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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

PROGRAM IN SCIENCE AND TECHNOLOGY

A progress report for USAID/BELIZE project # 505-84-001 entitled:

Genetic and Demographic Assessment of *Strombus gigas* fisheries and Development of Potential for an Inshore Research and Study Facility

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BACKGROUND INFORMATION

The proposal entitled, "Genetic and Demographic Assessment of Strombus gigas Fisheries and Development of Potential for an In-shore Research and Study Facility in Belize" was submitted to the U.S. Agency for International Development, Program in Science and Technology, during August of 1983. Official approval of the proposal was made in October, 1984. During the interim period, Dr. William Steiner, Research Director, accepted a position with the United States Department of Agriculture. Due to his responsibilities in his new position, and potential conflicts of interests, Dr. Steiner was no longer at liberty to serve in his capacity as co-Principal investigator. Also, Mr. Tom Skelly, originally proposed as on-site manager, was no longer available to fill his position.

Mssrs. Jack Sobel and Gregg Marshall, graduate students at the State University of New York, Stonybrook now serve as on-site co-managers, sharing responsibilities during the summer months and alternating during the university class sessions. Mr. LeRoy Creswell, Harbor Branch Oceanographic Institution, Inc., and Dr. David Phillips, Illinois Natural History Survey, serve as project consultants. Mr. Creswell's primary responsibilities are design of the laboratory facility, procurement and shipment of equipment and supplies to Belize, and technical assistance to project staff. Dr. Phillips provides expertise in starch-gel electrophoresis techniques used to genetically characterize queen conch populations from Belize, a primary objective of the project proposal. Mr. Winston Miller, Belize Fisheries Administrator and Principal Investigator, provides adminstrative support and coordinates project needs with Belize Fisheries Unit personnel.

SITE SELECTION AND DESCRIPTION

In the original proposal submitted by the Illinois Museum of Natural History and the Belize Fisheries Unit (BFU), a small laboratory was made available on the property of the Caribena Fishing Cooperative. During a site-visit in January 1985, Dr. Steiner and L. Creswell concluded that the proposed site was inadequate for the project needs based on the following criteria:

1. The only access to seawater was on the lagoon side of the island in proximity to processing wastes from the Caribena Cooperative. Water quality would be too poor to support a hatchery facility, particularly in the summer when water temperatures increase.

2. The laboratory was too small for the proposed research. It was being used as a storage shed and dive locker for other marine research programs being conducted by the New York Zoological Society and IDRC in association with the BFU.

3. Access to high quality seawater was several hundred yards away. Putting in a seawater line would entail trenching through two streets and several residences. In addition, the size pump needed to carry water that distance would have been cost prohibative.

4. The building was adjacent to the power station for the Belize Electricity Board, with exhaust fumes and diesel fuel spills directly adjacent.

Alternative sites for the laboratory were investigated along the eastern shore of the town of San Pedro. Since most of the property was privately owned, potential locations with access to public utilities were very limited. An attractive site for the laboratory was on the property of the San Pedro High School, under construction and slated for opening in the fall of 1986. This property runs for several hundred feet along the coast on the north side of the San Pedro. With a prevailing southerly current, nearshore waters are probably less polluted than closer into town where boat traffic is heavy. Also, the location of the laboratory at the local high school had an exciting potential for including marine science courses in the teaching curriculum.

In January 1985 the proposal to build a marine laboratory on school property was presented to the San Pedro High School Board. The proposal was accepted enthusiastically, and the details of the property arrangements were negotiationed between the San Pedro School Board and the BFU.

In August 1985, a formal agreement was signed, and funds were released to begin construction of the laboratory. Greg Marshall and Jack Sobel arrived in the middle of June to begin their employment as site co-managers. Blueprints for the proposed laboratory were supplied by Mr. Creswell, and ground clearing and laying the foundation began. With the assistance of Mr. Bill Robinson, a Peace Corps volunteer assigned to the San Pedro High School, the main structure of the laboratory was completed. A fiberglass head tank (1000 gallon) was fabricated and installed on an eight foot high scaffolding adjacent to the hatchery. The scaffolding supporting the head-tank was enclosed and now serves as a pumphouse and storage area.

Due to administrative difficulties, the advance funds for purchasing materials and laboratory supplies were not forthcoming until February 1986.

Since suppliers had been identified and price quotes submitted during the interim, purchases and delivery of equipment and supplies were expedited. Materials were delivered to the Harbor Branch Oceanographic Institution where they were inspected for damage, inventoried and consolidated for shipment. In March 1986 all available supplies were transported to the Miami port and loaded into a 20' container for shipment by Hyde Shipping Co. to Belize City. Upon arrival in Belize City, the container was off-loaded and transported by boat to San Pedro.

