HSWRI Aquaculture Program Research Report
**** August & September 2009 ****

Record Year for Production of California Yellowtail

The 2009 season was a record year for juvenile production of California yellowtail (YT) at HSWRI's research laboratory on Mission Bay. While the actual numbers of fish produced is still experimental in scale (~45,000), the improvement in larval survival (~5%) is becoming more favorable for future commercial considerations (Figure 1).

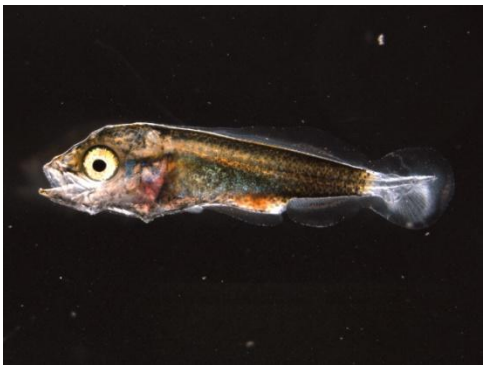

Figure 1. Photograph showing larval YT at 16 dph

We have maintained a single breeding population of YT since 2003 that typically spawns from April to August under ambient photoperiod and temperature conditions. Historically, we raised larvae through to metamorphosis (35 dph) in temperature controlled recirculating 1,600L conical tanks and then graded them into smaller, shallower 1,000L flat bottom tanks. In 2009 we changed our methods, largely based on the behavior of the fish. Specifically, by 10 dph they are found in the upper 25 cm of the water column, so we thought increasing the surface area of the rearing vessel at that age would be a logical approach to reduce density in that microhabitat. We accomplished this by moving the delicate larvae from the deep, narrow conical tanks of <1.5 m in diameter and 2 m deep (Figure 2) to shallower flat bottom tanks that were 4 m in diameter and 1 m deep. This effectively increased the surface area by 6-9 times. In addition to this major modification to our methodology, we improved the consistency and intensity of our tank lighting and weaned the fish even more aggressively.

Figure 2. Photograph showing 1600 L narrow, deep egg hatching and early larval rearing vessels.

Next year we hope to further improve larval survivorship and culture efficiency, and also reduce the frequency of deformities, which is very high at 40-60%.

Research and Development of Soy-Based Diets for Marine Fish

Throughout 2009 we continued to test various soy-based protein sources in the diet of white seabass (WSB) and YT (Figure 3). This work is being conducted in collaboration with Dr. Allen Davis of Auburn University with funding from the United Soybean Board.

The first trial for WSB tested a series of practical diets formulated to contain 31-46% protein and 6-12% lipid with 20-30% fish meal. At the conclusion of this trial weight gain ranged from 278-346% and food conversion rates (FCRs) were 1.3-1.4. The results indicate that protein levels as low as 40% will support good growth under experimental conditions. The second trial utilized a 40% protein 10% lipid test diet formulated with 18% fish meal and the remainder of the protein from plants (primarily soy) to provide insight into the need for specific amino acid (AA) supplements that are commonly limiting for fish in plant-based diets. Supplements of methionine and taurine were evaluated at different levels (in the 18% fish meal diet) and the results compared to a diet containing 36% fish meal. Diets supplemented with taurine gave a significant improvement in performance over un-supplemented diets, while methionine showed a more modest but still positive effect.

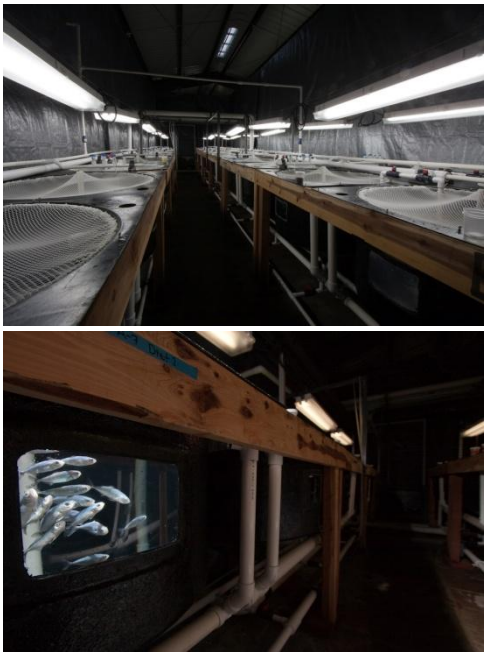

Figure 3. Photographs showing one of four experimental systems currently used for nutrition studies. YT visible in window in lower photograph.

