



Aquaculture of Opihi, Years 1 and 2

Funding level: \$100,000
 Project start date: August 1, 2010
 Duration: 2 Years
 Participants: Oceanic Institute (Lead Institution), University of Hawaii at Manoa, Texas A&M University

Opihi are a high value product in Hawaii, where an established niche market bolstered by the need for opihi at Hawaiian gatherings exists. Demand for opihi exceeds the level that the wild caught fishery can supply because of low natural abundances due to overfishing. While some highly academic marine biology studies have been conducted, a concerted aquaculture research effort has never been attempted and research is needed to develop cost effective means of opihi culture. In an effort to develop aquaculture of opihi, six researchers at three institutions will 1) collect wild giant opihi and establish a broodstock holding facility; 2) develop an artificial feed for opihi starting with natural diets and including artificial feeds made for other benthic grazers; 3) identify the best method of spawning opihi and develop larval rearing methods to increase survivorship; 4) identify optimal nutrient and attractant levels by systematically varying each individually; 5) rate the flavor and texture of cultured opihi using a panel of experienced opihi eaters; 6) work on sustaining the life cycle in culture, with a focus on improving management practices; and 7) transfer technology to motivated stakeholders via extensive, hands on extension and an industry manual summarizing the developed techniques for opihi aquaculture.

Developing a Value-Added Product “Half-pearls” from the Blacklip Pearl Oyster *Pinctada margaritifera* in Pohnpei (The Federated States of Micronesia), Years 1 and 2

Funding level: \$93,167
 Project start date: August 1, 2010
 Duration: 2 Years
 Participants: College of Micronesia: Land Grant Program (Lead Institution), Pakin Community Association

When they become incapable of producing sellable round pearls, so-called “useless” pearl oysters are killed and sold to the shell market as materials for buttons, handicrafts, and accessories. However, hemispherical pearls (“half pearls,” or “Mabe pearls,” as they are more commonly known) give value-added opportunities to the pearl oyster shells (mother-of-pearl shells) in jewelry and handicrafts. In Micronesia, where there is a niche tourism market, the half-pearls have potential to support a sustainable pearl business and rural development,

particularly for small family and/or community-based enterprises. The College of Micronesia Land Grant Program (COM) has been training Micronesians in half-pearl seeding for the last five years. These local seeding technicians have proven their ability to successfully produce half-pearls, and under the auspices of this project will transfer this technology to Pakin Atoll so the small community may benefit from this new revenue stream. Five participants representing one university and one community organization will collaborate to 1) conduct half-pearl seeding and produce half-pearls; 2) demonstrate and train half-pearl seeding techniques (to be completed by COM's Micronesian technicians) to selected youth from pearl farming communities; 3) demonstrate half-pearl pendants and accessory making (COM staff); and 4) conduct quality assessment of half-pearls and pearl shell-related accessories.

DNA-Based Identification and Selection of High-growth Tilapia in Hawaii

Funding level: \$100,000
Project start date: August 1, 2010
Duration: 2 Years
Participants: University of Hawaii at Manoa: Land Grant Program

The lack of genetically suitable seedstock of tilapia has been a limiting factor for tilapia aquaculture in Hawaii. Importation of tilapia strains to Hawaii has been challenged by environmental concerns and field-testing experiments. However, tilapias existing in the wild and on farms in Hawaii can be used as genetic resources for developing high-growth tilapia without importing new strains. Advances in molecular genetics have been applied for species identifications and genetic improvement of economically important traits. Specifically microsatellite genotyping and gene expression analysis have been proven as effective tools for genetic selection of superior animals with desirable production traits. The tilapia strains or hybrids currently existing in Hawaii can be classified by COI sequencing, allowing DNA-based genetic selections to be applied for the development of high-growth tilapia broodstock. The sole researcher conducting this project has identified the following objectives to meet this goal: 1) identify and classify wild and captive tilapia strains and hybrids in Hawaii by DNA-based methods; 2) develop DNA-based testing tools for selecting high-growth tilapia by using existing strains or hybrids in Hawaii; and 3) distribute educational materials and research results.

Collection and Health Certification of Coralgroupers Broodstock in the Mariana Islands

Funding level: \$58,360
Project start date: August 1, 2010
Duration: 1 Year
Participants: University of Guam (Lead Institution), Hawaii Department of Agriculture: Aquaculture Development Program

Coralgroupers are among the most sought after and valuable food fish of the coral reef habitat worldwide. They are some of the highest priced fish in the Live Food Fish markets in Hong Kong, where they are imported from across vast regions of Asia and Oceania. As such, many are listed as vulnerable on the IUCN Red list, including the species *Plectropomus leopardus* and *P.*

laevis. They are suffering from over fishing on Guam to the point where their natural recruitment may be threatened, and there is interest to restore the natural stocks of these two species. Furthermore, the aquaculture industry of Guam has a strong desire to develop a local, high end product that can be marketed as a live, in-restaurant product to the tourist trade. The bright red coloration of the Leopard coral grouper and the distinctive markings of the saddleback phase of the Giant coral grouper make them ideal products for a premium live fish dish in any white table cloth Asian cuisine restaurant. The purpose of this project is to begin the process of establishing a domesticated, high health population of the Leopard and the Giant coral grouper in Guam. Three researchers representing two organizations will aim to 1) capture sufficient numbers of each species to establish a breeding population; 2) test all fish for viral infections and maintain the fish in a secure, high health environment; and 3) raise the fish to the point where they have sufficient numbers of mature fish both sexes to undergo reproduction trials.