HATCHERY DESIGN AND METHODS

The laboratory, a 20 x 30 foot concrete and cinderblock building with a sloped floor to facilitate drainage, was constructed by project staff with the aid of local craftsmen. A corrogated fiberglass roof allows for adequate light penetration for phytoplankton cultures yet provides sufficient shading to prevent extreme high temperatures. Seawater is pumped by a 3/4 hp electric pump through dual 500 foot, two inch PVC, intake lines to supply a 1000 gallon reservoir. Water level in the reservoir is monitored by two electrical float switches that automatically refill the reservoir as the water level drops.

After pre-filtration through a sand filter (30 micron nominal filtration), seawater is gravity fed to culture tanks within the hatchery building. Seawater destined for larviculture tanks is treated further with cartridge filtration (5 micron) and ultraviolet (UV) sterilization lamps. Untreated seawater supplies several aquaria and water tables used in the

laboratory. Aeration is provided (30" pressure) by a single 1/20 hp piston-type air blower. Back-up aerators, water pumps and sterilizing units are in the laboratory inventory.

A constant temperature/humidity room (8 x 10') serves as a phytoplankton and small culture room. Also, sensitive equipment, such as microscopes and balances are used and maintained in this area of the laboratory. An inventory of laboratory and equipment purchased or donated to the project are itemized in Appendix 1. For security precautions, expensive equipment is locked in the enclosed algae room, and two outdoor flood lights have been installed.

PHYTOPLANKTON CULTURE

Four species of unicellular algae are being cultured at the laboratory as food for juvenile conchs. They include:

Thallasiosira pseudonana

Isochrysis galbana (Tahitian strain)

Nannochloris oculata

Chaegtoceros gracilis

Stock cultures are maintained in ten ml glass test tubes, 250 ml Ehrelenmyer flasks and 2000 ml Fernbach flasks. Filtered seawater is autoclaved, and a sterile enrichment (Guillard and Ryther, f/2) is added prior to inoculation of algae cells.

Unialgal cultures are provided constant illumation and temperature in an enclosed room until the culture is transferred to a larger container. Twenty liter carboys are sterilized using a chlorination-dechlorination

procedure prior to enrichment and inoculation. Carboy cultures are maintained in the hatchery section of the laboratory, and they are fed directly to the larvae in the culture tanks.

EGGMASS COLLECTION AND BROOD STOCK PENS

Two methods have been undertaken to provide a reliable supply of eggmasses to support hatchery operations. Both have met with limited success. Due to overfishing, natural aggregations of adult queen conchs are rare, and they are usually found at depths only accessable by SCUBA divers. Also, the most promising sites are several miles from the town of San Pedro so that rough sea conditions preclude collection during several weeks of the spawning season (April - September or October). Although some eggmass have been collected from the Rocky Point area, at depths exceeding 60 feet, other deep water sites have not been identified. Collection from the Rocky Point area is both costly and time consuming.

Collection of eggmasses from areas distant from San Pedro, as discussed in the proposal, is a difficult task. Since large aggregations of adult conchs are difficult to find, and usually in deep water, searching areas not readily accessible may take several days. Transport of eggmasses back to the laboratory in a timely manner is also a problem. Other alternatives for collecting eggmasses are being investigated. The opening of the conch fishing season will provide several fishermen willing to retrieve eggmasses and properly transport them. Also, adults from waters further south will be placed in an enclosure adjacent to the lab so that eggmasses from that population can be collected.

An alternative method for providing eggmasses which has been successful in other areas of the Caribbean is the use of an "egg farm" or "brood stock enclosure". Several hundred adult conchs are placed in a screened enclosure large enough to provide sufficient grazing area for the population for the duration of the spawning season. The enclosure is checked daily for eggmass production.

Three brood stock enclosures were constructed and stocked during the 1986 spawning season. Two deep water sites stocked during the early part of the spawning season were quickly poached, and due to our inability to secure the area these pens were abandoned. This is unfortunate since deep water enclosures are less likely to be influenced by seasonal or meteorogical changes than enclosures in shallow water.

The third enclosure, located near-shore immmediately adjacent to the hatchery, has proven more successful. Constructed of vinyl coated wire mesh, this pen measures approximately 3000 square meters and houses approximately 100 adult conchs. During the peak of the spawning season (July and August), eggmasses were found consistently in this pen. However, from mid-August through September no eggmasses have been observed. Although overgrazing is difficult to detect, since conchs feed primarily on epiphytes rather than seagrasses, food depletion may be a contributing factor in the arrest of breeding activity. Also, it is believed that conchs will cease to spawn during tropical depressions, rough sea state and declining temperatures during the fall. Conchs held in shallow water enclosures are more likely to detect these changes than those held in deep water enclosures.

