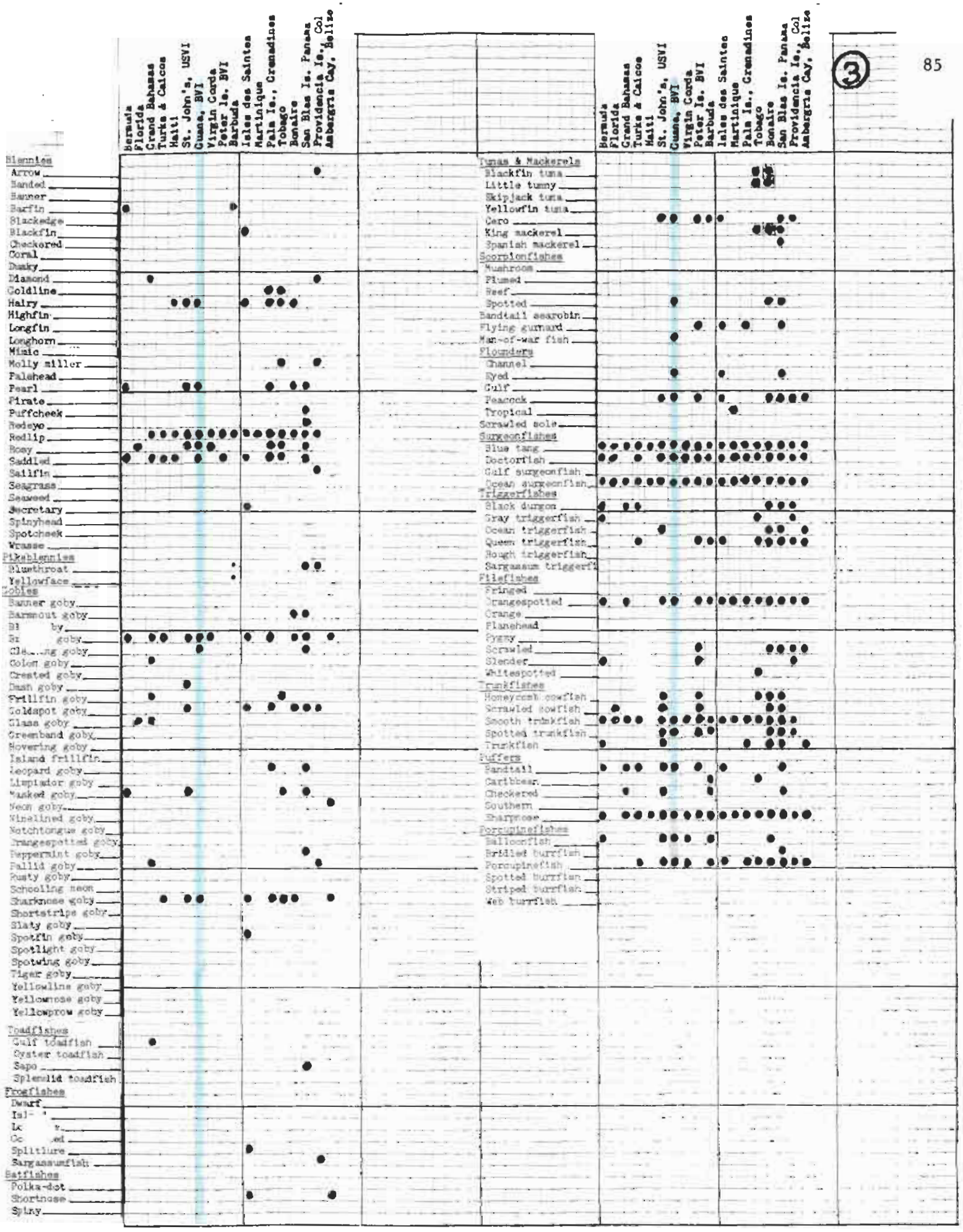

INTRODUCTIONS

I continue to work on bringing back species which used to occur on Guana, or at least close by in the BVI, but which are now rare or extirpated. There are four target species:

Flamingo. -- You have already seen Charlie Cook's report on how to deal with the flamingos when we are able to get some. Barring continued drought and another wave of disease, we should be able to get young flamingos in 1986, but there are the same number of ironclad guarantees in wildlife biology as in psychiatry. Richard Winchell, in Bermuda, remains ready, willing, and able to give us flamingos as soon as he has any to give. I was glad to hear that other island owners (Necker, Mosquito) would like to have flamingos too, and I hope they will contribute financially. However, none of these islands has enough habitat in my opinion to support a breeding population (Mosquito has none). The best hope for perpetuating flamingos in the BVI remains -- as I have always said -- Anegada. If the birds were breeding again on Anegada we could pretty much count on them coming to the smaller salt ponds regularly. Maintaining a few pinioned birds at Guana and elsewhere would work well for luring in wild birds. I think the Guana habitat might be big enough to support breeding, but infusion of new genes would always be necessary in such a small population. I see building up the flamingo population as a long-term project, if we want it to continue beyond the lifetimes of individual birds.