Adapting Aquaponics Systems for Use in the Pacific Islands, Years 1 and 2

Funding level: \$68,024
Project start date: August 1, 2010
Duration: 2 Years
Participants: University of Hawaii at Manoa

There is an interest in expanding the local production of fish and produce in the Pacific Islands. One solution is the integration of plant culture with fish farming, commonly called aquaponics. Extension of an existing aquaponics system has been attempted before in Saipan, but failed due to its reliance on expensive, breakage-prone, high maintenance mechanical components and a lack of basic scientific knowledge to modify the system. Preliminary studies suggest that retro-engineering of complex recirculating aquaponics systems may be possible by achieving an understanding of the nutrient flow in the system and developing an integrated recirculation/anti-denitrification system. Promising results have been obtained with a small scale (50 m²), modular tilapia and lettuce co-culture system that does not use much electricity and is comprised of one piece of equipment. Four researchers from the UH College of Tropical Agriculture and Human Resources will conduct the necessary research to finalize the system and transfer the technology interested Pacific Island clients. Specifically, project objectives are to 1) test the efficacy of the air breathers' Chinese catfish *Clarias fuscus* and Asian snakehead *Channa sp.* for aquaponics in Hawaii (use of air breathers could obviate the need for aeration and further simplify this system); 2) determine the nutrient profile of fish water generated by metabolism of a locally produced feed and determine the need for supplementation of this feed; 3) develop a planting and harvest scheme that will allow constant marketing of product; 4) complete a manual describing the construction, start up, and operation of the new aquaponics system; 5) transfer the system and accompanying training to a client in the Pacific and build a system; 6) conduct research in Hawaii that will refine the system for the Pacific Island client and/or expand the system to produce other desirable hydroponics vegetables; 7) make a site visit to extend this technology, and possibly assist other farmers to establish an aquaponics system; and 7) work with any interested fish farms in Hawaii to integrate hydroponics into their current production scheme, or agriculture farms interested in expanding into fish or reducing fertilizer costs.

Pacific Regional Aquaculture Information Service for Education (PRAISE) and

Publications, Year 5

Funding level: \$84, 079
Project start date: August 10, 2010
Duration: 1 Year
Participants: University of Hawaii at Manoa, Center for Tropical and Subtropical Aquaculture, Hawaii Department of Agriculture: Aquaculture Development Program

Acquisition and dissemination of marine science information and data about the Pacific region, especially as it relates aquaculture, is essential to the education and development of our industry and its researchers. An important component of dissemination is improving communication within the aquaculture community and increasing access to research materials. The goal of this project is to supply the aquaculture community in Hawaii and the U.S.-affiliated Pacific Islands with relevant information, using the Internet, traditional print formats, and other media. Educational support is the main focus of the Pacific Regional Aquaculture Information Service for Education (PRAISE), and information dissemination is the main focus of the CTSA Publications Specialist. Five individuals from two organizations will collaborate on Year 5 of this project with the following objectives: *PRAISE*: 1) create new web portal: Pacific Aquaculture News; 2) develop current bibliographies on aquaculture “hot topics” for inclusion on the News Portal; 3) promote Pacific Region information infrastructure; 4) continue to provide established services; and 5) transfer of technology. *Publications*: 1) inform industry members, educators, and other key individuals of pertinent aquaculture information, and update them on the status of regional aquaculture through various media; and 2) inform the aquaculture community and interested parties of the progress of CTSA and other Regional Aquaculture Center (RAC) projects in relation to our mission through the dissemination of our own and other publications.

Regional Biosecurity: Operational Biosecurity and Diagnostic Surveillance, Years 1 and 2

Funding level: \$199,997
Project start date: August 1, 2009
Duration: 2 years
Participants: Oceanic Institute (Lead Institution), Hawaii Department of Agriculture: Aquaculture Development Program, University of Hawaii at Manoa: Sea Grant Program

In response to a request by the Industry Advisory Committee (IAC) of the Center for Tropical and Subtropical Aquaculture (CTSA), the Hawaii Aquaculture Association (HAA), Aquaculture Development Program (ADP) and the University of Hawaii Sea Grant College Program (UHSGCP) are collaborating on this project to develop operational biosecurity procedures for the prevention of diseases, as well as improved diagnostics and surveillance capabilities in the region. The overall goal of the proposed project is to continue the expansion and diversification of Hawaii and Pacific aquaculture industries. A team of five researchers from three organizations have split the work into two separate segments. Specific objectives for Operational Biosecurity are to 1) develop a general aquaculture biosecurity plan for Hawaii and the Pacific Region and 2) develop specific biosecurity plans for major culture species and specific farm operations.