Project goals for the next spawning season include:

1. Identifying other natural populations in deep water areas close to San Pedro.
2. Arranging eggmass collections from fishermen in other areas.
3. Expansion of the existing brood stock enclosure.

COLLECTION, TRANSPORT AND DISINFECTION OF EGGMASSES

Eggmasses are collected using SCUBA gear or snorkeling from beneath females during the act of egg laying. Eggmasses are placed in plastic zip-lock bags with seawater and put in a cooler on board the boat to avoid elevated temperatures. Immediately after transport to the laboratory, the eggs are disinfected with sodium hypochlorite by mixing a 0.4 % solution of "Clorox" bleach. The eggmass is immersed in the solution for 45 seconds, while gently separating the strands of the eggmass and removing the sand particles. After chlorine treatment, the eggmass is rinsed in three separate containers of filtered, UV sterilized seawater.

The eggmasses are placed in a screen cage which is suspended in a larviculture tank supplied with filtered, UV sterilized seawater at a flow rate of two to three liters/minute. The eggmasses are moved to a fresh tank every other day to avoid contamination of Vibrio sp., a surface coating bacteria highly toxic to conch larvae. Larval development is monitored through daily microscopic observations of an excised portion of the eggmass. The veligers begin to exhibit a spinning motion and increased ciliary activity of the velar lobes within one day prior to hatching. Egg development is temperature dependent; hatching occurs 105 to 120 hours after fertilization.

LARVICULTURE AND FEEDING

The culture tanks at the USAID/BFU research station have a working volume of 450 liters. Disinfected eggmasses are separated into three sections and placed in each tank, thereby reducing the density to 100 - 300 larvae/liter, depending on the size of the eggmass. Filtered, UV sterilized seawater is supplied to each tank at a rate of 2 - 3 liters/minute, exchanging the tank at least four times per day. Flow-through circulation begins after the eggs are placed in the tank and continues throughout the larviculture period. Exchanges of culture tanks commence on the second day post-hatch and continue on alternate days. Four days after hatch the larval density is decreased to 50 larvae/liter. A three inch diameter PVC airlift is suspended vertically in the tank about five cm from the tank bottom to provide aeration and to resuspend larvae on the bottom of the tank.

Feeding commences two days post-hatch. Mixed phytoplankton from 20 liter cultures are provided at a rate of 1,000 cells/ml for days 2 - 5, 5,000 cell/ml for days 6 - 9, and 10,000 cells/ml for the rest of the larval cycle (day 21). Tanks are left static for 2 - 3 hours after each exchange to allow the phytoplankton to remain in the culture tank at the appropriate cell density without dilution. The flow-through circulation is then initiated for the rest of the day. After several hours of flow-through, additional algae is added to the culture tanks by gravity feeding from a carboy overhead. The flow rate of the drip feeder is adjusted for the flow rate into the larviculture tank and the cell density of the phytoplankton.

Larvae are induced to undergo metamorphosis 21 to 30 days post-hatch by immersion in a solution of seawater and an extract from the red alga, *Laurencia poeitii*, collected from waters adjacent to the laboratory.

Competency of the larvae is determined by their siphonal length, duration in the larviculture system and morphological indicators. Although extracts from several species of red algae (Rhodophyta) have successfully induced metamorphosis in queen conch, species of Laurencia indigenous to Belize are being evaluated.

After metamorphosis, the juvenile conch are placed in screen bags in 60 liter aquaria. The bags are soaked in phytoplankton cultures so that algal cells adhere to the screens. Juvenile conch browse the phytoplankton from the bag, which is changed when all of the food has been consumed. Also, macrophytic algae and algal turfs collected on screens floating at sea are harvested, blended or seived through 80 micron mesh and provided to the bag as food. This method holds promise for feeding large numbers of juvenile conchs held on-shore in nursery facilities. Providing sufficient food for large numbers of newly set conchs has been a major constraint to large-scale production of this species.

FIELD GROW-OUT EXPERIMENTS

Four enclosures for grow-out of juvenile queen conchs have been constructed in the lagoon adjacent to the hatchery. The enclosures are made of 2.5 cm mesh galvanized wire standing 18 cm above the substrate. The wire is secured to the bottom with one cm diameter metal reinforcement bar wands. Each enclosure is 18 meters in circumference, enclosing an area of 27 square meters. The four sites were chosen to represent those habitats presently considered most appropriate for seeding young juvenile conchs. The four sites are labelled as follows:

1. Reef crest

This site is characterized by turbulent hydrographic conditions and a predominantly coral rubble subrate around sand pockets. Epilithic algal turf species constitute the dominant flora. Syringodium filiforme and Thalassia testudinum are also present, but only incidentally. Water depth averages one meter. The behavioral and physiological response of conch seeded in this enclosure will help define the suitability of high-energy reef areas with limited floral covering as potential reseeding areas.

