



Summaries of Projects 2005-2011 Western Regional Aquaculture Center

Optimizing the Larval Nutrition of Marine Finfish Aquaculture Species Along the West Coast

Funding level: \$198,094
Project start date: Pending NIFA approval
Project duration: 3 years
Participants: Hubbs-SeaWorld Research Institute (Lead Institution), NOAA Fisheries, Oregon State University, USDA/ARS-Hagerman Fish Culture, University of California-Davis

The long term goal is to develop the Western Region's finfish aquaculture through developing and implementing innovative larval feeds and feeding techniques. This goal involves:

- 1) Establish baseline indices for each species using current culture techniques as a benchmark for evaluating the project's success over time;
- 2) Refine and implement methods that allow assessment of larval feed intake and behavior;
- 3) Increase survival and growth during the larval stage through optimization of live food types and enrichment formulations; and
- 4) Increase survival, fitness, and growth during weaning from live foods to formulated feeds through the development and/or identification of formulated micro diets.

Environmental and Endogenous Factors Affecting Egg Quality and Caviar Yield in Farmed Sturgeon

Funding level: \$480,000
Project start date: Pending NIFA approval
Project duration: 4 years
Participants: University of California-Davis (Lead Institution), Washington State University, Montana State University, College of Southern Idaho, Fish Breeders of Idaho, Sterling Caviar, The Fishery, Blind Canyon Aqua Ranch

The long term goal is to improve the yield and quality of caviar in farmed sturgeon in the Western Region. This goal involves:

- 1) Conduct feeding trials to determine the effect of dietary energy on roe yield in early and late maturing females;

- 2) Conduct a feeding trial with prepubertal sturgeon to determine effects of dietary energy on accumulation of ovarian fat in early ontogeny;
- 3) Determine the effect of farm, diet, and maturity age on chemical and sensory properties of caviar;
- 4) Determine the dietary effect on the crude chemical composition of sturgeon ovaries and proliferation of adipose tissue in prepubertal fish;
- 5) Determine the effect of genotype on roe yield and ovarian adiposity in adults and on ovarian adiposity in prepubertal sturgeon;
- 6) Develop an integrated approach for management of farmed sturgeon with high caviar yield and quality as outreach for project.

Optimizing Dietary Protein and Energy Utilization to Improve Production Efficiency of Tilapia in the Western United States

Funding level: \$201,379
Project start date: FY 2009
Project duration: 3 years
Participants: U.S. Fish and Wildlife Service-Bozeman Fish Technology Center (Lead Institution), USDA-ARS trout Grains Project, University of Arizona, University of Idaho, Rangen Inc.

The long term goal is to optimize commercial tilapia diet formulations for the intensive culture systems utilized in the Western United States. This goal involves:

1. Identifying the optimum dietary protein to energy ratio(s) in practical diets for two different size classes and species of tilapia;
2. Evaluating the ability of vitamin supplementation to improve growth performance at different protein:energy ratios as well as further evaluating potential formulations identified by laboratory testing in a pilot-scale on-farm trial; and
3. Developing an integrated outreach program, including at least one WRAC Extension publication, to meet the stakeholders' needs.

Cost-Effective, Alternative Protein Diets for Rainbow Trout that Support Optimal Growth,

Health and Product Quality

Funding level: \$359,728
Project start date: FY2009
Project duration: 3 years
Participants: U.S. Fish and Wildlife Service-Bozeman Fish Technology Center (Lead Institution), Washington State University, Colorado State University, USDA-ARS trout Grains Project, University of Idaho, Rangen Inc., Silver Cup Fish Feed

The long-term goals are to develop cost effective alternative ingredient diet formulations that support maximal growth, health and product quality and to increase the amount of information available to feed manufacturers regarding amino acid availabilities and retention efficiencies of synthetic amino acids, thus improving utilization of alternative ingredients in trout feeds. To achieve these goals the project will:

1. Identify commercially available alternate ingredient combinations that can meet the production needs of rainbow trout;
2. Further refine amino acid balance as a means of reducing interactive growth depressions when novel combinations of ingredients are utilized;
3. Compare formulations in fish growth to market size and the influence of the formulations of growth, fish health, product quality and consumer acceptance; and
4. Develop an integrated outreach program including at least one WRAC Extension publication to meet stakeholders educational needs.

