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STUDENT PROJECT PROPOSAL TO THE

UNIVERSITY OF HAWAII MARINE OPTION PROGRAM

Study of Feasability of Closed System Rearing of Marine Larval Crustacea: Specifically With Respect to Those Species Popular in the Marine Aquarium Industry

DURATION

May 15, 1983 - August 1, 1983

PROJECT LEADER

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PROJECT MEMBERS

ADVISOR

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ABSTRACT

Due to steady increases in the marine aquarium industry there is today a large demand for exotic marine specimens. At the present time this demand is only partially met by a network of collecting stations and wholesalers. This project hopes to develop methods for raising large numbers of larvae of many species of exotic crustacea popular among aquarists to maturity. Very little work has been done with larval crustacea of these types, although there is information available describing the methods used to raise to postlarval stages several species of edible crustaceans. A system of six 40 gallon aquaria serviced by mechanical, biological, and activated carbon filters, and a UV sterilizer, has already been assembled.

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Over the last thirty years there has been a steady increase of interest in the keeping of marine aquariums. This is the result of a number of different things, for example development of silicone sealant allowing construction of sturdy all-glass tanks without the metal frames that could contaminate salt water, improvements in air pumps and filters, the production of high quality artificial salt water mixes, and, of course, the advent of cheap rapid jet freight services allowing aquarists access to specimens. With this increase, a network of isolated collecting stations, wholesalers and transhippers has sprung up to maintain a steady supply of specimens for hobbyists and for public aquaria. This network is at best only semi-efficient at catering to the market, it causes prices to be high, and variety and quality of specimens to be low. It is for these reasons that I wish to develop a system to raise in captivity as many as possible of the most sought after tropical marine crustaceans. Hopefully lowering prices, increasing the quantity and variety of these species available and perhaps as a secondary result expanding the market for them.

Up until this time very little published research has been available concerning techniques for the successful rearing of larval crustacea. Most of the information that does exist is tied to crustacea which are potential food sources. In this area considerable work has been done with the Malaysian prawn (Macrobrachium sp.)[1], with the American lobster

(Homarus americanus)[2], and with the Penaeid shrimp[3]. Other crustacean species have had their growth and larval molt stages carefully documented even where no efforts were made to raise these larvae to adulthood under controlled conditions. Among these are studies of Brachyuran megalopa[4], larvae of decapod crustacea[5], adult and larval stomatopods[6] and Palinurid and Scyllarid lobster larvae of the Natal coast, South Africa[7]. Reports of attempts to raise the more exotic and less 'practical' species of marine crustacea including all those which I hope to try, e. g. Harlequin shrimp (Hymenocera picta)[8], Banded coral shrimp (Stenopus hispidus), Cave shrimp (Stenopus sp.), Cleaner shrimp, Anenome shrimps, Red-haired and Yellow-haired hermit crabs, some rarer deep water shrimp and also perhaps slipper lobster (Scyllarus sp.) and spiny lobster (Palinuris sp.), - although these last have been unsuccessfully tried many times in the past[9] - are almost non-existent. I have a verbal communication with Dr. E. Reese of the University of Hawaii dept. of Zoology that he successfully raised at least one species of local hermit crab at his lab facilities on Coconut Island (HIMB), His technique which he breifly outlined to me consisted of feeding newly hatched brine shrimp, frequent changes of water, use of antibiotics and separation of larva into individual containers (this last because he was attempting to collect molted exoskeletons at each stage of development).

Over the last two and one half years I have tried repeatedly to raise larvae of the Harlequin shrimp (Hymenocera picta). This species is a particular favorite of mine, and as well, is probably one of the most valuable economically if it can be successfully reared to adulthood. It is rare in the natural environment, has a limited range, and sells for a high price when it is available in aquarium stores. My first efforts at

raising these larvae were made using one gallon glass jars and feeding freshly hatched live brine shrimp. The results were dissapointing, with no larvae suviving beyond ten days (actually there was about ninety percent survival for the first four or five days and after that a fairly exponential mortality rate). This failure led to an examination of literature which was found to be lacking in any relevant information, not only for Hymenocera, but for all other non-edible crustacea I could think of which might have similar larvae. Sid Crowle, who at that time was in charge of larval rearing projects at the Waikiki Aquarium, provided me with a culture of rotifers and phytoplankton. Using this a second attempt was made using an identical arrangement to that used initially. The jars were half filled and lightly aerated and rotifers were added regularly, however the results were much the same as in the first trial, with the last larvae dying after about ten to twelve days. For a third try I moved down to the Waikiki Aquarium and set up four shallow tubs each holding three to four gallons of water. Water movement was provided by a jet of air across the surface of the water, and new water was added every three days. Several combinations of food were provided in the different tubs, i.e. brine shrimp, rotifers and phytoplankton, rotifers and phytoplankton, and rotifers and phytoplankton separately. Concentrations were also varied for each of these combinations. Although there was some variation in mortality rates from tub to tub this did not seem significant and in none of the tubs did any larvae survive more than fourteen days.