2. Back Reef

This area forms a transitional zone between the reef crest and the grass flats. Although it exhibits much of the hydrographic qualities of the reef crest site, its sandy substrate enables the seagrasses mentioned above to proliferate into scattered stands. The blades of the seagrass are covered with epiphytic algae. The depth of this enclosure is approximately two meters.

3. Grass flat

This site might be considered classic conch habitat. The enclosure is at approximately two meters depth, and hydrographic conditions are mild except during storm seas. Syringodium filiforme and Thalassia testudinum form dense stands over most of the sandy substrate. Epiphytic algae is common.

4. Beach slope

At this near-shore site the red macroalga, Laurencia poetii is abundant on a sandy substrate. Water depth is 1.5 meters, and although this is a near-shore site, circulation is good.

At each site, twenty-five juvenile conchs collected from natural stocks nearby are tagged with bouyant, one inch plastic tags using 40 lb test monofilament line. The siphonal length, tag number and date are recorded for each conch placed in the enclosure. The initial length of conchs placed in these pens ranged from seven to ten centimeters. Growth rate and survival are monitored bi-monthly.

Daily observations of the conch within each pen, as well as hydrographic conditions, are recorded. Within the laboratory, barometric pressure, wind speed and direction, and temperature are monitored to be correlated with behavioral and/or physiological changes in the tagged conchs.

The conch reseeding protocal, as described in the original proposal by Dr. Steiner, was one of many subjects on the agenda of a meeting between project staff and USAID during the July site visit of Dr. Marea Hatziolos. Due to the delay in project implementation to construct the laboratory, reseeding efforts will be limited since hatchery-reared juveniles will not reach an appropriate size until the end of the funding period. Also, monitoring growth and surivival of conchs seeded in areas far removed from the hatchery is logistically impractical. Dr. Steiner proposed holding sites in Tres Cocos, Water Caye and Caye Glory. The costs and availability of the fisheries boat for routine monitoring at these sites would be prohibitive. However, near-shore areas adjacent to the hatchery afford appropriate habitat for grow-out studies, and they can be monitored

frequently and maintained securely. Grow-out techniques with collected conchs and those reared in the hatchery during the 1986 spawning season are being investigated.

Project staff will work to coordinate their research efforts with the Internation Development Research Centre (IDRC) conch tagging program currently underway in San Pedro by the BFU.

GENETIC EVALUATION OF NATURAL POPULATIONS OF QUEEN CONCHS IN BELIZE

Conchs were collected from seven locations in Belize during the fall of 1985. Approximately 30 conchs were taken from each sample station using skin diving equipment. Two sites, Punta Azul and Boca Chica, lie at the extreme ends of Ambergris Caye, and collections were made using the 16' skiff purchased for project use. Conchs from more distant sites in southern Belize were collected during extended cruises in the Belize Fisheries Unit research boat, the "Lutjanus". Conchs were collected from five sites: North Water Caye, Caye Glory, Glover's Reef, Lighthouse Reef and Carrie Bow Caye. Information as to size and shell morphology of conchs from each sample site, as well as benthic habitat type was recorded at each location. Samples from conch populations in the southern-most waters of Belize will be collected on subsequent cruises.

Conchs were transported live back to San Pedro, where they were knocked and the soft parts blast frozen at the Caribena Fisheries Cooperative on San Pedro. Frozen samples were transported to the Illinois Natural History Survey, in Champlain, Illinois for initial electrophoretic analysis. Vertical starch gel electrophoresis was performed on these samples in

November, 1985 by genetic consultant Dr. David Phillip, site director Jack Sobel and technician Julie Claussen.

Several preliminary experiments were conducted to determine 1) which enzyme systems were resolvable, 2) which tissues produced the best results, 3) which buffer systems should be used, and 4) which enzymes were polymorphic in conchs from Belize. Once these experiments established the best procedures to follow, all of the samples were run and scored for those enzyme systems which were shown to be resolvable and polymorphic. Subsequently, vertical starch gels were performed at the USAID/BFU facility in March, 1986 during a site visit by Dr. Phillip.

Five enzyme loci were determined to by polymorphic and resolvable for queen conchs collected during 1986. These include:

Pgm-C	Phosphoglucomutase - C
Aat-A	Aspartate Aminotransferase - A
Mdh-B	Malate dehydrogenase - B
6-pgdh-A	6 - Phsophogluconate dehydrogenase - A
1 dh-B	Isocitrate dehydrogenase - B

Gene frequencies were calculated for each of the polymorphic alleles at each of the seven collections sites. Although some of the gene frequencies varied between the sites, the significance of the observed variation has yet to be determined.