Coldwater Disease Prevention and Control Through Vaccine Development and Diagnostic Improvements

Funding level: \$324,874
Project start date: FY2008
Project duration: 4 years
Participants: University of Idaho (Lead Institution), Washington State University, Clear Springs Foods, Inc., USDA-ARS National Center for Cool and Cold Water Aquaculture, University of Idaho, USGS-Wahington, Troutlodge

The goals of this project are to evaluate strategies that would aid in developing more effective ways of managing coldwater disease (CWD) at aquaculture facilities, and to identify possible bacterial genes that may be targeted for vaccine development and testing. Presently, disease management is difficult at many facilities and there is no commercial vaccine available for *Flavobacterium psychrophilum*, the causative agent for CWD. The specific objectives of the project are as follows:

1. Identify potential vaccine candidates using in vivo-induced antigen technology (IVIAT) followed by screening with convalescent serum from trout;
2. Validate quantitative diagnostic assays (ELISA and ovarian fluid filtration FAT).
3. Based on the results from objective 2; develop other assays (e.g. real-time quantitative

- PCR) for quantification of infection in ovarian fluid; and
4. Develop an integrated outreach program to meet stakeholder's needs.

Potential Threat of Great Lakes VHS Virus in the Western United States

Funding level: \$100,000
Project start date: FY2008
Project duration: 2 years
Participants: USGS Western Fisheries Research Center (Lead Institution), University of Washington, USGA Western Fisheries Research Center Marrowstone Marine Station; Oregon State University, University of Idaho, Clear Springs Food, Inc.

Viral hemorrhagic septicemia (VHSV) was first identified in the Great Lakes in 2005 as the causative agent of a large-scale die-off of freshwater drum in Lake Erie. Since then, numerous epidemics in multiple host species have occurred in the Great Lakes region, resulting in an extreme level of concern and severe restrictions on aquaculture activity. This project has outreach and research objectives that address specific needs of fish farmers in the western region of the United States, and will contribute to the national response to the emergence of VHSV in the Great Lakes. The five specific objectives for this project are:

1. Assemble and distribute biosecurity information currently available for dealing with VHSV;
2. Develop diagnostic assays to differentiate Great Lakes VHSV IVb from endemic West Coast VHSV Iva;
3. Test susceptibility of yellow perch, rainbow trout, herring, and Chinook salmon to disease and mortality caused by Great Lakes VHSV IVb, West coast VHSV Iva and European VHSV I;
4. Test ability of relevant host species to act as carriers and/or reservoirs of different VHSV genotypes; and
5. Develop outreach materials to communicate project results.

Economic Impacts of Private Sector Aquaculture-Based Recreational Fishing in the

Western USA

Funding level: \$198,698
Project start date: FY2007
Project duration: 4 years
Participants: Colorado State University (Lead Institution), University of California-Davis, University of Alaska-Anchorage, New Mexico State University, University of Idaho Extension, University of Arizona, Cline Trout Farms, Inc.

The objective of this project is to collect primary data from three distinct subpopulations: Aquaculture Suppliers of Recreational Fish (ASRF), their direct customers, and recreational anglers, and prepare an economic report quantifying the magnitude and value of the economic contributions of the ASRF industry. The specific objectives of this project are as follows:

1. Collect Primary data from three distinct subpopulations: Aquacultural Suppliers of Recreational Fish (ASRF), their direct customers, and recreational anglers, and prepare an economic report quantifying the magnitude and value of the economic contributions of the ASRF industry;
2. Provide and appropriate sampling frame for tracking and documenting trends over time in the ASRF Industry for use in subsequent economic analyses;
3. Generate primary research about the impacts of the regulator and competitive environment on the aquaculture industry, including the relationships between private and public hatcheries, interstate trade regulations, and Native American reservation policies; and
4. Develop a variety of outreach materials (including final report, peer-reviewed articles, extension, and popular press articles) and disseminate information (conferences, meetings, etc.).