Perhaps before I continue this saga of my attempts to raise Harlequin larvae some general information about them would be helpful. The adult pair of shrimp which supplied me with larvae were collected in

about fifty feet of water off Lanai Lookout using SCUBA. They were found together under a rock eating a Linkia starfish which along with two or three other starfish species including the crown-of-thorns are the only food of the adult shrimp. I kept this pair for many months in a ten-gallon aquarium and throughout this time they reliably kept me supplied with larvae. Every nineteen to twenty two days, on one evening between 9:00 p.m. and 2:00 a.m., and regardless of whether or not the aquarium was lighted, the female would become agitated and active, distinctively jolting the large clumps of eggs attached to the pleopods under her tail. As she did this a few eggs would come loose and sink slowly to the bottom for a couple of seconds before popping open into transparent zoea larvae which immediately began swimming towards the nearest light source. Finally after an hour or two of this behaviour the female would climb to the top of a rock and shake free in one powerful movement all the remaining larvae. Generally the female would molt several days after releasing her young and at this time mating took place followed a day or two later by the appearance of new bright red eggs on her pleopods. As in other shrimp these eggs are carefully cleaned and aerated by gentle movement of the pleopods. Development of the larvae within the eggs is indicated by increasing translucence of the eggs and loss of their original bright color.

The larvae themselves are about two to three millimeters at birth, they are strong swimmers with large eyes and are phototaxic - clustering in a dense group at the surface under the aquarium light. numbers of larvae released varied considerably, from two hundred up to a thousand. Although the larvae are translucent at birth they soon develop small areas of pigmentation. Under a microscope it can be seen that they have

several pairs of grasping claws situated on either side of their mouth. Although I never raised any Harlequins to adulthood, still the larvae generally molted three or four times at fairly regulary spaced time intervals before dying.

My last efforts to raise these larvae were made with the aid of the facilities and personnel of the HBRC lab at Kewalo Basin. They provided a technique for collecting and fertilizing sea urchin eggs which were then used as a possible food. Again results were poor with the larvae living for ten to fourteen days and going through only two or three molts. Finally, as a last attempt, larvae were floated in buckets with fine mesh bottoms into which fresh unfiltered sea water - from HBRC's open water system - was constantly added. Here again the mortality was exponential after the first six or seven days, however, on this last occasion three larvae survived for twenty days, and went through at least five molts before dying.

Reef Life of Hawaii, a wholesale importer and exporter of marine fish and invertebrates, which is located on the grounds of Paradise Park at the back of Manoa valley, has been very generous in aiding this present project. All materials, tools, space, etc. which went in to the present system (see methods and materials for description) have been provided at no cost. In addition special equipment such as the UV sterilizer and certain of the pipe fittings needed were purchased by Reef Life specifically for the system.

METHODS AND MATERIALS

At the time that this proposal is being written a system has already been assembled and constructed in which it is hoped that larvae of a variety of the crustaceans mentioned in the introduction of this proposal can be raised. Essentially the system is like that which has been successfully used to raise American lobsters. It is a closed system of two hundred and forty gallons with a biological gravel filter hooked to a three component filter system of first a diaton element, then an activated carbon element and finally an ultra-violet sterilizing unit. Water is moved through this filter system and then returned to the six rearing tanks above through half-inch 'PVC' pipe. At either end of each of the six tanks a branch pipe goes down inside the tank to the bottom where there is an elbow and nozzle set so that two small streams of clean water are jetted towards opposite ends of the tank. this hopefully will prevent any build up of material on the bottom of the tank by forming a constantly rising, rotating column of water.

Diagram

Water is siphoned out of the tanks at the top by an overflow device constructed of three-inch piping drilled with holes and covered with a fine mesh. From here water runs into a communal drain of three-quarter-inch pipe running under the row of six tanks and is finally returned to the biological filtration tank below. The included diagram should make this description much clearer.