During the duration of the funding period, several additional sites will be sampled to further expand our comparison of the genetic characteristics of Belizean conch populations.

EDUCATIONAL PROGRAM

The proposal outlines a training program for Belizean fishermen from each fishing cooperative to spend two months learning the techniques for rearing conchs in the hatchery environment. Project staff and USAID/Belize staff concur that conch fishermen would not benefit from the proposed training for the following reasons:

1. Fishermen could not afford to spend two months away from their regular fishing activities to attend an educational workshop.
2. Aquaculture technology requires individuals with a minimum educational background of a Bachelor's Degree in biology or chemistry.
3. Host country technicians employed by the project have the educational background to assimilate the technology for conch mariculture, and they can serve as resource persons to transfer this information for on-going programs in conch mariculture.

A more appropriate use of funds for marine science education would be to provide introductory marine science and conch biology lectures to fishing cooperatives and to the secondary education programs throughout Belize. Also, the production of a video presentation of conch biology and related educational publications will be circulated. To that end, we propose to allocate funds provided in the original proposal for the two-month training of fishermen to be used to support the following programs:

1. Creation of a lecture series accompanied with a video and slide presentation of the ecology and fishery of queen conch in Belize. A Peace Corps volunteer experienced in video photography will work in

conjunction with project staff to create a presentation depicting the life history and mariculture of queen conch which would serve as the cornerstone of the educational effort. Video equipment will be provided by the USAID/Belize mission. One-day seminars will be presented at each fishing cooperative, at secondary schools throughout the country and civic organizations, such as the Belize Audobon Society and Lion's Clubs. Arrangements are being made for seminars to be presented at the fishing cooperatives throughout Belize.

2. Distribution of educational materials describing the ecology of the queen conch will be distributed during lecture trips. A publication describing the biology of queen conch, written by Katherine Orr through funding from RARE and the World Wildlilfe Fund, is available at low-cost for distribution. This brochure could be purchased with funds allocated for library and training supplies.

3. An educational presentation is being constructed by project staff for display at the Belize Fisheries Laboratory, the Agricultural Trade Show and other public events to inform the public about the importance of the queen conch fishery in Belize.

PROPOSED ACTIVITIES FOR YEAR 2 AND BUDGETARY CHANGES

Modifications in the focus of our research efforts and a no-cost time extension for the grant through 31 March 1988 have been discussed with USAID/Belize mission staff and Dr. M. Hatziolos (LAC/DR). A revised budget reflecting line item transfers to accomodate this no-cost time extension, as well as additional changes discussed at that meeting, is attached. In some cases, where anticipated expenditures for 1987 will exceed funds budgeted under that line item, utilities for example, surplus funds from the 1986 budget have been allocated. Please note that in all cases where budget increases for second year funding are necessary, money has been made available from carry-over funds for Year 1 from line items where no further expenditures are anticipated. Budget line-items for which funding increases are requested are outlined below:

1. Salaries for on-site managers, J. Sobel and G. Marshall, from June 1, 1987 to August 30, 1987 is requested to allow their participation in the project through the 1987 conch spawning season. Their efforts during this extension period will include a continuation of hatchery production, a proposed education out-reach program to schools and fishing cooperatives, and report generating.
2. A salary increase and extension of employment for Belizean technicians to December 31, 1987. Due to the high cost of living in San Pedro compared to other communities in Belize, as well as the satisfactory performance of the technicians during the first

six months of employment, a 20% pay increase is requested after a six month evaluation. In addition, an increase from 43 to 46 weeks employment per annum is requested so that both technicians can continue an active role in the hatchery process. The six month extension for their employment (June - December, 1987), as well as the salary increase and the three weeks additional employment are available from funds originally allocated for technician's salary. No transferral of funds from other line-items in the budget will be necessary to accommodate this change.

3. An increase in in-country travel to cover expenses incurred while presenting seminars to schools and fishing cooperatives.
4. An increase in funds for technical supplies (expendable items) to reflect a six-month extension of hatchery operations.
5. An increased allocation for utilities based on projected costs. Monthly electricity bills during peak operation of the hatchery can be as high as $250.00 US/month (based on charges from May - August of 1986).

The attached sheet summarizes the balance of funds for each budget line-item through August 1986. Following is a spread sheet showing change requests for expenditures through the end of the funding period.

