HSWRI Aquaculture Program Research Report
**** December 2009 & January 2010 ****

Growth of California Yellowtail at Different Temperatures

One of the most important environmental parameters exerting an influence on fish is temperature. Because most fish are cold-blooded they cannot thermoregulate metabolically and therefore must adapt to the water temperature in their environment. In the wild, fish cope with this by swimming to areas of "comfortable" temperature. Thermal "comfort zones" vary among species and life stages. In an aquaculture setting, the fish's movement is restricted, so the local thermal environment and fish's thermal comfort zone must be well understood and matched in order to ensure good fish health and performance. Recirculating aquaculture systems offer the luxury of being able to control the water temperature (at a cost), so that an "optimized" thermal regime can be provided for the fish year-round. In more open systems, like offshore cages, the temperature varies seasonally and with depth, so it is critical to match the species needs with thermal characteristics of the site. In a new project funded by the USDA National Institute of Food and Agriculture, we have begun to investigate the relationship between temperature and growth for California yellowtail (YT), striped bass (SB), and white seabass (WSB). In this article we will focus on YT.

Figure 1. Research Scientist, Jeff Smiley, works among the replicate thermally controlled tank systems.

We recently conducted a 6-week growth trial on YT at rearing temperatures of 16, 19, and 22 °C. Coastal temperatures in southern California range from 12-22 °C, so this trial encompassed the mid to upper thermal range that caged fish would experience. The weight of fish were measured before the experiment began and

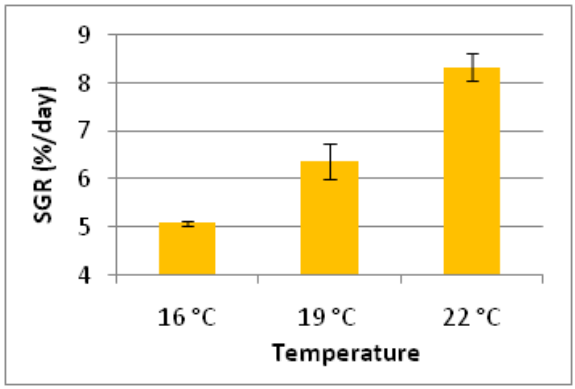

Figure 2. Specific growth rate (SGR) of YT during a six week trial when maintained at 16, 19, and 22 °C.

every two weeks for six weeks. Fish were acclimated from their initial rearing temperature of 19 °C to their experimental temperatures at 1 °C per day. All fish were fed to satiation twice daily. As expected, there was a direct positive relationship between temperature and growth (Figure 2). The weight of YT increased from 1.3 g to 11.7 to 20.3 to 44.0 g at 16, 19, and 22 °C, respectively. Food conversion rates were consistently less than 1.0 and better with increasing temperature.

HSWRI Modernizes White Seabass Broodstock Systems

After more than 15 years of continuous and reliable duty, we have initiated the process of modernizing our main breeding pools for WSB. This process builds off of a very successful collaborative project recently completed with Dr. Ron Malone of LSU, which was funded by the USDA National Institute of Food and Agriculture (formerly CREES). This project, reported in our October-November 2008 newsletter, was focused on the use of an air-lift driven bead filter as the central component in a recirculating maturation system for YT brood fish.

We have incorporated this same energy-efficient technology into the first phase of retrofitting our five WSB maturation systems (Figure 3), which historically have operated off of rapid sand filters. In addition to the filtration components, the WSB systems are photo-thermally controlled to induce spawning in the fish year-round, which requires a side-loop heat exchange system that is computer controlled. Although this feature is different from our YT system, it has been standard on our WSB pools. Among the modernized features of the new WSB systems are 1) the use of an elevated deck and egg collection sump that are made exclusively from non-corroding, sturdy plastic materials, 2) the integration of an automated electronic dimmer that simulates sunrise-sunset, and 3) customized fiberglass lids to improve insulation, biosecurity and aesthetic qualities of the system. The first of five pools has been successfully retrofitted and is currently holding 48 brood fish weighing 3 to 28 kg.

Figure 3. **N**ewly designed and constructed recirculating maturation system for WSB.

We are currently seeking additional funding that will allow us to evaluate the system performance under rearing densities that are routinely much greater (15-20 kg/m3) than our YT system (~5kg/m3). We are also interested in understanding the thermal efficiencies of the system as driven by an airlift.

Reducing the Level of Fish Meal in the Diets of Marine Finfish

We are continuing research funded by California Sea Grant with Co-Investigators Dr. Rick Barrows of the USDA/ARS and Dr. Ron Hardy of the University of Idaho with the

goal to reduce or eliminate fish meal and oil in diets for marine finfish. This research continues to yield exciting results.

In a recent feeding trial with YT, we tested a series of diets with fish meal being replaced by blends of alternative proteins including soy, corn gluten and poultry by-product proteins. The performance of YT on diets containing 20, 10 and 0% fish meal was compared to a 62% fish meal control diet. Similar to previous results with WSB, YT performed very well on diets with as little as 10% fish meal, and diets of 20% fish meal actually outperformed the 62% fish meal control. Only the 0% fishmeal diets showed poorer performance than the 62% fish meal control. This is very exciting because YT are considered a high performance species requiring high quality diets.

We recently completed two additional trials with WSB testing a series of 0% fish meal diets made with a high quality chicken by-product protein, and corn protein concentrate with *Spirulina* and liver meal as palatability enhancers. WSB did very well on these diets, outperforming fish that were fed both a fish meal and a commercial control diet. The diet with *Spirulina* seemed to be accepted by the fish more quickly at the beginning of the trial than the other diets, suggesting that *Spirulina* may be a palatability enhancer.

Figure 3. California yellowtail wait to be fed in one of the experimental tanks.

Acknowledgements

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HSWRI's aquaculture research program has been active for more than 25 years. 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

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- Chevron Corporation
- The Catalina Seabass Fund
- The Shedd Family
- The Fletcher Foundation
- California Sea Grant
- NOAA Fisheries
- USDA National Institute of Food and Agriculture
- United Soybean Association
- San Diego County Fish and Wildlife Advisory Commission
- NOAA's Saltonstall-Kennedy Program

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