# Guana Island

## MARINE SCIENCE MONTH REPORT

July, 1997

prepared by:

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24 July, 1997

Dear Henry and Gloria,

The 1997 Marine Science Month Program (MSM)on Guana ran quite smoothly this year, despite problems with the SCUBA equipment at the start (see "accounting" section). Scientists completed their work in good time; there were no use-conflicts with boats; the managers were accommodating and friendly; and we were able to transport equipment easily. There were, as expected, some problems, but we were able to solve them early. As it happened, nearly all participants came for the last two-and-a-half weeks of June. Only Dave Carlon and his assistant continued work into July.

Ian Greenspan assisted for a week. He helped Dave Carlon in the sea table, though he also got "wet" frequently, while assisting various scientist underwater. As he gets older, Ian is becoming independent and offers valuable help on some projects. It was suggested that we seek mature SCUBA-certified BVI students in future years to assist in research. I would like to approach this next year. Both Alex and Dave are willing to accommodate a local assistant, given that he or she is capable. To attract a competent student, however, we would have to offer the student a stipend for the duration of the program.

The following pages represent a compilation of reports from participants this year. You may find the report section thin because we ran an extremely paired down program last year (I was away last summer). As you will remember, only Graham Forrester and Christina Leahy came (during October). Thus, for the other scientists, only their 1997 proposals are included here. Also find the report from the Science Education Workshop we held on Guana in early June and the report on the Marine Science Mentorship Program and the report n. Guana's scientists really strove to give these students an intensive scientific experience. I was so pleased with their with the MSM participants enthusiasm and willingness to compromise their own research schedules for the educational program.

Alexander Kerr, a graduate student in molecular systematics at Yale, was new to MSM. He collected a series of shallow-water holothuroidians (sea cucumbers) for DNA systematics, and he hopes to publish a paper describing the holothuroidian fauna of Guana Island.

Dave Carlon has a new paper in review that represents three years of work on Guana. A study that I have been working on with David Garbary at St. Francis Xavier University, Canada, is nearly ready for submission. And Graham

Forrester promises to complete a couple papers with his Guana data this year. (See the "publications pending" section)

Graham Forrester continued his long-term monitoring of Guana's reefs and is starting to see patterns of change. He now has good before-and-after data on Guana's reefs affected by hurricanes Luis, Marilyn, and Bertha. He also continued is study of population dynamics in bridled gobies.

As we discussed on Guana, Graham has agreed to take over scientific review of proposals for marine research on Guana. His long-term participation in MSM and present position as faculty at UCLA put him in a more effective position to ensure scientific quality than me. As per our discussion on Guana, GIWS will pay his air fare to Guana in future years (this will be a first for MSM). I, of course, will continue to read proposals, coordinate, work out logistical and equipment issues, and organise educational programs.

During MSM '97, I spent most of my time doing the usual running around to keep everything going well. In fact, between the compressor and boat engines, I started to feel like a mechanic…good thing I had just finished the College's outboard engine mechanics course! Additionally, I directed and partially taught the Marine Science Mentorship Program, helped Christina follow up on the bird box project initiated with Conservation and Fisheries last year, and started working on creating a digital photographic database cataloging rare and interesting wildlife in the BVI.

As you know, I will be going to England in late September to begin PhD studies. Unfortunately, this precludes me from working with the Science Month group in October. I will plan the annual symposium, however, and then, with everything already scheduled, leave the implementation to Clive Petrovic, who has offered to take over this responsibility.

I thank you on behalf of the scientists, assistants, and all who benefit from their presence, for supporting this program and for your continued interest in the promotion of scientific research.

Love,

Liana

## Accounting

| | |
|---|---|
| Film, processing, and digitizing (for digital database) | $384 |
| Stipend (3 weeks full-time, plus 2 weeks half-time, plus 30 hours preparation @ $16/hr) | $3,040 |
| Phone, fax, and mailing costs | $68 |
| Please send me a check for the above, totaling | **$3,492** |

The following expenses were paid for by GIWS through Guana's Hotel Office (therefore I don't have the figures)

Visual inspection of steel tanks

(this was necessary only because the tanks had all been completely emptied and valves left open, allowing moist air to enter and promote corrosion.)

Rental of six tanks for two weeks

(this was necessary because the compressor, which had been sent away for repairs, was put together in an nefarious manner--without appropriate filters, incorrect oil, overfilled oil reservoirs, and missing parts. It took weeks to get the proper filters, oil, and parts for the compressor running properly. After that, though, it ran better than it has in a couple years!)

Compressor parts ordered from Drummer Inc.

