Aquaculture of Hawaiian Marine Invertebrates for the Marine Ornamental Trade, Year 2

General Information

Reporting Period October 1, 2003–September 30, 2004 (final report)

Funding Level

Year	Amount
1	$55,000
2	**$35,000**
TOTAL	$90,000

Participants

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Objectives

Develop and transfer culture techniques for Hawaiian marine invertebrates to promote economic opportunities without dependence on wild-caught specimens.

1. Determine the feeding requirements for broodstock maturation.
2. Determine methods for the artificial spawning of feather duster worms.
3. Validate grow-out phase in natural and artificial systems.
4. Determine estimated costs for the settled feather dusters to attain market size.
5. Summarize and disseminate the resulting information in journal articles, newsletter articles, and workshops.

Principal Accomplishments

Objective 1: Determine the feeding requirements for broodstock maturation.

At OI, three different potential food types (*Nannochloropsis*, *Chaetoceros,* and pond water) were tested at three different volumes (10, 100, and 1,000 ml). Three replicate tanks (ca. 75 L each) per treatment volume for each food type tested were stocked with four wild-collected animals. Animals in control tanks were given the treatment volumes using clean seawater. A total of 36 tanks were maintained for each treatment period. Egg barriers were installed in each tank to capture any spawns that may have occurred during the treatment period. The barrier was a plastic frame covered on one side with 100-micron Nytex screen. The barrier was placed across the width of the tank in front of the drain a few centimeters above the water to approximately 15 cm in depth. Flow rate for each tank was maintained at approximately 1 L/min.

All animals were treated daily for two months after which two from each tank were sacrificed for analysis (six animals total per treatment). Each worm was removed from the test, and the crown was discarded. The animal was patted dry on a paper towel, and the wet weight (grams) was recorded. An incision was made, and the coelomic contents were then extracted using a pipette and placed on a microscope slide for inspection under a compound microscope. The presence of any gametes was then recorded according to a density scale: 0 = no gametes, 1 = <100/ml, 2 = 1,000/ml, 3 = 10,000/ml and 4 = >100,000/ml. Densities were estimated using a haemocytometer.

Results: No significant differences were detected among the wet weights of worms used in the study (one-way ANOVA, P>0.05). None of the worms (excluding untreated wild animals) had spawned during treatment or demonstrated advanced stages of egg development. The animals appear to be hermaphroditic, though smaller individuals (ca. <1g) tended to produce sperm, and larger individuals (ca. >1.5g) tended to produce eggs.

Objective 2: Determine methods for the artificial spawning of feather duster worms.

To date, the ablation technique is the only successful method for the artificial spawning of feather duster worms.

Spawning trials using wild-caught worms were conducted at HIMB. Investigations to determine the extent of the natural spawning season are also ongoing, and preliminary evidence indicates that the feather duster worm has a discrete spawning season that occurs during the months of October through January.

The entire experiment was repeated during the fall of 2003 with similar results with the exception that spawning was more varied, occurring between three and four days after ablation. In summary, spawning success occurs in about 80% of the trials using the ablation technique. Other trials (e.g., temperature shock, lighting, and salinity) were also conducted but did not yield any spawning results. The ablation technique remains as the only reported means of inducing the feather duster worms to spawn.

Objective 3: Validate grow-out phase in natural and artificial systems.

A focused effort was conducted on the culture of the feather duster worm under artificial conditions. These experiments were conducted at HIMB.

