
HSWRI Aquaculture Program Research Report

*** August - September 2015 ***



WRAC Larval Nutrition Workshop Deemed a Success

After months of planning and preparation, HSWRI recently hosted a 3-day workshop entitled “Larval Feeds and Feeding Strategies for Marine Fish”. The workshop was designed as an education, training and discussion platform focused on feeds and feeding strategies for larval marine fish with applicability to other marine and freshwater organisms that are fed. It was organized by experts from the National Oceanic and Atmospheric Administration (NOAA), United States Department of Agriculture (USDA), Oregon State University (OSU), University of California Davis (UCD), and Hubbs-SeaWorld



Figure 1. Participants at the recent Larval Nutrition Workshop take time from a busy agenda to pose for a group photo.

Research Institute (HSWRI). The workshop represented an extension

component of a recently-completed three year collaborative research project funded by the Western Regional Aquaculture Center (WRAC). The workshop incorporated lectures with hands-on learning activities with marine fish of different life stages from eggs to juveniles.

A total of 27 people participated in the workshop, which culminated in a tour of HSWRI’s marine fish hatchery in Carlsbad, CA. Recognizing that nutritional approaches to larval rearing success must be coupled with other sound husbandry practices, the agenda covered a broad range of topics from broodstock husbandry to microbial management strategies. Approaches to larval nutrition were partitioned into the live and formulated feed stages, with a discussion of approaches to co-feeding. The live feeds section of the workshop included copepods, rotifers, *Artemia*, as well as associated enrichment strategies. The section on microdiets included formulation and manufacturing processes, which were shared with participants in a video format that greatly enhanced the learning experience. Research methods and results were also shared



Figure 2. Clockwise from upper left – participants engaged in presentations; a demonstration of egg harvesting methods and quality considerations; a demonstration of methods used to make formulated broodstock feeds; and a demonstration of basic larval rearing methods used at HSWRI.

among the participants, including the use of novel feed markers to track ingestion; novel delivery methods for incorporating specific nutrients into live prey and formulated diets; development of open formula feeds; testing of different food particle types and associated manufacturing processes; and behavioral methods in larval nutrition research.

Lively discussions during the meetings and mandatory social hours reinforced the fact that many of the challenges in rearing marine fish larvae are shared throughout the small community of researchers and growers in the United States.

HSWRI and OSU Continue Larval Nutrition Research

HSWRI researchers and collaborating partners from Oregon State University recently received funding for their project “Nutritional approaches in larval marine fish culture to maximize fish production and quality for stocking and farming programs” through NOAA’s Saltonstall-Kennedy program. The project addresses a specific theme that has been identified by NOAA as a priority – “Increase the supply, quality, and diversification of domestic seafood”.

Building off R&D success from a recent three year WRAC project, the team is well positioned to make further significant advances in larval feeds development. This research proposal is focused on white seabass and California yellowtail - two commercially desirable, high value species in the southwest region that will benefit from improved culture methods yielding greater quantities and quality. Those species are being cultured for traditional farming and stock enhancement applications – two important means for taking pressure off wild stocks and supporting a sustainable seafood supply. The primary goal of this project is to apply nutritional approaches to larval culture that yield at least a 10% increase in survival from egg to a juvenile stage, and a similar decrease in bony malformations. To achieve these goals we will seek to optimize enrichment methods for increasing the levels of taurine, iodine, selenium, vitamin C and HUFA in rotifers and *Artemia* using liposomes. Once this is complete, we will evaluate the effects of the liposome-enriched live feeds on the growth, survival, and deformity rates of marine fish larvae.



Figure 3. Kevin Stuart from HSWRI and Matt Hawkyard from OSU collaborate on feeding study at HSWRI.

The impacts and benefits of this project are expected to be significant within the southern California and beyond, especially as it appears regulatory hurdles are being surmounted for cage farming in U.S. waters.

Feeding Trials in Coastal Cages Successful in San Diego Bay

HSWRI has been conducting feeding trials for many years to develop low fish meal formulations for marine finfish. Most of these trials are relatively short in duration, up to 10 weeks. While effective at evaluating and developing formulations under highly controlled and replicated conditions, these trials have their limitations particularly when the results are to be applied with confidence over long term growing periods that are typical of a commercial farm. Recognizing these limitations, we have begun conducting longer term trials of up to 10 months in recent years.



Figure 4. Location of growout feeding trial in San Diego Bay.

The most recent of these trials was conducted in cages moored in San Diego Bay - a unique and very urban setting. This site is primarily operated as a growout facility for the Ocean Resources Enhancement and Hatchery Program (OREHP) in conjunction with the San Diego Oceans Foundation. For this trial we stocked three 14m³ cages with 100 white seabass weighing 90g each. The fish in each cage were fed either a high (36%) or a low (12%) fish meal diet, or a commercial formulation over a period of five months. The supplemental protein source in the low fish meal diet was primarily soybean meal. These diets were formulated by co-researchers at Auburn University and manufactured by Iowa State University. Health and survival were good among all



Figure 5. Juvenile cultured seabass harvested from a cage.

treatments, with greater than 90% survival in all cases. The commercial diet provided the best growth performance with fish reaching an average weight of 276g. The fish fed the high and low fish meal diets reached an average weight of 162g and 194g, respectively. These results are encouraging because our low fish meal diet outperformed the high fish meal diet but clearly there is more work to be done to optimize the formulation. Because the commercial formulation is proprietary, it is difficult to determine why it outperformed our experimental formulations. However, the commercial diet does serve as a reference for what level of fish performance is achievable. We plan to continue conducting long term feeding trials with experimental formulations with graded levels of ingredients to elucidate differences and optimize more sustainable diets.

Acknowledgements

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The aquaculture research program has been active for more than 35 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 Mark Drawbridge at mdrawbridge@hswri.org.

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



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- Avalon Tuna Club Foundation
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