Compressor Oil ordered from AirTech, St. John

Regulator parts from local dive shops

Marine Science Tools

(these had to be replaced because the dive locker, which had previously been locked, was broken into and all the tools were gone. Tools were replaced are now stored under double lock with the compressor in the tool shop near the generator house.)

## Recommended Work to be completed before next MSM

- re-surface and seal the sea table (it is cracked and leaks)
- replace O-ring in first air filter on compressor
- replace stud that holds third air filter cover on compressor
- replace missing bolts holding compressor to frame
- hydrostatically test nine aluminum SCUBA tanks
- service three regulators
- restock spare parts kit, and include tank burst disks
- equip whaler with anchor (rather than cinderblock)

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## Publications pending

Carlon, D. in review. Vertical structure in Caribbean reef corals: recruit, juvenile, and adult patterns. Marine Biology.

Burton-MacLeod S.M., L. Jarecki and D.J. Garbary. in preparation for submission to Nova Hedwigia. Biodiversity and ecology of algal mats from hypersaline ponds in the British Virgin Islands (Caribbean Sea).

«Title» «FirstName» «LastName»
«Company»
«Address1»,
«City», «State»

4 June, 1997

Dear «Title» «LastName»,

On May 31st, the HLS Community College's Natural Sciences Department held a workshop to discuss science education in the BVI. Fourth-form, fifth-form, and College science teachers, as well as key individuals working towards science education in the BVI community were invited to this meeting, which was hosted by Guana Island.

The set goals of the workshop were:

1) to improve communication between the BVI High School, HLS Community College, and other BVI organisations involved in upper-level science education.
2) to identify means for stimulating interest and commitment to science beyond high school and to encourage enrollment in the HLSCC science programs.

In attendance were:

| HLSC College | BVI High School | Dept. Education | National Parks |
|---|---|---|---|
| Kenneth Challenger (Technical & Vocation.) | Dawn Lutchman | Beverlie Brathwaite | Cleveland Sam |
| Lianna Jarecki (Natural Sciences) | Wayne Parris | | |
| Pat Johnson (Education) | Chandra Ramroop | | |
| Clive Petrovic (Marine Studies) | Ann Russell | | |
| Asha Ramnarine (Natural Sciences) | | | |
| Arlene Szabo (Virgin Gorda Centre) | | | |

Participants in this productive meeting discussed numerous ideas and set objectives to meet the said goals. New cooperative projects, including the development of informative materials on careers in science, specifically in the BVI, and formation of a National Scientific Advisory Committee were proposed. Overall, the meeting stirred enthusiasm for cooperation in promoting science education in the BVI.

Enclosed is a summary of discussions and recommendations ensuing from the meeting, which will direct us towards further, cooperative development of science education in the BVI. I warmly thank all participants for their enthusiasm and input.

Sincerely yours,

Lianna Jarecki
Head, Natural Science Department
H. Lavity Stoutt Community College

# Science Education Workshop
# HLSCC/BVIHS/Education Dept./NPT
# Guana Island, 31 May, 1997

## Notes on Proceedings

After introductory comments from Lianna Jarecki, Chandra Ramroop, Beverlie Brathwaite, Cleveland Sam, and Kenneth Challenger, the participants divided to form three round-table discussion groups with the following foci:

Group 1: In which areas the different organisations can most effectively cooperate and assist one another.

Group 2: Student advisement in high schools and the availability of career information to students.

Group 3: Organisation of a "Science is Fun Day" for fourth and fifth-form science students at the College.

After deliberation, each group presented their recommendations to all assembled. The following is a summary these presentations.

**Group 1:** In which areas the different organisations can most effectively cooperate and assist one another.

1. Existing cooperative efforts to promote science education in the BVI were identified:
    a) National Science Fair: popularizing science through activities; organised by the Department of Education
    b) Christmas Bird Count; organised by Rowan Roy
    c) Migratory bird exchange program for primary schools; organised by National Parks Trust
    d) Environmental camp on Anegada; organised by National Parks Trust and the Anegada Beautification Committee
    e) Coastal cleanup; organised by the Conservation and Fisheries Department
    f) Summer program for primary school students; organised by National Parks Trust and Conservation & Fisheries.
    **Recommendation: this program should be run for primary school teachers as well.**
    g) Tilapia aquaculture project; organised by the College and the Agricultural Department
    h) Native plants on campus; organised by the College and the Agricultural Department
    i) Primary school science lessons include slide presentations on mangroves, sea grass, turtles, and beaches that were prepared by the Conservation and Fisheries Department
    j) The College is in negotiation with Island Resources in St. Thomas to acquire their extensive library collections of Caribbean environmental documents.

