HSWRI Aquaculture Program Research Report
**** April & May 2011 ****

Utilizing Seafood Processing Trimmings in Diets of Farmed Marine Finfish

A large portion of seafood caught for human consumption is discarded after the edible portion has been removed despite the fact that the "trimmings" are still an excellent source of high quality protein meal and oil (Figure 1). In order to make use of this underutilized resource and help relieve a burden on other exploited fisheries, such as sardine, HSWRI researchers are attempting to use regionally sourced processing trimmings to replace industrial fish meal and fish oil in aquaculture feeds for marine finfish. This project is funded by NOAA's Saltonstall-Kennedy Program in collaboration with Pete Nicklason of FishTek, Inc in Seattle, WA, and Steve Foltz of Chesapeake Fish Company in San Diego. Project advisors include Dr. Mike Rust of NOAA Fisheries, Dr. Rick Barrows of USDA/ARS and Chris Nelson of Nelson and Sons Feed Company.

To start this project, HSWRI conducted a regional survey of fish processing facilities in Southern California to document the seasonal availability of various types and quantities of processing trimmings. Additionally, processors were asked if they would be interested in participating in a program that recycles their trimmings. Feedback thus far has been very positive.

Figure 1. Sample of fish processing trimmings that will be turned into fish meal and oil for experimental diets.

In the main part of this project, Chesapeake Fish Company is sending various types of processing trimmings to FishTek for analyses and further processing into meal and oil components. Proximate composition of the trimmings (content of protein, lipid, fiber, ash, etc.) is being used to determine how to best include them in diet formulations. Research Scientist Dave Jirsa will begin conducting feeding trials this summer using white seabass (*Atractoscion nobilis*) and California yellowtail (*Seriola lalandi*) cultured at HSWRI.

Quality Control Considerations in the Culture of Marine Finfish

Product quality is paramount for success in any farming or manufacturing business. Nowhere is this truer than in a culture-based stock enhancement program, where quality is linked directly to post-release survival. As production success increases, HSWRI scientists are focusing more attention than ever on quality attributes that include both the physiological and physical condition of the fish in culture and at the time of release. This newsletter article discusses recent work on the physical aspects of fish quality with a focus on hard tissue damage and malformations.

Figure 2. (Top) A young white seabass that has been cleared and stained to view hard and soft internal tissues. (Middle) A grossly deformed white seabass juvenile that is culled from the population. (Bottom) An X-ray of a California halibut showing fusion of the vertebrae.

HSWRI scientists have initiated a comprehensive plan to identify, define, and document malformations and their potential causes in the marine finfish under culture, recognizing that malformations are a common problem in finfish aquaculture worldwide (e.g. see http://www.finefish.info/finefish/). The causes of malformations may include nutrition (e.g. too much or too little of a particular vitamin or fatty acid), physical or mechanical forcing (e.g. water flow, total gas pressure), behavior (e.g. wall-nosing), and genetics, and can be difficult to pinpoint.

In addition to traditional photographic documentation, we are exploring various radiographic methods, such as CT and X-ray scanning, and clearing and staining techniques to aid in identification of missing or malformed bones and soft tissue structures internally. As part of our approach, we are also documenting "normal" development and anatomical features in cultured and wild fish. Concurrently, we are conducting tank-based experiments that we hope will help determine the cause of the malformations. For example, we currently have a feeding study underway funded by California Sea Grant that is testing various levels of phosphorous in the diets of fish to

see what effects it has on the performance of marine fish, including bone development, where it makes up a significant percentage of the tissue biomass. Information gathered from these investigations will be used to optimize our culture techniques to help reduce the occurrence of malformations among fish in our aquaculture program.

Raceway Conversion Project Nears Completion

After several years of planning and construction, HSWRI researchers are nearing completion on a demonstration project that has converted dual concrete raceways operating on a flow-through water supply into a single rearing unit coupled to a recirculating aquaculture system (RAS; Figure 3). This conversion to RAS offers several significant benefits. First it allows greater control over the culture environment to maximize fish performance and general health. For example, recirculation allows you to control water temperature cost-effectively (because the heated or cooled water is not discharged but rather re-used) thereby maintaining each species and life stage in its "comfort zone". This in turn can be used to maximize growth and feed conversion efficiency and minimize health problems that would otherwise be facilitated in fish under thermal stress. Secondly, RAS provides greater protection from naturally occurring pathogens. Recirculation systems effectively reduce the volume of new water entering the system, which represents the primary vector for diseases on flow-through systems. This reduces the number of pathogens passing through the system and exposure to the fish. In addition, because makeup water flow is significantly reduced in recirculation systems, it can be cost-effectively sterilized with ultraviolet light or ozone. In other words, recirculation systems allow the implementation of a much more stringent

Figure 3. Fiberglass pool being lowered in concrete raceway for assembly.

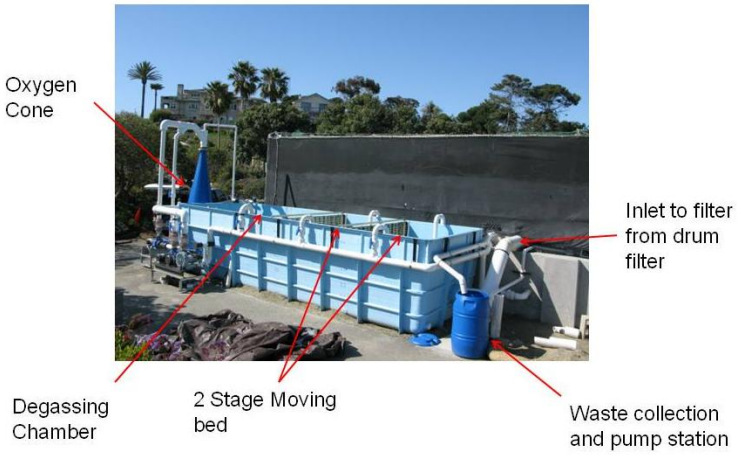

Figure 4. Various components of the RAS filtration system set behind the rearing tank.

biosecurity program. Finally, RAS allows buffering against external perturbations – both natural and manmade. These perturbations include fluctuations in temperature, total dissolved gas, and salinity that occur daily and seasonally, as well as red tide events that have become increasingly common along the coastline. Agua Hedionda Lagoon is also dredged periodically, which results in other perturbations such as increased suspended solids.

The new RAS system consists of a fiberglass D-end raceway outfitted with an overflow box and four bottom drains for solids removal. Filtered water is supplied to the raceway at 1,900 liters per minute and is then gravity fed to a micro screen drum filter for solids removal down to 60 microns before reaching a horizontal filtration unit. The filtration unit measures 7.3 x 2.4 x 1.8 m (24 x 8 x 6 ft) and houses a $5m^3$ moving bed bio reactor and a degassing chamber to bring total dissolved gas pressures to 100% and vent CO_2 (Figure 4). Efforts are being made to incorporate protein skimming capabilities as well. Before returning to the tank a portion of the water is redirected to an oxygen before it rejoins the full flow and passes through a 750 watt UV Sterilizer.

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The aquaculture research program has been active for more than 30 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 aquatic farming. Please direct any questions to Dr. Kristen Gruenthal at kgruenthal@hswri.org.

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- NOAA's Saltonstall-Kennedy Program
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- SeaWorld Parks and Entertainment
- SeaWorld San Diego
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- The Shedd Family
- The U.S. Fish and Wildlife Service's Sport Fish Restoration Account
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