Iguana. -- I believe this a wonderful project of even greater biological value than the flamingo project because *Iguana pinguis* is so much more critically endangered. I hope you will decide to support it.

Tortoise. -- Paula says there are now six adults on Guana: five from Water Island and one from St. Thomas. I can hardly wait to see them and compare them to the accounts in the literature (which I have in hand). Has anyone yet taken good photographs? I hope you like them, and that their population will explode.

White-crowned pigeon. -- A long-term prospect. I planted red mangroves last year and hope they grow rapidly. These are what white-crowns nest in. Soon I will investigate getting some young birds to raise on Guana. The source will probably be Roosevelt Roads, Puerto Rico.

PROPOSAL FOR 1986

My initial proposal is for the month of July, basically as in 1984 and 1985. We are planning a show-and-tell session on or about 15 July, especially for the Jareckis and other people in the BVI. Louis Potter is working up a list of invitees. He is also considering selection of two students to work with us for two weeks each. Everyone seems most enthusiastic about both of these aspects of the 1986 project.

Here is my proposed cast for July with approximate number of days in parentheses; asterisks denote those requiring airfare:

Archeology, etc. -- Gibbons (30) and Assistant (30).

Herpetology. -- Lazell* (40), Jenifer Bush* (40), Dale Ford (30), Elayne Azevedo (30), Greg Mayer* (30), Nan Mayer (10), Bill MacLean (10), Ellen MacLean (10), and one BVI student (15).

Ornithology. -- Robert Chipley* (20), Liao Wei-ping* (30), and Robin Lyons (20).*

Invertebrates. -- Scott Miller* (20), Pam Miller* (20), Margaret Collins (30), Ed Ross (10), Sandy Ross (10), and one BVI student (15).

My secondary proposal is for a two week stay in November. This would include me, Greg Mayer, Scott Miller, and at least three assistants.

I have two other projects to propose, each of which would require about one month's full-time work by me, and both of which would be done at MCZ, Harvard, in the fall of '86:

1. Life table and reproductive biology of the slippery-back skink, Mabuya sloanii.
2. Diet from pellet analysis of Newton's barefoot screech owl, Otus nudipes newtoni.

Both are virtually guaranteed to result in important refereed publications. It is critically important to maintain (and increase) our rate of publication because this Agency is a scientific -- not charitable -- non-profit corporation. Our tax-exempt status -- and the deductibility of all contributions such as Mocatta's -- depends on our scientific output. We are doing well in this respect, but we can do much better. Both of the proposed papers would be very important contributions to knowledge of extremely rare and little-known species -- ones we just happen to have more potential knowledge of than anyone else.

* I need one more full-time equivalent = 30 days here. Probably jungle-scrambler 20 days, radio man 10 days

FINANCIAL STATEMENT

My time tabulates as follows:

	weeks	days	hours
June 26 - 3 August on Guana	7	4	
16 August		1	
27 August		1	
28-29 December		2	
12 September			2
28 September			2
20 October			2
2 November			2
17-18 November			3
27 December			1
TOTALS	7	8	12

At $500.00 per week, $100 per day, and $12.50 per hour, that all comes to:

Value for time spent	$ 4,450.00
Less advance taken in June (medical)	3,000.00
Balance due	1,450.00
Artist allowance negotiated 17 Nov. '85	1,200.00
Cost for putting Island... on disks	400.00
TOTAL	$ 3,050.00

I would really appreciate it if you could send a check for $3,050.00 as soon as possible to Sarah H. Taylor, Treasurer, 6512 Sky Farm Drive, San Jose, CA 95120. Scott Miller is especially anxious to get his artist working, and we need the published work that will result.

If there are problems or questions please contact me c/o Ford, 1227 Washington St., Key West, FL 33040 before the first of February, or at 1140 Monroe St., Jackson, MS 39202 up to about mid-February. I'll surely call in the meantime to make sure you got this.

Hope the ciguatera has vanished, and that you'll have a great New Year!

Best,

JDL:CES