k) HLSCC Public Lecture Series

l) HLSCC Nature Club

**Recommendation: an independent branch of the nature club or a science club should be started at the BVI High School. The HLSCC Nature Club students may be interested in assisting its organisation.**

m) HLSCC/Guana Island Science Symposium each October at the College

n) Scientific research mentoring program for fourth-formers; organised by National Parks Trust, HLSCC, Guana Island, and BVIHS

o) National Parks is sending two High School science teachers to a workshop in Bermuda

p) Summer training workshops in environmental management; offered on request by HLSCC

2. Resources for information sharing were identified:

   a) Libraries containing scientific documents at Conservation & Fisheries, National Parks Trust, HLSC College, BVI High School, and the Public Library

   b) A Resource Center is planned for the Education Department; organiser is Mrs. Valentine Lewis at Town and Country Planning.

3. **Recommendations for developing further formal cooperation were made:**

   a) Organise a Science Career Fair to which all government departments and businesses in the BVI would be invited to promote awareness of present and potential jobs in science in the BVI. This could be part of the "Science is Fun" program.

   b) Form a National Science Advisory Committee hosted by HLSCC

**Group 2:** Student advisement in high schools and the availability of career information to students.

1. All science teachers in the BVI should have HLSCC catalogues.
2. Students need to be aware of career options, jobs available, and what level of education is necessary for those jobs.
3. Published documents on science careers should be assembled. They are available in guidance counselor offices, but most students don't go look for them.
4. A publication should be prepared specifically for BVI students describing careers in science and educational opportunities.
5. A presentation targeting third-formers and their parents on careers and education in science should be organised. This could be part of the "Science is Fun" program.
6. Representatives from the HLSCC Natural Science Department should meet with all science teachers at each high school to discuss HLSCC's programs and entry requirements and to distribute catalogues.

7. A summer job/apprenticeship program should be organised, and it should not be limited to those students whom have already chosen science as their study area.

**Group 3:** Organisation of a "Science is Fun Day" for fourth and fifth-form science students at the College.

1. Objectives:
    a) Attract more students into science
    b) Attract more students to enroll in HLSCC science programs
2. Actions:
    a) Organise a Science is Fun Day for third-formers in Trinity Term (April).
    b) Organise a second Science is Fun Day for fifth-formers in Advent Term (September).
    c) Include all BVI students
    d) Organise a meeting of the following to plan these events
        - third form year head
        - fifth form year head
        - guidance counselor
        - Dept. Education
        - Teachers of Biology, Chemistry and Physics from Anegada, Virgin Gorda, and Tortola high schools and from the College
3. See also point 3a by Group 1 and point 5 by Group 2

# Marine Science Mentorship Program Report

*a program for fourth-form high-school students, organised by the Guana Island Wildlife Sanctuary, the National Parks Trust, the BVI High School, and the H.L.S. Community College*

**9 July, 1997**

by Lianna Jarecki
Head, Natural Sciences Department
H. Lavity Stoutt Community College

Program Dates: June 27th - 29th

Venue:

All activities were conducted on Guana Island during the annual Marine Science Month program. Students were ferried between Guana and Tortola each day and were served lunch by the Guana Island Hotel.

Description:

Eight fourth-form students from the BVI High School were selected by the National Parks Trust and BVI High School Science instructors to spend three days on Guana Island working with scientists participating in Guana Island's Marine Science Month. Students were selected based on an interest in science, academic excellence, and ability to swim (as most studies required underwater sampling). On the first day, these students were given an orientation session, in which they became familiar with BVI ecology, rare animal conservation programs, common forest plants, and common marine animals. In the latter part of the orientation day, students worked on snorkeling skills and explored the marine environment. A group discussion of the importance of field biology in the BVI, particularly in relation to nature conservation and tourism development, helped students fit specific research projects into a larger and more relevant perspective.

On the second and third days, students were assigned, in pairs, to specific studies. Under the supervision of principle scientific investigators, students learned to identify their research organisms, select appropriate study sites, set up replicate samples, collect and record data, and statistically analyse results to determine the outcome of their studies. Research projects included a study of reef fish population dynamics, larval recruitment in corals, taxonomy of echinoderms, and bird behavior.

Students were required to keep notebooks and to write constructive comments on the program. Copies of these notebooks are on file in the Natural Sciences Department, HLSCC.
This program was developed as part of the International Year of the Reef Initiative and may be continued annually.