BALANCES FOR BUDGET ITEMS FOR PROJECT #PA 505-84-001

1 June 1985-15 August 1986

Insurance	$ 516.00	
Steiner	1400.00	
Siddall	1000.00	
Creswell	400.00	
Phillip	630.00	
Internation travel	2213.29	
In-country travel		-488.89
Fuel - fisheries boat	524.63	
Biochemical reagents	1405.70	
Organic chemicals	720.26	
Glassware		-13.59
Filters	149.40	
Film and developing	212.70	
Technical supplies		-765.42
Fuel - on site skiff	1170.56	
Construction supplies	961.94	
Seawater system	105.72	
Air conditioning	241.00	
Contract labor	18.69	
Miscellaneous tools	205.31	
Office supplies	6.13	
Triple-beam balance	67.43	
Communication equipment	531.00	
Algae equipment	308.55	
Microscopes		-2.73
Calculators	88.55	
Miscellaneous equipment	235.56	
Diving equipment		-410.89
Motorboat engine	16.74	
Power supplies	200.00	

ph meter and electrode	303.72	
Refridgerator	163.10	
Larviculture tanks	120.88	
Head tank	1175.17	
UV sterilizers	242.46	
SCUBA fills		-4.40
Utilities		-185.09
Telephone	497.48	
Equipment maintenance	262.49	
Shipping		-422.08
Training per diem	---	---
Training supplies	500.00	
Audiovisual equipment	350.00	
Library supplies	767.96	

EXPENDITURES FOR PROJECT FUNDING FROM 1 JUNE 1986 - 31 MARCH 1988

Category	Funds budgeted for Year 2	Funds available (Carryover)	Total amount available
G. Marshall	$ 7000.00		
Extension			
1 June 1987 - 30 August 1987		$ 2868.78	
Other funds available		2868.78(training per/diem)	
			$ 9869.78
J. Sobel	$ 7000.00		
Extension			
1 June 1987 - 30 August 1987		$ 2868.78	
Other funds available		$ 2868.78 (training per/diem)	
			$ 9869.78
J. Azueta	$ 3300.00	$ 1845.00 (salary)	
Salary increase and extension		5378.24	
Other funds available		720.26 (organic chemicals)	
			5865.26
E. Gomez	$ 3300.00	$ 3300.00	
Salary increase and extension		5224.53	
			6600.00
Insurance	1000.00		1000.00
W. Steiner	1500.00		1500.00
D. Phillips	2500.00	630.00	3130.00
L. Creswell	6000.00		
S. Siddall	1000.00		1000.00

International travel	8450.00		8450.00
In-country travel	520.00	-488.89	
* Increase to $ 1100.00			
Other funds available		1176.17 (head tank)	
			1206.28
Fuel			
fisheries boat	$ 1200.00	524.63	1724.63
Biochemical reagents	$ 2500.00	1450.70 (transferred)	2500.00
Organic chemicals	$ 1000.00	720.26 (transferred)	1000.00
Glassware	$ 100.00	-13.59	86.41
Filters	100.00	149.40	249.40
Film and Developing	250.00	212.70	462.70
Technical supplies	350.00	- 765.42	
* Increase allocation to $1000.00			
Other funds available		1170.56 (fuel on-site skiff)	
		308.55 (algae equipment)	
			1063.69
Fuel on-site skiff	2300.00		2300.00
Construction supplies		935.46	935.46
Seawater system		105.72	105.72
Air conditioning	0.00	241.00 (transferred)	0.00
Contract labor	0.00	21.29	21.29

Miscellaneous tools	450.00	205.31	653.31
Office supplies	50.00	27.53	77.53
Triple beam balance	0.00	67.43	67.43
Communication equipment	0.00	531.00 (transferred)	0.00
Algae equipment	0.00	308.55 (transferred)	0.00
Microscopes	0.00	-2.73	-2.73-
Calculators	0.00	88.55	88.55
Misellaneous equip.	0.00	235.56	235.56
Diving equipment	0.00	-410.89	
Other funds available		163.10 (refridgerator)	
		200.00 (power supplies)	
		241.00 (air conditioning)	
			193.21
Motorboat engine	0.00	16.74	16.74
Power supplies	0.00	200.00 (transferred)	0.00
ph meter	0.00	303.72 (transferred)	0.00
Refridgerator	0.00	163.10 (transferred)	0.00
Larviculture tanks	0.00	120.88	120.88
Head tank	0.00	1175.17 (transferred)	0.00
UV sterilizors	0.00	242.46	242.46

SCUBA fills	500.00	-4.40	
			495.60
Utilities	600.00	-185.09	
* Allocate $250.00/month for 15 months (1/10/87-31/12/87) = 3750.00			
Other funds available		516.00 (insurance)	
		1400.00 (Steiner)	
		1000.00 (Siddall)	
		400.00 (Creswell)	
		1405.70 (biochemical reagents)	
			5136.61
Telephone	400.00	497.48	897.48
Shipping	500.00	-422.08	
* Allocate $300.00 additional funds			
Other funds available		531.00 (Communication equip.)	
		303.72 (ph meter)	
			912.64
Fishing coop. per/diem	6500.00	5737.56 (transferred)	
			762.44
Training supplies	600.00		600.00
Audiovisual equip.	0.00	350.00	350.00
Library supplies	500.00	767.96	1267.96