Specific objectives for Diagnostic Surveillance are to 1) establish a local diagnostic laboratory with PCR technology able to provide rapid turn around time for providing test results; 2) hold a workshop with koi producers to solicit participation and input in establishing health status of Hawaii's koi with regard to koi herpes virus disease (KHVD); 3) establish pro-active screening methods for KHVD; 4) conduct an initial survey of KHVD in farmed and feral koi populations statewide; 5) conduct a survey for Hawaii Tilapia *Piscirickettsia*-like organism (HTPLO) in farmed and feral tilapia populations regionwide; 6) produce technical handouts of the resulting information (information obtained is to also be included in the Operational Biosecurity handouts); and 7) conduct a follow up workshop to disseminate information and begin discussions on the challenges and opportunities of establishing a health certificate program for farmed koi and farmed tilapia.

Value Added Approach for Tuna Fish Roe: Local Ingredient for Shrimp Maturation Diet?

Funding level: \$50,000
Project start date: December 1, 2009
Duration: 1 Year
Participants: University of Guam (Lead Institution), University of Hawaii at Manoa, Oceanic Institute

The lack of a nutritionally complete, cost-effective and bio-secure maturation diet for shrimp broodstock remains a bottleneck for most shrimp hatcheries. Many research attempts have been made to develop artificial shrimp maturation diets, and much progress has been made in recent years. However, there is currently no artificial diet that, when used alone, can yield reproductive performance comparable to "fresh-frozen" maturation feeding regimes that commonly consist of bloodworms, squid, adult artemia, and/or bivalves. The over-arching goal of this project is to develop new knowledge to increase the value of underutilized tuna fish roe by exploring its potential usage as an aquaculture feed ingredient in a shrimp maturation diet, and to do so in a sustainable manner. Five researchers representing three organizations are conducting this work. Specific objectives are to 1) analyze the nutritional values of tuna fish roe, and verify its specific-pathogen-free status; 2) develop a semi-moist maturation diet with tuna fish roe as the major ingredient; 3) evaluate the reproductive performance of shrimp fed with the tuna roe based maturation diet, in comparison with conventional fresh-frozen maturation feeding regimes; and 4) publish the findings from the project and conduct one workshop on utilization of tuna fish roe.

Analyze and Compile the Nutritional Composition of Potential Feed Ingredient Resources

in American Samoa into a Feed Manual for Use in Tilapia Feeds

Funding level: \$36,450
Project start date: August 1, 2009
Duration: 1 Year
Participants: Oceanic Institute (Lead Institution), University of Hawaii at Manoa: Sea Grant College, Sea Grant Extension American Samoa

Feed is the largest single variable cost in aquaculture production. For remote or island locations, the cost of transportation of ingredients or complete feeds contributes considerably to the cost of production. Better utilization of locally available feed ingredient resources may enhance development of regional aquatic animal production by lowering feed costs, particularly in American Samoa, a tropical island nation with a small fish culture industry that is dependent on feeds imported from Asia. The agriculture industry in Samoa generates a wide variety of plant and animal products and byproducts, some of which may be efficacious in feeds development for local aquaculture farmer. Therefore, four researchers at three institutions aim to 1) identify, quantify and collect potential local products and byproducts for aquatic feeds development in American Samoa and dry samples for shipment to the Oceanic Institute (OI) for compositional analysis; 2) analyze the nutrient composition of selected samples; 3) compile a feed manual containing analyzed nutrition composition data for locally available ingredients and byproducts, formulated diets for tilapia using the local ingredients, established feed processing methods and quality control tests and information about their availability, quantity and price; and 4) transfer technology and disseminate information through a work shop and feed manual hand-outs to local producers and farmers.

Diversifying Freshwater Aquaculture Products for Hawaii: Two Crossover Species, the Red and Black Pacu (*Piaractus brachypomus* and *Colosomma macropomum*), Years 1 and 2

Funding level: \$100,000
Project start date: September 1, 2009
Duration: 2 Years
Participants: University of Hawaii at Manoa: Sea Grant Program (Maui Community College, UHM)

Due to the limited availability of freshwater food fish species for culture in Hawaii, current freshwater enterprises are limited to live niche markets and a fledgling freshwater ornamental industry. One innovation that can be utilized in the freshwater aquaculture industry is to develop the culture of species that have multiple profit opportunities for farms; in effect, crossover species, i.e., species that can be sold at different life stages for the aquarium market and as a food fish species. Two researchers with the UH Sea Grant program (one on Maui, one on Oahu) are aiming to diversify Hawaii's aquaculture industry with the investigation of the suitability of at least one crossover species, the red pacu. Specific objectives of this project are to 1) characterize growth of juvenile red pacu under monoculture conditions utilizing locally available commercial feeds; 2) compare growth and survival in monoculture and polyculture growout trials; 3) initiate the establishment of broodstock populations for red pacu on three islands; 4) obtain and collate technical information available on pacu including those written in foreign

languages; 5) locate sources of the black pacu that meet import requirements for the state of Hawaii; 6) conduct pilot-scale monoculture growout enterprises in collaboration with private sector farms; 7) characterize growth and survival of juvenile red pacu in closed recirculating systems; 8) test market pacu as a food fish species on both Oahu and Maui and conduct survey of ornamental market demand; and 9) conduct technology transfer to appropriate end users via workshops, one technical publication, and at least two fact sheets.