Organisers:

**Lianna Jarecki**: Guana Island Wildlife Sanctuary: Marine Science Month Director, and
H. Lavity Stoutt Community College, Head of Natural Sciences Department
**Joseph Smith**: National Parks Trust: Deputy Director
**Laverne Chalwell-Brewley**: BVI High School: Head of Science Department
**Charmian Dawn Lutchman**: BVI High School: Integrated Science Instructor

Research Scientists:

**Graham Forrester**, Ph.D.: Fish ecology, University of California, Los Angeles (UCLA).

**Dave Carlon**, Ph.D.: Coral spawning and recruitment, University of California, Davis.

**Alex Kerr**, Ph.D. candidate: Echinoderm taxonomy, Yale University, Connecticut.

**Christina Leahy**, M.Sc.: Hawk behavior, Bristol, Squibb and Meyers, Connecticut.

**Elizabeth Kintzing**: Diving safety officer, University of New Hampshire

Student participants:

Hemant Doodnauth
Richard Georges
Lorraine Larose
Paul Maduro
Chrisneal Abby O'Neal
Karen Sookram
Kimberly Sookram
Janne-Marie Williams

Some comments from the students:

"I learned a great deal about marine biology and this program has actually inspired me more into studying biology... This Guana Island Program should be a regular event because it is extremely fun and educational." **Hemant Doodnauth**

"On a whole, everything that we were exposed to was both new and exciting...The opportunity to experience this is indeed beneficial for whoever is fortunate enough to have come." **Richard Georges**

"I did not know much about the marine and wildlife that surrounded me and I am pretty sure that there are many other people who, by having this experience, might have a very genuine interest in biology.
This programme is 100% beneficial...This programme should not only be available on Guana Is. but if possible on other islands too because there might be other rare, thought to be extinct, or new species to discover. I really enjoyed myself these three days and it would be nice to have others to share in fun and knowledge. I did things that I have never done before like go hiking and snorkel." **Loraine Larose**

"This program has really made me consider going into the scientific (marine) field after school." **Chrisneal O'Neal**

"This trip was very interesting and will help me decide which field of science I want to go into. I hope I would come back again and have the privilege of working with the scientists. These three days were very much worth getting up early for." **Kimberly Sookram**

"This has been the MOST educational, enjoyable, wonderful and interesting time I have ever had in my life." **Karen Sookram**

"I have found this programme to be very interesting and fun. It has taught me a lot of facts and given me new ideas on organisms I have never even been aware of in my environment... It has been a great privilege to be included in this program." **Janne-Marie Williams**

# Fax

| | | | |
|---|---|---|---|
| **To:** | Lianna Jarecki | **From:** | Graham Forrester |
| **Fax:** | (809) 494-4996 | **Pages:** | 3 |
| **Phone:** | 494-4994 | **Date:** | May 6, 1997 |
| **Re:** | Guana | **CC:** | |

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply** ☐ **Please Recycle**

• **Comments:**

Hi Lianna

Did you not get the Fax I sent a couple of weeks ago?? Anyway, here is a second one. Along with this note is a short proposal/report for this year. It's short because I'm working in several papers using the Guana data that I expect to finish during the summer. Linda and Katherine and I are planning to come to Guana from (roughly) June 16 -June 30. I had hoped to come for longer, but the two constraints are (1) I have to teach at UCLA until June 15, and Linda can't stay more than 2 weeks. We have not bought tickets yet (or got Katherine a passport) but as soon as we do I'll let you know.

I did have a really good candidate for someone who could work on Guana but he has another commitment in June this year. He would be great in the future though (I'll tell you more about him later).

I hope all is well. I'll try to call and chat soon.

Take care, Graham

# GUANA ISLAND MARINE SCIENCE MONTH

## PROPOSAL FOR 1997 AND REPORT FOR 1996

### Population regulation in coral reef fishes: a long term study

Introduction and methods

This part of the project is a continuation of the monitoring study initiated in 1992. Its aim is to provide a long term analysis of patterns in the abundance of reef fishes and how they relate to characteristics of the reef habitat. The proposal for June 1997 is to continue censuses initiated during 1992. The censuses during 1997 would be done at the sites established in 1992 using the same methodology as in previous years (see previous proposals).