Although not as glamorous it is hoped that this system will meet the requirements of one, dispersing larvae and food, two, flushing tank surfaces clean, and three, providing a physical environment which does not damage larvae. These are the three major advantages cited by the California researchers

who successfully raised American lobster larvae in special tanks called 'spherical bottom kreisels'. reference?

The system described and illustrated above was constructed over a period of ten days in May and April of 1983 by myself at the invitation of Colin Young owner of Reef Life of Hawaii a wholesale importer and exporter of tropical marine fish and invertebrates.

Adult gravid crustaceans for the project will come either from collectors who regularly supply Reef Life, or will be collected by myself. They will be gradually acclimized into one of the six aquariums in the system and kept there until their eggs hatch. Larvae will be regularly fed live Artemia nauplii which can be hatched either right in the aquarium or in a separate container. In addition it is hoped to be possible to maintain a rotifer and phytoplankton culture as alternate food.

Disease control may be a major factor in the success of this project. It is hoped that the UV-sterilizer will prevent bacterial organisms from spreading, and perhaps some antibiotic e. g. streptomycin sulfate could also be used, however this might interfere with the biological filter and will not be used initially. For fungal diseases a two minute dip in five ppm malachite green solution is recommended at two day intervals.

BUDGET

At present all materials mentioned in the description of the system in the methods and materials section have been supplied free of charge to me by the owner of Reef Life of Hawaii. In addition a workspace at their location on the grounds of Paradise Park in the back of Manoa valley was given to me indefinitely to use for the set up of the seven forty gallon aquaria and the associated filtration equipment. The owner has also agreed to transport water for the system and to aid in getting adult crustaceans from which to obtain larvae by passing on a list of eligible species to the three groups of collectors who regularly bring in specimens. Also if things go well, then as the project progresses, other species of crustacea not found in Hawaiian waters might be imported, e.g. anenome shrimp of which there are numerous species in the Indo-pacific region.

Since the owner is covering essentially all costs of supplies the budget submitted in this report is relatively simple. It would provide for stipends to cover hours spent maintaining the system; i.e. changing and cleaning filter materials, basic water tests such as salinity, pH, and temperature, observation and recording of all activity in the aquaria such as when larvae were released, gestation time of parents, changes and growth of larvae etc., feeding of larvae and maintaining of food cultures both of brine shrimp and of rotifers. A maximum estimate of the time required for these chores is fifteen to twenty hours a week. Possible other time consuming activity might be in collecting suitable specimens from which to obtain larvae. This depending on the success of those groups that regularly sell fish and invertebrates to Reef Life in collecting specimens we need.

Finally it is preferable that the budget be flexible to allow extra hours of stipend - if needed - to be provided to a second Marine Option Program student who as well as sharing in above duties might also do work in one or more of the following areas: one, investigating procedures for and then setting up and maintaining a phytoplankton culture with this in turn supporting a rotifer culture which could be used as an alternative food source in the rearing tanks, two, illustration, and possibly microscopic photography of different larval stages of the various species, three, detailed microscopic examination of larvae - describing and perhaps identifying possible disease organisms both bacterial and fungal (see methods and materials section for a brief description of diseases and treatments).

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CURRICULUM VITAE

PERSONAL DATA

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POST-HIGH SCHOOL ACADEMIC BACKGROUND

1979-present University of Hawaii at Manoa, Honolulu, Hawaii graduating in May of 1983 with a B.S. in Geology/Geophysics.

1978 University of Hawaii at Hilo, Hilo, Hawaii.

COURSEWORK AND GRADES RELEVANT TO PROPOSED PROJECT

1. Botany 201 (A) 2. Zoology 101 (A) 3. Invert. Zoology (B) 4. Zoology seminar: Behaviour of Marine Animals 499 (A) 5. Four semesters of Chemistry

EXPERIENCE RELEVANT TO PROPOSED PROJECT

Sept. 1975 - May 1976	Full-time employment collecting fish and invertebrates in the Marshall Islands.
1973 - present	Approx. 500 hrs. SCUBA, many more skindiving in Pacific region.
Feb. 1980 - spring 1982	Worked independently at the Waikiki aquarium and at PBRC Kewalo Basin lab attempting to rear Hymenocera larvae.

SKILLS, HOBBIES AND MEMBERSHIPS RELEVANT TO PROPOSED PROJECT

1973 - present	Set-up and maintanance of numerous marine aquaria.
1974	Basic SCUBA certification, MAUI, Toronto
1976 - present	Underwater photography
1982	Advanced open-water SCUBA, PADI, Honolulu

Diagram of Present System For Rearing Larval Crustacea