Pacific Regional Aquaculture Information Service for Education (PRAISE), Year 4

Funding level: \$20,000
Project start date: August 1, 2009
Duration: 1 Year
Participants: University of Hawaii at Manoa

Acquisition and dissemination of marine science information and data about the Pacific region, especially as it relates aquaculture, is essential to the education and development of our industry and its researchers. An important component of dissemination is improving communication within the aquaculture community and increasing access to research materials. The goal of this project is to supply the aquaculture community in Hawaii and the U.S.-affiliated Pacific Islands with relevant information, using the Internet, traditional print formats, and other media. Two individuals are collaborating on Year 4 of this project with the following objectives: 1) contribute Hawaiian names for marine fauna to www.ubio.org; 2) collect and disseminate aquaculture technical information or news related to the CTSA region in PRAISE and CTSA web sites four times per year; 3) promote Pacific Region information infrastructure; and 4) transfer technology.

Alternative Methods for Marine Copepod Production in Hawaii, Years 1 and 2

Funding level: \$49,754
Project start date: August 1, 2008
Duration: 2 Years
Participants: University of Hawaii at Manoa: Sea Grant Program (Lead Institution)
University of Hawaii at Hilo

Traditional methods using natural seawater and cultured microalgae as feed create costs per unit of copepod product that are greater than costs per unit of rotifers (the major alternative as a small first feed), due to the fact that copepods have not been cultured nearly as densely as rotifers. This project will develop methods in copepod production that could be used by smaller businesses, including those that may wish to investigate new marine fish as products but cannot or would not invest in the technology and staffing required to produce microalgae and operate intensive copepod culture systems. Three researchers from two universities are attempting to adapt the locally important copepod species (*Parvocalanus*, *Bestiolina*, *Euterpina*) to small-scale production in artificial seawater and with alternative feeds, including yeasts and small-ground particles of prepared fish feeds. Objectives are as follows: 1) establish a project working area and one or more stock microalgal cultures in both natural seawater and a low cost artificial

seawater formulation; 2) obtain and acclimate cultures of defined marine copepods; 3) document baseline conditions for maintenance of the copepod cultures with microalgae in natural seawater; 4) conduct short-term controlled experiments to assess the adaptation of the copepod cultures to artificial seawater and artificial feed particles, and allocate test cultures for long-term maintenance and assessment; 5) conduct short-term controlled experiments aimed at intensification of copepod cultures in artificial seawater with artificial feeds; 6) assess and document results of long-term culture comparisons established during Year 1; 7) document experimental results in a summary report for use in workshops or technical publications, and prepare an extension bulletin in less formal language with photos describing practical protocols as appropriate; and 8) present public workshop sessions.

Pacific Regional Aquaculture Information Service for Education (PRAISE) and Publications, Year 3

Funding level: \$88,248
Project start date: August 1, 2008
Duration: 1 Year
Participants: University of Hawaii at Manoa, Center for Tropical and Subtropical Aquaculture

Acquisition and dissemination of marine science information and data about the Pacific region, especially as it relates aquaculture, is essential to the education and development of our industry and its researchers. An important component of dissemination is improving communication within the aquaculture community and increasing access to research materials. The goal of this project is to supply the aquaculture community in Hawaii and the U.S.-affiliated Pacific Islands with relevant information, using the Internet, traditional print formats, and other media. Educational support is the main focus of the Pacific Regional Aquaculture Information Service for Education (PRAISE), and information dissemination is the main focus of the CTSA Publications Specialist. Five individuals from two organizations collaborated on Year 3 of this project with the following objectives: *PRAISE*: 1) compile bibliographies on aquaculture-related business and technical resources and digitize appropriate non-copyrighted documents or link Web sites; 2) continue to catalog and digitize the papers of the University of Hawaii's Marine Option Program (MOP); 3) continue to provide established services; and 4) transfer of technology. *Publications*: 1) inform industry members, educators, and other key individuals of pertinent aquaculture information, and update them on the status of regional aquaculture through various media; and 2) inform the aquaculture community and interested parties of the progress of CTSA and other Regional Aquaculture Center (RAC) projects in relation to our mission through the dissemination of our own and other publications.

Sea Cucumber Hatchery Production Technology Transfer in Pohnpei, the Federated States

of Micronesia, Years 1 and 2

Funding level: \$69,836
Project start date: August 1, 2008
Duration: 2 Years
Participants: College of Micronesia: Land Grant Program

Processed sea cucumber is a valuable source of income for communities in remote areas of the Asia-Pacific region, as sea cucumbers are generally easy to collect, do not require sophisticated processing techniques, and fetch a high price on Asian markets. However, the supply of high-value sea cucumbers will not be sufficient to meet demand in the Asian market unless a viable sea cucumber aquaculture industry is developed to alleviate the stressed wild stocks. One researcher is transferring sea cucumber hatchery technology to Micronesia with the hopes of creating a sustainable aquaculture industry that can supply the demand for sea cucumbers. If the hatchery technology proves successful in achieving production objectives, then additional activities related to conservation and stock management programs could be developed in collaboration with different conservation groups, coastal communities, and “Marine Protected Area” programs. One researcher is conducting this project with the following specific objectives: 1) search for and collect sandfish (*H. Scabra*) broodstock in the Pohnpei lagoon; 2) conduct broodstock conditioning, spawning induction, and larval rearing; 3) develop a method for sandfish juvenile production in Pohnpei; and 4) train Micronesians in sea cucumber hatchery operation.