Some results of monitoring from 1992-6

Monitoring during 1992-95 identified some steady, but fairly minor changes in the reef community. For example, the % cover of live coral and feather soft corals increased slightly each year over this period. Other members of the community, such as branching soft corals and fish (overall), have remained relatively constant. The occurrence of two major storms in the vicinity of Guana just after the 1995 census (Luis and Marilyn) will allow me to evaluate the impact of such major disturbances on the reef community. The results of the October 1996 surveys indicate relatively little impact of the storms on most species. This is somewhat surprising given the often devastating impacts of storms reported on other coral reef systems. Continued monitoring in 1997 and future years will allow further documentation of the community response to the storms, and should provide an interesting comparison to community patterns observed in other areas. Some more specific relationships between the abundance of certain fish species and features of the reef habitat are now being prepared for publication.

### Detailed population studies of selected species

I initiated more detailed studies of the population dynamics of bridled gobies (*Coryphopterus glaucofraenum*) around Guana in 1994. This species were chosen as common, representative, members of the fish community occupying the reefs around Guana Island. The goal is to test hypotheses about the factors controlling population density of these species.

As a prerequisite to studying population processes I needed to be able to recognize individual fishes in their natural habitat, and follow their fates over time. In the past 3 years I have tested several methods of identifying fishes, based on injecting small spots of coloured ink or numbered fragments of plastic under the fishes skin. The results from Guana have been combined with similar tests on other species of fish in temperate habitats and are being prepared for publication.

From 1994-6 I conducted a series of experiments examining the response of goby populations to variation in their abundance. Specifically I assessed how rates of rates of loss (through mortality) and replenishment (by the arrival of larvae) varied at different levels of abundance. I also tested one specific hypothesis for variation in mortality rates with abundance: that loss to predation was greater in dense populations of gobies. The results of the experiments on the survival of adult and juvenile fishes are either published, or being prepared for publication. The results on rates of replenishment of goby populations are still inconclusive because settlement of larvae is highly variable. In 1997 I propose to replicate experiments conducted in 1995 and 1996 in order to increase sample sizes and reach a reliable conclusion about how larval settlement rates vary with population size. To test this hypothesis I will establish an array of replicate experimental reefs, each stocked with a different number of adult gobies (using methods developed in previous years). I will then determine the number of larval gobies that take up residence on each reef during the study period. The settlement rates for 1997. Will be combined with those from 1995 and 1996 for future publication.

## NEST BOX PROJECT

Twenty-two kestrel nest boxes were built on Tortola on October 5, 1996, following the directions outlined by Paul M. Roberts in *Kestrel Karetakers American Kestrel Nesting Box Program*, with the help of members from the Nature Group from the H. Lavity Stoutt Community College and a local high school shop class, under the supervision of Halstead Lima and Orville Phillips from the Conservation and Fisheries Department and Lianna Jarecki from the HLS Community College.

The nest box target species is the American kestrel, Caribbean subspecies *Falco sparverius caribaearum*. Another species that could potentially utilize these nest boxes is the screech owl species (Puerto Rican subspecies *Otus nudipes newtonii*) suspected to be in residence in the British Virgin Islands (BVI). It is possible that other avian species will occupy the nest boxes, the boxes potentially providing the opportunity for other cavity nesters. Any species utilizing the nest boxes will be monitored with the exception of the Pearly-eyed thrasher *Margarops fuscatus*, which is considered a nuisance species. The decision to halt nest building activity of Pearly-eyed thrashers was made due to the large population of this species in the BVI.

The nest boxes were placed in various habitat on Tortola, Guana Island, Beef Island, Virgin Gorda, and Anegada. All individuals involved in the project as well as nest box monitors were versed in field research techniques and data collection for this nest box study. Halstead Lima was the manager of the project aided by students from the HLS Community College and conservation officers from both the Conservation and Fisheries Department and the National Parks and Trust. A nest box study data base to be maintained by the students involved in this project was set up at the college for entering and storing in computer files the nest box field data collected by the monitors, thus providing easy access for data analysis.

This science month, the field notes for all nest boxes monitored will be collected and the nest box data base will be updated with the approximate nine months of potential data collected by the monitors. Missing information will also be collected and entered into the data base. All nest boxes will be visited and evaluated for further information. The nest box information for nest boxes Number 15 to Number 22 will also be collected and added to the data base. A few interested individuals in the community were scheduled to pick up a box, secure the box and monitor the nest site for any avian activity, collecting the appropriate data. The initial nest box data follows below.

The data collected by the monitors includes reproductive measures (clutch number, date of occupancy, date of nest building, egg laying dates, clutch size, hatching dates, fledging dates, number of fledglings, nest success, and sex ratio of young) of the avian species utilizing the nest boxes throughout this past year. Other pertinent avian data includes behaviors noted at the nest box site, nest materials utilized, food items brought to the nest site, and estimated breeding range. The date, time and weather conditions at the time of the observations are also recorded. Nest box data will continue to be collected yearly by the designated monitors especially with occupied nest boxes. The condition of the nest boxes as they become weathered will also be monitored for longevity data on the construction and wood type used on the boxes. I will continue to assist this project whenever and however I can, and aid in the data analysis when I return for the annual Guana Island Science Month.