The first trial for YT tested a series of diets formulated to contain 40-52% protein and 10-16% lipid, respectively with 41-54% fish meal. At the conclusion of this trial weight gain ranged from 789-1297% and FCR from 0.8-1.1. The results indicate that protein levels as low as 48% will support good growth under experimental conditions. The second trial utilized a 48% protein 14% lipid test diet formulated with 20% fish meal and the remainder of the protein from plants to evaluate the necessity for the dietary AA supplements of methionine, lysine and taurine. As with WSB, supplements of taurine had a positive effect on growth of YT. We hope to continue this research next year to determine specific requirements of limiting AAs which should help facilitate higher inclusion levels of soy protein in diets for both species.

Santa Catalina Island Netpen Operations and Infrastructure

Since 1998, HSWRI scientists have operated a netpen facility in Catalina Harbor, at the Isthmus of Santa Catalina Island. Originally built for a NOAA-funded pilot project, this facility is currently used to hold broodstock (Figure 4) and raise juvenile WSB. Historically this facility has also been used to support fisheries research, including studies of acoustics and catch and release. With recent modifications to our broodstock management and juvenile release plans, the need for this facility has become even more important. Specifically, our new broodstock management plan calls for rotating as many as 50 new adult fish into the hatchery breeding program each year. The net pens at Catalina serve as an excellent holding facility to meet this objective, especially since Catalina is a "hot spot" for WSB fishing. Secondly, our recent analysis of mark-recapture data clearly shows that acclimating fish in net pens prior to release significantly improves post-release survival. The net pen capacity of the WSB program is limited in this regard, and the Catalina facility is by far the largest.

Figure 4. WSB brood fish consumes fresh squid in net pen at Catalina Island.

Recognizing the ever-increasing importance of the Catalina facility, we made significant infrastructure improvements this year, with continued financial support from the Catalina Seabass Fund. First, we hired Patrick Jernigan as the new full-time site manager for the net pen operation. Patrick comes to us with excellent marine experience after working as a submarine navigator for the US Navy and obtaining his 100-ton USCG captain's license. He has been residing on Santa Catalina Island for the past few years absorbing useful local knowledge that will help him excel in his new position.

Secondly, we purchased a used vessel in good condition that will serve as Patrick's new home and site security for the net pen in Catalina Harbor (Figure 5). The *Sidekick* is a 32' Bayliner Conquest built in 1979 that comes complete with a galley, twin engines, full electronics, two staterooms and head. In addition to providing Patrick shelter, *Sidekick* is well equipped for fishing, which will advance our efforts to collect additional broodstock.

Figure 5. Newly purchased vessel *Sidekick* moored to Catalina net pen will fill critical needs of housing, on-site security, and brood fish collection.

These new additions promise to make the net pens at Santa Catalina Island an even more productive component to the WSB replenishment program in 2010.

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 Scientist and Aquaculture Program Manager, Mark Drawbridge.

The Aquaculture Research Program has been active for more than 25 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 mdrawbridge@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
- Cabrillo Power/NRG
- SeaWorld San Diego
- The U.S. Fish and Wildlife Service's Sport Fish Restoration Account
- Chevron Corporation
- The Catalina Seabass Fund
- The Shedd Family
- The Fletcher Foundation
- California Sea Grant
- NOAA Fisheries
- National Sea Grant Program, National Marine Aquaculture Initiative
- USDA Cooperative State Research, Education & Extension Service
- United Soybean Association
- San Diego County Fish and Wildlife Advisory Commission