Artificial and preserved feeds: One experiment focused on the use of various feed types and their impact on growth in feather duster worms. The experiment was conducted in twelve aquaria (57 L a piece) that were stocked with six small (mean tube diameter of 4 mm) worms each. An additional tank of the same size served as a control and was stocked with 18 small worms. Treatment 1 (tanks 1–3) received *Nannochloropsis oculata* (Reed Mariculture, San Diego, California) provided once a day at a density of 100,000 cells/ml. Treatment 2 (tanks 4–6) received a mixture of *N. oculata* and rotifers consisting of a density of 50,000 cells/ml and 5 rotifers/ml. Treatment 3 (tanks 7–8) consisted of rotifers stocked at 10 rotifers/ml. Treatment 4 (tanks 9–12) was a prepared diet (RotiMac, Aquafauna BioMarine, California), which was provided at a rate of 2.5 g/L/day. The control tank received unfiltered seawater from Kaneohe Bay pumped through the HIMB flow-through water system. All tanks were periodically flushed with filtered seawater for water quality maintenance. Tube diameter measurements were taken regularly as an indicator of growth. All treatments suffered mortalities, and minimal growth

Preliminary results indicate that feather duster worms do not grow well on a diet of artificial or preserved feeds.

was observed in all treatments. Highest mortality was seen in treatments 1 and 2, both of which used the preserved *N. oculata.* The lowest mortality was seen in treatment 3 (rotifers only). Mortality was exceedingly high in treatment 4 (Rotimac). Preliminary conclusions are that *Sabellastarte spectabilis* does not do well on artificial or preserved feeds as the results are in striking contrast to that obtained during the previous project activities. In those trials, live algae (*Chaetoceros* sp.) was used as the food source resulting in growth rates that were twice that of non-filtered Kaneohe Bay seawater.

Settlement conditions: An important step in the artificial propagation of the species is defining the appropriate conditions for settlement of the spawned larvae. Settlement trials were conducted at HIMB and began soon after spawning was observed. Larvae were pipetted from spawning tanks and placed in separate aquaria at a density of approximately 15/ml. Each aquarium was filled with filtered seawater, one half of which was exchanged every other day. Larvae were monitored for developmental change for approximately one week after which many individuals settled and began to metamorphose. Although mortality occurred throughout the week while larvae were in the water column, it increased soon after settlement and metamorphosis. Just before settlement, several substrates were placed in each tank (black plastic mesh, nylon mesh, clear fiberglass, dark fiberglass, oyster shells, coral rubble, concrete blocks, Styrofoam cubes, and air stones). All settlement materials were soaked in seawater for five days prior to use in order to obtain the necessary biofilms. Only three individuals were observed to settle, metamorphose, and begin to grow successfully. All three were found on the same air stone. The high larval mortality observed is probably due to a water quality issue. Marine invertebrate larvae are extremely sensitive to any impurity in the water. Individuals who have successfully raised polychaete larvae in the lab have used highly purified seawater.

Objective 4: Determine estimated costs for the settled feather dusters to attain market size.

Work on this objective is being deferred to Year 3 of the project because of the inconsistent results obtained during the settling phase of the culture process. From the results obtained to date, however, the production costs appear to be low because the worms are highly fecund, filter feeders, and at present, can utilize live phytoplankton alone as a feed under artificial conditions. There will be a need to protect the worms during the nursery and grow-out phases of the culture process. However, the challenges do not seem to be insurmountable.

Objective 5: Summarize and disseminate the resulting information in journal articles, newsletter articles, and workshops.

Two oral presentations, one poster presentation, and one manuscript were produced and submitted.

Impacts

Progress to date indicates that at least the feather duster worm and one species of soft coral can be developed for the marine ornamental trade. This will undoubtedly add to the inventory of enterprises engaged in the production of marine ornamentals. There are clearly some technical issues that remain to be resolved for the feather duster worm, and this is not the case with at least one soft coral species. For the soft coral, a non-technical constraint has emerged as an impediment and will need to be addressed before the full impact of the current project's work can be assessed.

Publications in Print, Manuscripts, and Papers Presented

Presentation

Bybee, D.R. 2004. Spawning periodicity and gametogenesis of the fan worm, *Sabellastarte spectabilis*, in Kaneohe Bay, Hawaii, USA. Page 38 *in* Eighth International Polychaete Conference Book of Abstracts. July 5–9, 2004, Madrid, Spain.