INVENTORY LIST FOR BELIZE CONCH PROJECT

CONSTRUCTION MATERIAL

Fiberglass panels (48)

Garage door (8') (1)

External wood door (1)

Internal wood door (1)

Ridge vents (40')

Corrugated seals (40')

Door locks (2)

Nails with washers (3 boxes)

3/4" plywood (2)

1/2" plywood (2)

1/2" styrofoam sheets (4)

Vinyl coated shelving (18')

SEAWATER SYSTEM

PVC pipe (2") 1000'

PVC pipe (1") 1000'

1" SxSxT Tees (20)

1"x1/2" SxS bushing (10)

2"x2"x1" SxSxFIPT Tees (15)

1" compression fittings (10)

2" compression fittings (10)

PVC glue (qts = 6)

Teflon tape (4 rolls)

2" 90° SxT Ells (5)

1" 90° SxT Ells (20)

1"90° SXS ELL (20)

2" VALVE (5)

1" S X FIPT COUPLING (20)

2" S X S ELL (10)

1" VALVE (10)

2" T PLUG (3)

1" T PLUG (10)

1" S X S COUPLING (20)

1" T CAP (10)

2" T CAP (5)

2" MIPT ADAPTER (10)

1" MIPT ADAPTER (20)

2" S X S COUPLING (20)

2" S X FIPT COUPLING (10)

1 1/2" MIPT X 2" SL ADAPTER (8)

3" T PLUG (1)

3" 90°S X S ELL (1)

3" Y S X S X S (1)

1 1/2" 90°S X S ELL (1)

1 1/2" 45°S X S ELL (1)

1" 45° S X S ELL (2)

Thru hull fittings - 2" (2)
1" (10)

Hose clamps (# 16H1S (13/16"-1 1/2") (30)

Hayward 1 hp water pumps (2)

Baker sand filter with multiport valve (1)

Silica sand (50 lb. bags) (6)

ELECTRICAL SUPPLIES

240V,10, 100A Service entrance panel/main.
min 12 poles, surface mount (1)

1/2" Romex connectors (10)

Safety switch, non fuse
raintight (20A (2)

Double 40W Flourescent
shop lights w/tubes (9)

Copper clad ground rod
with clamp (S588) (1)

15A single pole breaker (1)

20A single pole breaker (5)

20A double pole breaker (2)

Surface mount weathertight
switch 3/4" inlet boxes (15)

Duplex outlets, covers (12)

SPST switches, covers 145-ICP (3)

3/4" PVC conduit (60 ft.)

PVC male adapter w/locknuts (3/4") (15)

12/2 type UF w/ground (250 ft.)

12/3 type UF w/ground (50 ft.)

Electrical staples (500)

16/3 SJ rubber covered appliance cord
(25 ft.)

Junction box w/blank cover (4x4) (4)

Mounting fasteners
3/4" 2 hole PVC strap 12 9.20/100 1.10
BOX - asst. switches, outlets, breakers

TOOLS AND SUPPLIES

Skill saw (6.5") (1)

Silicon sealant (4 tubes)

hammer (1)

Electric drill, 3/16" shaft

Drill bit set

Screw driver set

Measuring tape

Channel locks

Liquid nail (4 tubes)

Caulk (12 tubes)

hot melt glue gun (1)

hot melt glue (2 boxes)

Push broom (1)

hack saw and extra blades (1)

pipe dope (1 can)

stand pipes (6)

propane torch and fitting

Extension cord 50'

LABORATORY EQUIPMENT - GLASSWARE

Ohaus-Dec-o-gram, Model 3600 (1)

Ohaus Dial-O-gram balance (1)

Ainsworth semi-micro balance (1)

Magnetic stirrer (1)

Accumet analog pH meter (1)

Nalgene autoclavable beakers

50 ml	(24)
100 ml	(24)
250 ml	(6)
600 ml	(4)
1000 ml	(3)

Polyethytlene "Boston Round" bottles

500 ml (12)

1000 ml (6)

Polyethylene Jugs
    1 gal. (6)

Polyethylene wash bottles
    (500 ml) (4)

Test tube brushes
    13 - 19 mm (12)
    Extension brush (1)

Polycarb tubing clamps (36)

Kimwipes 18 boxes

Kimax beakers
    250 ml (12)
    1000 ml (6)

Kimax ehrlenmeyer flasks
    250 ml (24)