After a few years of continued nest box data collection, a publishable paper in an ornithology journal is possible. All nest box monitors would be sited and acknowledged in the publications and Halstead Lima would also be considered a principle investigator. I hope to utilize the nest box study to further my investigation of the life history of the Caribbean kestrel by providing necessary reproductive data and population statistics. The use of nest boxes also improves the ability to easily capture kestrels utilizing the nest boxes for banding purposes possibly at a later date.

Future banding of birds utilizing the nest boxes can be discussed with the Conservation and Fisheries Department. A bird banding training course could be taught in the near future by inviting experts to train conservation officers in this valuable method of avian research and monitoring for population status. Banding birds in the BVI will increase the ability of the researcher to achieve a more varied and complete picture of the life histories of avian species living in the islands. The important type of data gathered by banding provides accurate population estimates and critical information on habitat that might identify threatened avian species and allow for the protection of discovered species in jeopardy.

Christina Leahy
Behavioral Biologist, MALS

Christina L. Leahy

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May 11, 1997

Lianna Jarecki
H. Lavity Stoutt Community College
P. O. Box 3097
Road Town, Tortola
British Virgin Islands

Dear Lianna,

We seem to have a hard time getting in touch! I've just returned from two months in the San Blas Islands of Panama, so it has taken me a while to get organized for Guana. At any rate this letter contains my proposal for Marine Science Month 1997. The proposed schedule for this work is for me and my assistant to arrive for the last week of June and then work until mid-July. Please let me know if this will work out on Guana.

This year I would like to look at coral larval behavior in response to potential sponge competitors. My work with coral recruitment on Guana has indicated the coral recruitment declines with depth and corals tend to recruit on cryptic surfaces. Interestingly, the abundance of cryptic organisms such as sponges, bryozoans, and colonial ascidians increases with depth. These important space competitors are likely to have influenced the behavior and ecology of coral larvae. I will experimentally investigate whether sponges influence: 1) probability of metamorphosis, and 2) spatial position of corals on settlement surfaces. I will use larvae from two corals: the yellow sulfur coral *Porties astreoides* and the sunray coral *Leptoseris culcullata*. These two species have very different juvenile morphologies. *Porites* has a plating morphology which ensures interactions with other encrusting organisms. *Leptoseris* juveniles grow up and way from the substrata forming a spiral shaped canopy. This growth morphology may be an adaptive strategy to escape interactions with encrusting organisms near the attachment surface. The use of these two species is likely to provide interesting comparative results.

| Post-it® Fax Note 7671 | Date 5.11.97 | # of pages ▶ 2 |
|---|---|---|
| To LIANNA JARECKI | From D. CARLON | |
| Co./Dept. H.L.S. | Co. U.C. DAVIS | |
| Phone # (809) 494-4994 | Phone # (916) 752-2937 | |
| Fax # (809) 494-4996 | Fax # (916) 752-1449 | |

I will culture adults and larvae in the seawater table, and conduct larval experiments in the field with small plastic chambers. The project will involve lots of diving, mostly at the Iguana Head site. I will be bringing an assistant with me to help with the field work and diving, and can give you more details when the dates are firmed up. I look forward to seeing you again and working on Guana this Year!

Best,

Dave Carlon

Dr. David B. Carlon
Postdoctoral Fellow

**Evolutionary Ecology and Systematics of Holothuriid Sea Cucumbers**

Alexander Kerr

**Project description:** I wish to visit Guana Island to (1) compile an inventory of echinoderms from this, to my knowledge, previously unsampled island, (2) obtain specimens of to use in the first phylogenetic analysis of tropical holothuroids (sea cucumbers) and (3) observe previously unrecorded predator-avoidance/defence behaviours of holothuriid sea cucumbers. Below, I discuss each of these objectives and outline how Guana Island and its location are inimical to the completion of the proposed project.

*Species distributions.* Most distribution records of Caribbean echinoderms are from coastal continental sites and the large islands of the Greater Antilles. Yet, less is known about the faunas of smaller islands, including those of the British Virgin Islands. It is reasonable to expect that many of the widespread species are also found on the poorly sampled islands of the central Caribbean. However, the distributional limits of many less commonly encountered taxa are not clear and warrant further sampling. I propose to survey the echinoderms of Guana Island to clarify the local fauna's affinities to that found on the nearby and better sampled island of Puerto Rico, as well as to the rest of the Caribbean province. This field season, I would concentrate on the holothuroids and attempt to provide an exhaustive listing of at least this group.