Determining Ripeness in White Sturgeon Females to Maximize Yield and Quality of Caviar

Funding level: \$200,002
Project start date: FY2007
Project duration: 4 years
Participants: U.S. Fish and Wildlife Service-Bozeman Fish Technology Center (Lead Institution), University of California-Davis, Washington State University, Eastern Oregon University, Montana State University, Blind Canyon Aqua Ranch, Fish Breeders of Idaho, University of Idaho Extension, Sterling Caviar LLC

The long-term goal of this study is to develop a less-invasive, faster, and better predictor of maturity than oocyte polarization index (PI) in sturgeon. The overall objective of this study is to correlate current predictors of maturity with instrumental and biochemical assays conducted at different stages of ovarian maturity in white sturgeon. The specific objectives of this study are as

follows:

1. Determine how currently utilized morphological characteristics (oocyte PI, ovarian follicle size, gonadosomatic index, age and live weight) correlate with caviar quality and yield;
2. Determine how plasma sex steroid, total calcium, and plasma protein levels and crude chemical composition of eggs change with maturity;
3. Evaluate short wavelength near infrared spectroscopy (SWNIR) and ultrasound as a non-invasive technique to predict fish maturity by taking spectra of gonads in fish;
4. Evaluate Fourier-transform infrared spectroscopy (FT-IR) as a method to predict fish maturity from spectral measurements of blood and roe; and
5. Using SWNIR and plasma steroids, determine whether it is possible to detect the early signs of ovarian atresia to avoid sacrificing fish with inferior quality roe and use them during the next production cycle.

Physiological Changes Associated with Live Haul: Maintaining Healthy Fish

Funding level: \$352,100
Project start date: FY2005
Project duration: 4 years
Participants: NOAA National Marine Fisheries Service(Lead Institution), Clemson University, Oregon State University, Scientific Hatcheries, Fish Breeders of Idaho, University of Idaho, Troutlodge

The overall objective of this research is to improve the fish health and survival of transported fish. The potential economic impacts of hauling mortalities are complex and not easily estimated. The project will analyze the effects of transport on live fish and develop a mortality model to allow prediction of post-haul mortality based on the hauling conditions and quality of fish at the end of haul. A measure of hauling intensity (or hauling stress) and fish quality will also be developed. Based on the mortality model, recommendations will be made for modification of existing transport systems to industrial cooperators. Program objectives include:

1. Compare crowding and different net types on bodily injury;
2. Determine effects of pre- and post-transport salt-dips on survival after transportation of tilapia;
3. Assessment of parasitic and bacterial load of transported tilapia;
4. Determine the effects of fasting on ammonia levels of transport water;
5. Conduct detailed water quality monitoring during tilapia and adult chinook hauling trip;
6. Modify existing holding systems for 1- to 1.5-pound tilapia and develop simulated hauling systems for laboratory use;
7. Assemble low light video systems for directly observing tilapia in raceways, crowding, and in hauling tanks; and
8. Conduct outreach projects

Development and Evaluation of Starter Diets and Culture Conditions for Three Subspecies

of Cutthroat trout and Gila Trout

Funding level: \$355,229
Project start date: FY2005
Project duration: 4 years
Participants: Colorado State University(Lead Institution), U.S. Fish and Wildlife Service-Bozeman Fish Technology Center, Cline Trout Farms, U.S. Fish and Wildlife Service-Mora National Fish Hatchery and Technology Center, University of Idaho, Nelson and Sons Inc., Silver Cup Fish Feed

The purpose of this research is to improve the growth, quality, and survival of cutthroat trout (*Oncorhynchus clarki* subsp.) and Gila trout (*O. gilaegilae*) with the ultimate goal of providing fish culturists and feed manufacturers with information that can be used to improve the production of these species. Specific objectives include:

1. Determine the effect of feed texture and formulation on survival, growth, and quality of cutthroat and Gila trout;
2. Determine the effect and interaction of diet texture and formulation on trout growth, survival, and quality when reared at different water temperatures under laboratory conditions;
3. Determine the effect of rearing density on trout growth, survival, and quality
4. Conduct production-scale evaluations of the best diet x temperature x density combinations identified in the first three objectives. This will also allow us to test our assumption that a diet developed for two to three subspecies of cutthroat trout will provide superior performance for other untested cutthroat trout subspecies (e.g. Rio Grande cutthroat trout, *O. clarkii virginalis*, and greenback cutthroat trout, *O. clarkii stomias*) than diets developed for rainbow trout; and
5. Develop outreach products to provide fish culturists and feed manufacturers with information on optimal growth temperatures, optimal rearing densities, and diet formulations for inland cutthroat trout subspecies and Gila trout;

An Evaluation of the Effectiveness of Various Florfenicol Treatment Regimens to Control Mortality Caused by *Streptococcus iniae* in Cultured Hybrid Striped Bass

Funding level: \$94,711
Project start date: FY2005
Project duration: 3 years
Participants: U.S. Fish and Wildlife Service-Bozeman Fish Technology Center (Lead Institution), Intrinsic Lifesciences, Washington State University Cooperative Extension, Oregon State University, Kent SeaTech Corporation

The purpose of this research project is to determine whether an alternate (i.e. higher concentration and/or longer treatment duration) treatment regimen (other than 10 mg florfenicol/kg fish body weight administered on 10 consecutive days) is more efficacious in

controlling mortality in hybrid striped bass (HSB) caused by *Streptococcus iniae*. Specific objectives include:

1. Using isolates of *S. iniae*, determine which route of infection (immersion or IP injection) of HSB that will consistently yield a mean cumulative mortality of 50% in the exposed group with the least statistical variation among replicates. Also, identify important dose-dependent variables, such as: time to onset of first morbidity, time to first mortality, and total cumulative mortality;
2. Refine methodologies identified in #1 to consistently yield a mean cumulative mortality of 50% in HSB of a different age exposed to isolates of *S. iniae*;
3. Using the optimal dose and exposure route described in #2, determine the most effective treatment dose of florfenicol to control mortality in HSB experimentally infected with *S. iniae* fed a medicated feed top-coated with either 0, 10, 15, or 20 mg florfenicol/kg fish/d for 10 d. This data will identify the lowest treatment dose that results in the highest survival during the 10 day trial;
4. Using the lowest treatment dose that resulted in the highest survival (identified in #3), determine the most effective treatment duration of florfenicol to control mortality in HSB experimentally infected with *S. iniae* fed a medicated feed for either 0, 10, 15, or 20 days. This data will identify the shortest treatment duration that results in the highest survival; and
5. Demonstrate and substantiate that the most efficacious treatment regimen identified in #4 is also effective when florfenicol is administered to HSB naturally infected with *S. iniae* (i.e., controlled field trial).

AQUARIUS: Shellfish Sanitation Simulator, Rainfall and Water Quality Closure Rule Evaluator Version 2.0

Funding level: \$6,500
Project start date: FY2005
Project duration: 1 year
Participants: University of California-Davis (Lead Institution), California Department of Health Services

This is an Extension outreach proposal designed to complete the development of Aquarius Version 2.0, a computer-based, software simulation and statistical evaluation program used to evaluate hypothetical and proposed shellfish sanitation rainfall induced harvest closure regulations. The program is designed for State and Federal health service agencies and the commercial shellfish industry. It is used to evaluate proposed or hypothetical changes in rainfall closure rules in conditional approved shellfish growing areas based on rainfall and fecal coliform databases maintained by regulatory agencies. The original software program (Aquarius Version 1.0) was built by UC Davis personnel in cooperation with the California Department of Health Services (CDHS), and representatives of the California shellfish industry (Conte and Ahmadi, 2003). Aquarius Version 2.0, already under construction, will incorporate twelve new features. New features include a new design that increases its power of analysis through expanded simulation and additional statistical components that increase the program's capability in

assisting human health related decisions. The redesign and expansion is based on input from CDHS, state, federal, and industry representatives from California, Oregon, Washington, Alaska, and Canada who make up membership of the Pacific Rim Shellfish Sanitation Conference (PacRim). PacRim is the deliberating body that develops issues and recommendation of regulatory changes to be submitted to the Interstate Shellfish Sanitation Conference and the Federal Food and Drug Administration. The program has regional, national, and international application.