Promoting Health Management of Shrimp Aquaculture on Guam and the Commonwealth of the Northern Mariana Islands (CNMI)

Funding level: \$35,000
Project start date: August 1, 2008
Duration: 1 Year
Participants: University of Guam (Lead Institution), University of Arizona, Oceanic Institute

Shrimp disease outbreaks remain the most profound threat to the fast growing shrimp aquaculture industry, and they have caused billions of dollars in economic losses worldwide. Consequently, the application of biosecurity, a concept widely used in livestock industries, has been introduced to aquaculture as a preventive practice for exclusion of specific pathogens from cultured aquatic species at various levels, from the facility/farm level to regional and country levels. The main goal of this project is to enhance health management on Guam and the CNMI through biosecurity awareness and the establishment of a surveillance program. Four researchers from three institutions are carrying out the following objectives to 1) evaluate current shrimp health management practices in the region by conducting biosecurity audits of all existing shrimp farms and identify the key risk factors; 2) set up farm-specific, bimonthly surveillance programs at two major shrimp farming facilities as models for other operations; 3) promote awareness of biosecurity in the region via various means of education; and 4) prepare and

distribute a comprehensive summary report to aquaculture stakeholders and corresponding

government agencies.

Improving the Hatchery Output of the Hawaiian Pink Snapper (*Pristipomoides filamentosus*), Years 1 and 2

Funding level: \$48,000
Project start date: August 1, 2008
Duration: 2 Years
Participants: University of Hawaii at Manoa (Sea Grant Program, Hawaii Institute of Marine Biology, Bekesy Laboratory of Neurobiology, Hawaii Natural Energy Institute)

Successful development of hatchery technologies for the Hawaiian pink snapper, known locally as opakapaka, presents a significant opportunity for the continued expansion and diversification of open-ocean ventures, which are currently limited to the production of only two species. Previous research, while successful in producing small numbers of opakapaka fry, did not utilize the proposed laboratory-scale experiments to obtain the necessary information needed to construct an appropriate feeding regimen, an omission that was undoubtedly part of the reason for the limited successes to this point. Seven researchers from the University of Hawaii are currently developing hatchery technologies with the goal of producing a juvenile opakapaka output necessary for commercial-scale open-ocean culture activities that satisfies its utility as a tool for fisheries management. Specific project objectives are to 1) increase survivorship and growth of opakapaka larvae by 10-fold through improvements in live feeds through controlled feeding trials and complementary observations on foraging behavior; 2) increase hatchery output by improving other tank conditions; 3) define the requirements for transitioning opakapaka larvae from copepod nauplii to rotifers and to *Artemia* nauplii by two weeks post-hatch; 4) increase hatchery output (e.g., 10,000 fry) by improving hatchery conditions for growth and survival by optimizing food and larval densities and other tank conditions; and 5) transfer developed technology to appropriate end users.

Improving Outputs in Commercial-Scale Production of Swordtails in Hawaii, Year 3

Funding level: \$35,000
Project start date: August 1, 2008
Duration: 1 Year (continuation from 2 previous years)
Participants: University of Hawaii at Manoa: Sea Grant Program

Freshwater ornamental fish producers in Hawaii indicate that continued development of new technologies, or improvement to the production efficiency of already developed technologies, will help the industry to continue to grow. In a recently completed survey, the swordtail was found to be a major contributor to the overall value (ranked 2nd) and volume (ranked 1st) of Hawaii's freshwater ornamental industry. It has been rationalized that a focused effort on improvement of the overall production efficiency and development of all female homozygous lyretail populations would be one means to expand and diversify the industry. This project was the third year of a three-year project focused on achieving the goal of elevating swordtail

production in Hawaii to the point at which it becomes a major driver in the expansion of the freshwater ornamental fish industry. Four researchers with the University of Hawaii had the following objectives for the final year of this project: 1) establish two varieties of homozygous lyretail strains; 2) demonstrate that feminized females can alleviate the highly skewed female sex ratio on farm sites; and 3) transfer technology to appropriate end users.

