HSWRI Aquaculture Program Research Report
**** October & November 2005 ****

A New Home for the Rockfish

HSWRI proudly unveiled its "new" 30,300 L rockfish aquarium earlier this fall (Figure 1). While the aquarium is new to our rockfish, it is actually a decades-old aquarium from the original Atlantis Restaurant that is now our laboratory. This new environment provides a realistic setting for rockfish by mimicking an oceanic rocky habitat. Water temperature (9.2 ± 0.2 °C) and lighting (0-82 Lux) profiles were designed to simulate open ocean conditions in southern California at a depth of 90 m. The 30 m^3 tank measures 6.4 x 2.4 x 2.1 m deep and has viewing windows on two sides. The 568 Lpm chilled recirculating system maintains pristine water quality by filtering the seawater through a bead filter, fluidized sand filter and protein skimmer.

Figure 1. Rockfish aquarium provides a realistic setting for deepwater broodstock at HSWRI.

The 13 inhabitants of the aquarium currently include three vermilion (*Sebastes miniatus*), six bocaccio (*Sebastes paucispinis*), and four cowcod (*Sebastes levis*). The fish have an average weight of 4.8 kg and consume <1.0% of their body weight per day. As natural cohabitants in the wild, the three species are vertically stratified in the aquarium — vermilion near the surface cowcod on the bottom and bocaccio in the middle. We recently noticed that one of the bocaccio was gravid and we are hopeful that fertilization will occur. An egg trap has been added to the recirculation system to collect any larvae that may be released by the females.

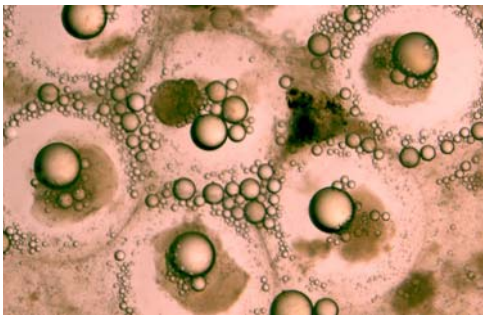

Figure 2. Unfertilized eggs cannulated from a resident cowcod.

In related news from our other rockfish breeding pools, we were excited to see two female cowcod captured this summer become gravid in October. Although the eggs were

apparently not fertilized and have since been reabsorbed (Figure 2), the natural ovulatory cycle displayed by the fish bodes well for future mating success.

Juvenile Halibut are Growing Up

Six months after the beginning of a prolific California halibut spawning season, the baby halibut are not so little anymore. The adult halibut spawned 75 times for a total of 140 million viable eggs. At 28-32 dph, the newly settled halibut were relocated into a raceway system that was adapted from one used successfully before at our Carlsbad Hatchery (Figure 3). It consists of nine horizontal trays stacked vertically in groups of three. Each raceway is 2.4 m long and has a water depth of 7.6 cm and a tray depth of 12.7 cm. To provide ample surface area and good water circulation, six of the raceway trays are 35.6 cm wide and have a flow rate of 45 Lpm. The other three are 78.7 cm wide and have a flow rate of 76 Lpm.

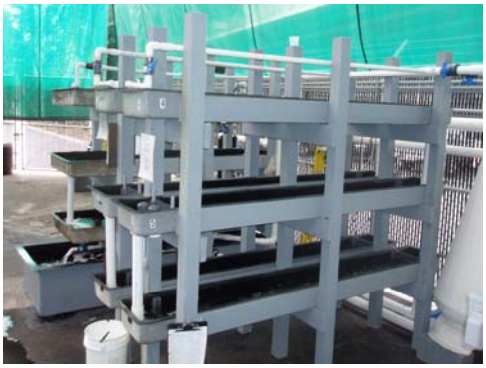

Figure 3. A rack system of shallow water raceways for juvenile halibut.