*Phylogenetic relationships.* The systematic relationships within Holothuroidea are poorly known. Much of this uncertainty stems from the group's lack of an integrated skeleton, a feature that provides the numerous phylogenetically informative characters and the extensive fossil records of other echinoderms. Soft tissue features could provide a wealth of characters for phylogenetic analyses, but have been systematically studied in only a few species. Because of the uncertainty of the evolutionary affinities within Holothuroidea as based on these traditional cues, an independent estimate of their relationships is warranted. Using nucleotide sequence data, I propose to examine relationships in the most speciose family of holothuroids, the tropical Holothuriidae. Because of its central location in the Caribbean, the British Virgin Islands likely possesses a diverse array of species from this family and the relatively undisturbed Guana Island would be an ideal site at which to collect specimens for the proposed analysis.

Tentatively, one or two species from each genus or subgenus in Holothuriidae will be used. Variation in at least two genes is currently being assessed: A. Arndt (pers. comm.) of Simon Fraser University successfully used partial sequences of *cytochrome oxidase I* gene and 16s rDNA to resolve relationships within and between closely allied holothuroid families in Dendrochirotida, and these genes' utility in the proposed study will be checked. Genomic DNA will be extracted according to methods used for holothuroids (A. Arndt, pers. comm.), then amplified via the polymerase chain reaction and directly sequenced. Alignment will be performed on the software *Clustal W* and phylogenetic reconstruction on *PAUP*.

*Evolutionary ecology of habitat selection and predator avoidance.* The phylogeny of Holothuriidae will provide a rooted topology from which to examine the evolution of this group's ecology. I will initially focus on habitat selection and predator avoidance behaviours. Members of Holothuriidae either burrow in the sediment, are cryptic (i.e., living entirely within crevices), are semicryptic (i.e., living with only their anterior ends exposed), are cryptic during the day and semicryptic or epibenthic nocturnally; or are semicryptic to epibenthic day and night. Most of the potential immediate outgroups to Holothuriidae or Holothuriidae+remaining Aspidochirotida suggest that the primitive condition among the holothuriids is an exposed lifestyle. Conversely,

with the taxonomically enigmatic *Labidodemas* as an immediate outgroup, holothuriids may be primitively cryptic. Regardless of Holothuriidae's affinities, the diversity of lifestyles within this family probably indicates convergence of at least some habitat choice and patterns of diurnal activity.

Choice of habitat and diurnal activity among holothuriids may be adaptations to predation. Predation by diurnally active fishes is believed to have led to the primarily nocturnal activity of marine invertebrates. The class Holothuroidea possesses numerous other presumed predator defenses, including body swelling to avoid gape-limited predation, peristaltic bounding, swimming, autotomy, luminescence, dermal toxins, a plated calcareous test and Cuvierian organs, the sticky collagen tubules ejected through the cloacal wall and anus when the animal is disturbed. Extensible Cuvierian organs, which often occur within Holothuriidae, have little deterrent effect on fishes and appear to be an adaptation against nocturnal predators: crabs become entangled in the sticky strands (A. Kerr, unpubl. obs.), while the holothuroids' principle predators, the gastropods *Tonna* spp., may pause to consume the material and possibly allow the holothuroid to escape.

Habitat selection and patterns of diurnal activity are among the most fundamental life history characteristics, determining to a large degree the ecological context of evolutionary change experienced by an organism. How these two parameters modify selection on other organismal features is therefore a subject of considerable interest and a continued need exists for insights from case studies. Using a modified form of Felsenstein's method of independent contrasts, I will use the aforementioned phylogeny to test the hypothesis that Cuvierian organs evolved to protect holothuriid sea cucumbers against nocturnal predators by determining when this trait has evolved relative to the evolution of two life history traits, crevice dwelling and nocturnal activity. Ancestral character states will be inferred by plotting the ecological characters onto the most likely topology or topologies with the aid of the software *MacClade*. To substantiate an adaptive scenario, extensible Cuvierian organs should have arisen only coincidentally or after a shift to a cryptic or nocturnal lifestyle. Specifically I ask: (1) Which lifestyle, defined as habitat and pattern of diurnal activity, is primitive in holothuriids? (2) Is the discharging of extensible Cuvierian organs an adaptation to a particular lifestyle(s)?