**Determining Aquaculture Bottlenecks of Pacific Threadfin (*Polydactylus sexfilis*):
Increasing Fry Survival, Growth, and Quality, Years 1 and 2**

Funding level: \$150,000
Project start date: August 1, 2008
Duration: 2 Years
Participants: University of Hawaii at Manoa: Sea Grant Program (Lead Institution),
University of Hawaii at Manoa: Hawaii Institute of Marine Biology,
Oceanic Institute

The Pacific threadfin, known locally by its Polynesian name, moi, is rapidly becoming a premier aquaculture species in Hawaii and throughout the Indo-Pacific. It is highly prized for its excellent flesh quality, fast growth, and adaptability to conditions of captive culture. Despite much progress in moi culture over the past few decades, the moi culture industry still faces major loss during early larval stages. The main limitation to increased production is the relatively low number of juveniles available for grow-out to market size. This can largely be attributed to high larval mortality ranging between 70–99% during the pre-metamorphic and metamorphic stages. The goal of this project is to characterize the efficacy of using aqueous and dietary iodide to improve survival and growth of larval and juvenile moi up to stocking age. Seven researchers at three institutions are conducting research to 1) assess the capacity to increase TH deposition into fertilized moi eggs by exposing moi broodstock to iodide through dietary and/or rearing water supplementation; 2) assess the efficacy of increased TH deposition in moi eggs to improve the survival and growth of moi larvae and fry to stocking size; 3) determine the efficacy of adding iodide to larval/fry rearing water to increase their survival, and growth to stocking size; and 4) prepare reports and publications for dissemination and transfer technology and methodologies to the public.

**Developing Bivalve Culture to Diversify and Position Hawaii as a Supplier of Safe,
Premium Edible Shellfish Products, Years 1 and 2**

Funding level: \$73,424
Project start date: August 1, 2007
Duration: 2 Years
Participants: University of Hawaii at Manoa: Sea Grant Extension (Lead Institution),
University of Hawaii at Hilo, Louisiana State University

Hawaii, although a major supplier of bivalve seed for export, has no major mollusk culture industry for food products, which is a lost opportunity for the State. Hawaii has ideal environmental conditions for bivalve culture at many sites, and its relatively pristine waters are

an additional asset when compared with shellfish growing waters on the continental United States, which are increasingly impaired by red tides, contamination, and epidemics of bivalve diseases. Three researchers at three universities are focusing on resolving issues that have historically impeded grow-out of edible bivalves in Hawaii, including issues related to appropriate species, sites, lack of a certified laboratory for shellfish growing water analysis and gaps in State policy. Their specific objectives are to 1) establish a Shellfish Working Group for Hawaii and the Pacific Islands to act as an advisory group and serve to represent the stakeholders' interested in bivalve culture; 2) determine which Hawaiian bivalve species represents the best potential for culture; 3) build on preliminary efforts and conduct a study to collect economic and market data for bivalves for Mainland U.S., Asia and Europe; 4) conduct preliminary spawning, nursery and grow-out trials in a laboratory setting for three Hawaiian species determined as having the most potential; 5) develop two pilot bivalve grow-out sites on Moloka'i for use in the growth trials and as possible future commercial sites; 6) work with State agencies responsible for shellfish sanitation to map out the required steps necessary to develop a system for shellfish sanitation; 7) determine whether permits can be obtained to culture established, non-native bivalves in open waters, and if successful, conduct grow-out trials with these species in fishponds; and 8) transfer results of research and raise awareness of the requirements to comply with shellfish sanitation guidelines.

Artificially Propagating the Feather Duster Worm *Sabellastarte spectabilis* for the Marine Ornamental Trade

Funding Level: \$35,000
Project start date: August 1, 2007
Duration: 1 Year
Participants: University of Hawaii at Manoa: Sea Grant Extension (Lead Institution),
University of Hawaii at Manoa (Department of Zoology)

In recent years, the marine aquarium industry has attracted much controversy, mostly due to the industry's dependence on wild caught stocks of invertebrates and fishes. Specifically, damaging collection techniques, high post-catch mortality, and poor husbandry throughout the supply chain are cited as reasons the industry is thought to be unsustainable. As with freshwater ornamentals, culturing the organisms that make up the industry is recognized as being the best solution to minimizing harvesting from the wild and sustaining the aquarium industry. Likewise, it has the added benefit of new economic (e.g., employment) opportunities. The feather-duster worm, *Sabellastarte spectabilis*, has become one of the most collected invertebrates from Hawaii, and is currently ranked fourth in number of individuals being collected in Hawaii's tropical marine ornamental trade. Three researchers at one university set out to establish its culture in Hawaii, and conducted their project with the specific objectives to 1) determine the most cost effective substrate for settlement; 2) determine whether supplemental feeding results in maturation of captive broodstock; 3) field test grow-out techniques in collaboration with private sector partners; 4) conduct technology transfer in the form of a workshop, fact sheet, newsletter article and peer reviewed journal manuscript.

Planning and Inter-institutional Coordination for a Guam Aquaculture Development Plan

Funding level: \$25,000
Project start date: August 1, 2007
Duration: 1 Year
Participants: University of Guam (Lead Institution), University of Hawaii at Hilo,
University of Arizona, Micronesian Environmental Services (MES)