The five month old halibut currently have an average weight of 1.5 g and average total length of 45 mm. Due to the large size disparity among individuals within cohorts and associated concerns about aggression, we initiated a grading scheme for the juveniles. Survival was disappointingly low during the early stages of culture in the raceways. We suspect that the elevated mortality was due largely to poor water quality associated with a prolonged red tide event. The stress event was followed by secondary infections of protozoans *Ichthyobodo* and *Costia*, and bacteria such as *Epitheliocystis*. The parasites were treated with hydrogen peroxide and the bacteria with oxytetracline-medicated feed. Malpigmentation was also very high among all cohorts (Figure 4).

Figure 4. Juvenile halibut are examined for pigment abnormalities.

In preparation for the 2006 spawning season, we plan to upgrade the raceway systems to accommodate more fish and also to provide greater environmental control. We are also planning a series of larval nutrition experiments that should help us produce more robust larvae that are normally pigmented.

The 2005 Aquaculture Live Feeds Workshop

HSWRI and INVE Aquaculture, Inc. hosted the 2005 Live Food Culture and Enrichment Workshop at our laboratory on Mission Bay during the first week of November. INVE Aquaculture specializes in advanced solutions for animal rearing and provided the instruction for this three day workshop. Lecturers focused on the production and enrichment of live feeds for marine hatcheries.

Figure 5. Nick King of INVE Aquaculture Inc. instructs the class on the finer points of *Artemia* rearing.

After reviewing rotifer biology and culture methods the class honed their skills by setting up a rotifer production tank (Figure 5). Later they harvested, inoculated and set up rotifer enrichment systems to further their understanding of the process. The workshop also devoted some time to *Artemia* culture by focusing on quality and enrichment procedures, as well as proper techniques for hatching and membrane separation.

HSWRI Hosts 2005 UJNR Conference

In 1964 the United States and Japan established the Cooperative Program in Natural Resources (UJNR) to promote conservation of marine and terrestrial resources through cooperation in applied science and technology. This year HSWRI was honored to host the annual meeting of the UJNR Aquaculture Panel. The week-long event included a formal business meeting followed by two and a half days of presentations by U.S. and Japanese experts. Finally, the conference participants were treated to tours of the HSWRI white seabass hatchery, Kent SeaTech's hybrid striped bass facility in Mecca, and the tuna farms of Maricultura del Norte in Ensenada (Figure 6).

Figure 6. Above, Ted Dunn owner of Maricultura del Norte describes his operation to interested UJNR participants. Below, bluefin tuna feed in a frenzy.

The conference provided a comprehensive update on the current status of finfish culture in the U.S. and Japan. The conference speakers highlighted numerous production improvements the industry has made in recent years including smaller, more efficient filtration systems for land based culture;

stronger open ocean cage designs able to withstand harsh weather; unmanned open-ocean feeding buoys; and real-time video surveillance.

Acknowledgements

This document reports on Aquaculture Research Projects supported by numerous grants, contracts and private contributions. It also represents the hard work of many dedicated staff and volunteers throughout southern California. This information was contributed by HSWRI staff, and compiled by Aquaculture Research Assistant, Lisa Goldie, under the direction of Senior Research Biologist and Aquaculture Program Manager, Mark Drawbridge.

The Aquaculture Research Program has been active for more than 20 years at HSWRI. The primary objective of this Program is to evaluate the feasibility of culturing marine organisms to replenish ocean resources through stocking, and to supply consumers with a direct source of high quality seafood through traditional aquatic farming. Please direct any questions to Mark Drawbridge at mdrawbr@hswri.org.

Aquaculture research at HSWRI is currently supported by these major contributors:

- The California Department of Fish and Game's Ocean Resources Enhancement and Hatchery Program
- The owners of San Onofre Nuclear Generating Station
- Cabrillo Power/NRG
- British Petroleum
- The U.S. Fish and Wildlife Service's Sport Fish Restoration Account
- Chevron Corporation
- The Catalina Seabass Fund
- The Shedd Family
- The Fletcher Foundation
- The San Diego Foundation's Blasker Grant Program
- The Marina del Rey Anglers
- The San Diego County Fish and Wildlife Commission
- Darden Restaurants Foundation