**Logistical considerations:** Information on habitat, activity patterns, predator defenses and body size for the latter portion of the project will be primarily obtained from field observations of holothuriids *in situ*. Much of the fieldwork can be accomplished in seagrass meadows and without the aid of SCUBA or a boat (provided the meadows are sufficiently close to the marine station). However, if possible, I would also like to spend at least a few days on the forereef, where a portion of the fauna is endemic. Ideally, much of this work, including that on the forereef, would take place at night when most holothuroids and their predators are active. However, the project will not be undermined by strictly diurnal surveys of the forereef nor by limiting the surveys to seagrass meadows, though a less comprehensive inventory would result. Holothuroids will also be observed in the running-seawater table. There, I will observe the response of the collected holothuroids to attack by *Tonna perdix*, the principle predator of Caribbean holothuroids. Since some species of echinoderms are identified primarily by microscopic skeletal characters, I will also use a compound and a dissecting microscope.

**Project dates:** I estimate that the project can be completed in about 10 days. I would like to visit Guana Island from 25 June to 5 July, though I am available for fieldwork anytime between 20 June and 10 July.

# Curriculum Vitae

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## Education

1994-
1997 Ph.D. program in biology, Yale University

1994 Master of Science in biology, University of Guam

1991 Bachelor of Arts magna cum laude in biology, University of Guam

## Awards

1995 Financial aid to attend short course, Marine Biological Laboratory, Woods Hole

1993 Short-term Visitor Appointment, National Museum of Natural History, Smithsonian Institution

1992 Lerner Gray Fund for Marine Research, American Museum of Natural History

1990 Malacological Grant, Guam Shell Club

1990 Best research paper, Micronesian Area Research Center, University of Guam

## Refereed Publications

Kerr, A. M. 1994. Shallow-water holothuroids (Echinodermata) of Kosrae, Eastern Caroline Islands. *Pacific Science* 48: 161-174.

Kerr, A. M. 1993. Unusually low frequency of stabilimenta in webs of *Argiope appensa* (Araneae: Araneidae) from the Mariana Islands: an indirect effect of an introduced avian predator? *Pacific Science* 47: 328-337.

## Refereed Publications (continued)

Kerr, A. M., R. M. Yoon and E. M. Stoffell. 1993. Abundance distribution of holothuroids (Echinodermata: Holothuroidea) on a windward and leeward fringing reef, Guam Mariana Islands. *Bulletin of Marine Science* 52: 780-791.

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## Technical and Environmental Survey Reports

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## Contracted Environmental Surveys Not Requiring Reports

1994 Transplanting scleractinian corals, Faifai, Guam. Experiments for Duenas and Associates, Agana, Guam.

## Contracted Environmental Surveys Not Requiring Reports (continued)

1993 Birds, herpetofauna and terrestrial invertebrates, Naval Deballast Facility, Guam. Survey for R. W. Beck and Associates, Boulder, Colorado.

1993 Insects (Coleoptera: Curculionidae) and arachnids (Araneae, Scorpiones) in the cloud forests of Kosrae, Federated States of Micronesia. Survey for Marine Laboratory, University of Guam.

1993 Insects (Coleoptera: Curculionidae) and arachnids (Araneae, Scorpiones) in the cloud forests of Pohnpei, Federated States of Micronesia. Survey for Marine Laboratory, University of Guam.

1993 Reef-building corals, macroalgae and conspicuous macroinvertebrates, particularly echinoderms, in Tarawa Atoll, Republic of Kiribati. Survey for Biosystems Analysis, Denver, Colorado.

1992 Freshwater fishes and invertebrates, Talofofo River drainage system, Guam. Survey for GMP and Associates, Agana, Guam.

1992 Birds, herpetofauna and terrestrial invertebrates, Ylig, Guam. Groom and Associates, Saipan, Commonwealth of the Northern Mariana Islands.

1992 Scleractinian corals, macroalgae and conspicuous macroinvertebrates, western barrier reef and Rock Islands, Republic of Palau. Survey for the Geological Survey of Japan.

1992 Birds, herpetofauna and terrestrial invertebrates, Naval Deballast Facility, Guam. Survey for R. W. Beck and Associates, Boulder, Colorado.

1991 Vascular plants, Sagua River, Guam. Survey for Pacific Basin Environmental Consultants, Agana, Guam.

1989 Vascular plants, Ngerukewid and Kmekumer Islands, Republic of Palau. Survey for the University of Guam Herbarium.

1987 Vascular plants, U.S. Naval Property, Guam. Survey for University of Guam Herbarium.