There has been little change in the aquaculture industry on Guam since the mid-1990s, when the production of marine shrimp was added to the local product mix. The Guam industry is aware of the vast changes in occurring elsewhere in the world, and would like to bring new species and technology to the island. However, industry stakeholders have had a difficult time evaluating the economic feasibility of adapting these changes locally. The last full aquaculture development plan was written in approximately 1988, and it had not been comprehensively revisited since, rendering most of the information available to potential local and foreign investors seriously outdated. Five participants representing four organizations revisited development plans for aquaculture on Guam, and devised a new plan that capitalizes on Guam's competitive advantages of US laws, location, air connections, climate and clean environment. The project had the following objectives: 1) form an Aquaculture Development Working Group to execute the work and improve institutional coordination and cooperation for future implementation activities; 2) review current status and potential areas for development including a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats); 3) review current and potential list of species available for aquaculture on Guam; 4) review local and federal policies, regulations and permitting processes effecting on-going and potential aquaculture development on Guam; 5) conduct an institutional analysis for public and private sector entities on Guam and potential partners located elsewhere; 6) review currently available economic incentives for aquaculture development on Guam; 7) suggest changes to the current regulatory and economic environment that could be locally adopted; 8) publish the results of objectives 1 to 7 as a CTSA/GADTC joint publication with distribution to all concerned stakeholders; and 9) make oral presentations of finding to concerned stakeholders and at aquaculture meetings/conferences.

Kahala Broodstock Management

Funding Level: \$92,500
Project start date: August 1, 2007
Duration: 1 Year
Participants: Oceanic Institute, Kona Blue Water Farms

Amberjacks and yellowtail (*Seriola* spp.) are emerging as premier aquaculture species worldwide due to their adaptability to conditions of intensive culture, extremely fast growth, and high market value. They are primarily cultured in Japan, and US imports (primarily fillets) of these fish are estimated at 5,000 MT and worth \$58 million annually. The majority of overseas production utilizes wild-collected fingerlings stocked in nearshore surface cages in bays and estuaries, a dependence that not only limits production, but also puts substantial pressure on natural stocks. The development of open ocean aquaculture in the U.S. offers an opportunity to substitute these imports with locally grown fish, and help sustainably reverse the staggering seafood trade deficit. Although broodstock have now been successfully domesticated, egg

supplies continue to be variable due to challenges in long-term broodstock maintenance and concern over the effects of environmental and dietary factors on egg quality. Therefore, this collaborative project between two participants representing two organizations was designed to establish and optimize broodstock holding conditions toward securing long-term broodstock health, and to develop a more reliable year-round supply of viable eggs to facilitate year-round hatchery output. Specific objectives were to 1) design and commission a two-tank recirculating aquaculture system (RAS) for holding kahala broodstock; 2) establish an expanded kahala broodstock population (eight tanks, four at OI and four at KB) for study of broodstock holding systems; 3) compare broodstock health and performance in flow-through versus water reuse broodstock holding systems using either water derived from saltwater wells (OI) or ocean water (KB); 4) evaluate long-term effects of a formulated commercial diet on broodstock health and reproductive performance at both OI and KB; and 5) disseminate project findings on kahala broodstock holding conditions through a presentation of results at the annual Hawaii Aquaculture Association meeting and through CTSA Regional Notes.

Kahala Parasites and Shrimp Viruses of Concern

Funding Level: \$83,800
Project start date: August 1, 2007
Duration: 1 Year
Participants: University of Hawaii at Manoa: Hawaii Institute of Marine Biology (Lead Institution), Oceanic Institute, Kona Blue Water Farms, Hawaii
Department of Agriculture: Aquaculture Development Program

Flukes, in one form or another, and shrimp viruses occur on a global scale. Cage culture presents unique challenges in terms of disease management, since uncontrolled water exchange allows for the potential movement of pathogens in and out of the cage system, and naturally occurring organisms in and around the cage may serve as disease vectors. Therefore, this project was conducted to address industry concerns relating to a parasite problem identified as a bottleneck to kahala culture in the region, and to continue a risk assessment from a previously-funded CTSA project to address regional shrimp virus biosecurity concerns. Five participants representing four organizations collaborated on objectives to 1) characterize the fluke (capsalid monogene trematode) affecting kahala, analyze fish immune response to the parasite to determine if vaccine development is feasible, and determine influence of net composition on egg accumulation in culture; 2) continue previous (CTSA Year 19) virus disease project, expanding sampling to include plankton that may pose a biosecurity risk to region facilities; and 3) transfer technology of the project results.

Improving Pearl Quality by Grafting Technologies and Husbandry Methods for a

Hatchery-based Black Pearl Industry Development in Pohnpei, the Federated States of Micronesia

Funding Level: \$146,300
Project start date: August 1, 2007
Duration: 3 Years
Participants: College of Micronesia: Land Grant Program

A sustainable hatchery-based black pearl industry is emerging in the Federated States of Micronesia (FSM) in the U.S. Affiliated Pacific Islands, due in large part to the College of Micronesia Land Grant Program's Pearl Project. Since its inception in 2001, the project has successfully transferred technology in hatchery spat production and ocean nursery / grow-out, as well as farming skills in grafting operations to its Micronesian staff and trainees. The quick adaptation of the staff successfully demonstrated the feasibility of producing pearls in the Pohnpei lagoon. Therefore, the current project is focusing on improving the quality of the pearls produced, which has always been a primary objective throughout the history of pearl farming, as the price of a cultured pearl is determined by a combination of factors representing the pearl quality. One researcher and one grafting technician are working together to 1) improve roundness rate by grafting techniques; 2) reduce flaws by grafting techniques and post-grafting husbandry methods; 3) improve host's survivorship by pre- and post-grafting husbandry methods; and 4) transfer pearl aquaculture technology immediately to the Micronesian and other regions.