Pyrex Fernbach flasks
    2000ml (8)

Pyrex ehrlenmeyer flasks
    1000 ml (6)

Nalgene filtering flask (1 liter) (6)

Polypropylene graduated cylinders
    50 ml (2)
    100 ml (2)
    250 ml (2)
    1000 ml (1)
    2000 ml (1)

"Sparklene" detergent (1.5kg)

Dissecting set (1)

Seriological pipettes
    10 ml (12)
    25 ml (2)

Dispo-pipettes (1000)

Microcapillary pipets
    10 ul (250)
    20 ul (250)

Pipette dropper bulbs (3ml) (24)

Bulb-type safety pipet (1)

Rubber stoppers

Size # 13 (2-hole) (8)
Size # 7 (2-hole) (16)

Test tubes (18 mm) (70)

Test tube rack (2)

Permeable membrane test tube caps
18 mm (1000)

Glass tubing (6mm OD)
pack of 5 (2)

Spatulas

Scoopula spatula (6)

Chemi-scraper (2)

Microscope (binocular) (1)

Microscope (dissecting) (1)

Microscope slides
3" x 1" gross
hanging drop (12)

Cover Slips (1000)

Hemacytometer (AO) (1)

Hot hand protector (1)

Ocular micrometer (1)

TCBS Agar

Agar Plates

Sterilizing loops (3 pks)

Thermometers
-20 to 110° (3)

Counter (1)

Magnetic filter funnel (1)

Membrane filters 100/pk

Depth filter 100/pk

Colored tape (4 rolls)

Magnetic stir bars (4)

Aspirator filter pump (2)

CHEMICALS

$NaNO_3$ (3kg)

$NaH_2PO_4.H_2O$ (1kg)

$Na_2SiO_3.9H_2O$ (500 g)

Thiamine-HCl (100 g)

Biotin (500 mg)

Vitamin B_{12} (500 mg)

Na_2EDTA (500 gm)

$MnCl_2.4H_2O$ (500 gm)

$CuSO_4.5H_2O$ (500 gm)

$ZnSO_4.7H_2O$ (500 gm)

$CoCl_2.6H_2O$ (100 gm)

$Na_2MoO_4.2H_2O$ (500 gm)

$Na_2S_2O_2$ (sodium thiosulfate) (3 kg)

Starch (10 kg)

Trizma-base (2kg)

Trizma-Hcl (500 g)

Boric acid (2.5 kg)

EDTA (500 g)

Citric acid (2 kg)

NAD (2 g)

NADP (2 g)

NBT (3 g)

PMS (3 g)

Glucose-1-phosphate (5 g)

Glucose-6-phosphate dehydrogenase (10,000 IU)

Fast Blue BB salt (25 g)

Pyridoxal-5-phosphate (2 g)

Aspartic acid (100 g)

a-ketoglutaric acid (50 g)

Malic acid (500 g)

G Phosphogluconic acid (1 g)

Isocitric acid (10 g)

Magnesium chloride (100 g)

HATCHERY EQUIPMENT

500 L. fiberglass larviculture tanks (7)

Tank holders (plywood) (4)

Standpipes (unassembled) (8)
Vinyl tubing - 1" (100')
1/2" (50')
1/4" (100')

Polyethylene tubing - 3/16" (100')

Vinyl tubing (FDA)
1" (150')
3/4" (100')

"Filon" fiberglass sheeting (100' roll)

"Porex" polyethylene filter material ($16'^2$)

Pecap Screens
PE 115 (3 yd)
PE 200 (2 yds)
PE 250 (2 yds)
PE 600 (1 yds)
PE 500 (2 yds)
PE 750 (2 yds)
PE 800 (2 yds)

Cartridge filters - 10 micron (25)

Cartridge filters - 5 micron (25)

Cartridge housing (3)

Aquatic Ecosystem L20 linear blowers (2)

Filtronics UV sterilizer - 30 watt (3)

UV replacement bulbs (3)

20 gallon long aquaria (4)

airline tubing (500 ft.)

airstones (36)

brass airvalves (36)

plastic buckets (8)

plastic carboys (8)

Garden hose (50')

Hose nozzle (1)

LABORATORY FURNISHINGS

Air Conditioner (1400 BTU) (1)

17 cu. ft. refridgerator (1)

Laboratory table - 8' (2)

Laboratory table - 4' (2)

Stainless sink - double (1)

Microscope desk - 8' (1)

Insulated wall panels - 4 x 8' (4)

41 qt. pressure cooker (1)

Commerical grade propane burner (1)

MISCELLANEOUS SUPPLIES

Shade cloth (assorted pieces)

Pre-cut screen pipe (6)

Vinyl coated wire (50' rolls) (2)