Shrimp Production Demonstration Project and Aquaculture Training for Industry Stakeholders of the Commonwealth of the Northern Marianas Islands and Guam.

Funding Level: \$69,101
Project start date: August 1, 2007
Duration: 2 Years
Participants: Oceanic Institute (Lead Institution), Saipan Aquaculture Inc. (SAI)

Due in part to the recent collapse of the garment manufacturing industry in the Commonwealth of the Northern Marianas Islands (CNMI), it is a critical time for the local government to stimulate and stabilize its economy through industry diversification. The development of an aquaculture industry (specifically a shrimp farming industry) in CNMI is attractive for several reasons, including a high demand for seafood fueled by the tourism industry and a high market value for live or fresh aquacultured shrimp. In addition, CNMI is located in close proximity to the large broodstock and seedstock markets of China and S.E. Asia, where these shrimp can fetch a high market price. There is a high level of interest in shrimp farming but unfortunately, inefficient farming practices and inconsistent seedstock availability have limited the development of this industry. The aquaculture industry of Guam is very similar to CNMI, with only a few small farms for tilapia and marine shrimp and inefficient farming practices and seedstock shortages. Like CNMI, the potential of shrimp farming in Guam is good due to the high domestic demand for shrimp, high market value for shrimp, and the geographic proximity of Guam to the large broodstock markets of Asia. Therefore, three participants from two organizations developed this project to support two aquaculture-training workshops for

stakeholders (and those interested in shrimp farming), and conduct a shrimp production demonstration project to improve efficiency of current farms and stimulate interest and investment in the fledgling CNMI and Guam aquaculture industries. Specific project objectives are to 1) improve efficiency of local shrimp production by educating industry stakeholders on current shrimp production methodologies; 2) address technical constraints or issues/interests specific to the Guam shrimp farming industry; 3) stimulate interest and investment in shrimp aquaculture in the CNMI and Guam by demonstrating profitable and environmentally friendly shrimp production using existing SAI facilities and culture techniques developed by OI; and 4) publish and distribute a farm guide.

Improving Outputs in the Commercial-Scale Production of Swordtails, Year 2

Funding Level: \$35,000
Project start date: August 1, 2007
Duration: 1 Year
Participants: University of Hawaii at Manoa: Sea Grant Extension

Freshwater ornamental fish producers in Hawaii indicate that continued development of new technologies, or improvement to the production efficiency of already developed technologies, will help the industry to continue to grow. In a recently completed survey, the swordtail was found to be a major contributor to the overall value (ranked 2nd) and volume (ranked 1st) of Hawaii's freshwater ornamental industry. It has been rationalized that a focused effort on improvement of the overall production efficiency and development of all female homozygous lyretail populations would be one means to expand and diversify the industry. This project was the second year of a three-year project focused on achieving the goal of elevating swordtail production in Hawaii to the point at which it becomes a major driver in the expansion of the freshwater ornamental fish industry. Four researchers with the University of Hawaii had the following objectives for the second year of this project: 1) complete a field tested technique that results in the production of all female homozygous lyretail swordtails; 2) increase lyretail swordtail production statewide; and 3) transfer technology in the form of workshops, technical handouts and newsletter articles.

Development of Captive Culture Technology for the Yellow Tang, *Zebrasoma flavescens*, Years 1-3

Funding Level: \$292,500
Project start date: August 1, 2007
Duration: 3 Years
Participants: Oceanic Institute

Due to its brilliant coloration and adaptability to aquaria, the yellow tang has become enormously popular in the world-wide aquarium trade. The vast majority of yellow tang specimens are collected from coral reefs around Hawaii. Official yearly exports for this species are estimated at 100,000 to 300,000, although actual collection numbers may be closer to one million per year. The State of Hawaii's Department of Land and Natural Resources has

expressed concern for the heavy collection pressure for this and other ornamental reef species, with an estimated 45% decline in natural yellow tang populations leading to the development of marine protected areas and intensive research. The development of land-based aquaculture technology for this species would provide a sustainable alternative to current reliance on wild collection and provide new economic opportunities for the Hawaii aquaculture industry. Three researchers from the Oceanic Institute are collaborating on this project to develop culture technology for rearing yellow tang (*Zebrasoma flavescens*) in captivity. Their objectives are to 1) develop methods to identify male and female yellow tang for stocking of broodstock tanks; 2) establish appropriate holding system/conditions for maintaining spawning stocks of yellow tang; 3) develop appropriate diet to maintain broodstock condition and produce high quality eggs; 4) establish early larval rearing system to maximize larval hatch and early (prefeeding) survival; 5) identify suitable first feed for yellow tang larvae; 6) scale- up culture of identified first feed to level required for conducting replicated larviculture trials; 7) develop larviculture feeding regimen suitable for rearing yellow tang larvae through metamorphosis; 8) develop suitable methods to transition yellow tang into juvenile settlement phase; 9) establish suitable feeds and holding system to ensure juvenile quality suitable for marine ornamental wholesale market; and 10) transfer technology to industry through workshops, conference presentations, and publication in CTSA Regional Notes.

Bioprocessing of Pacific Island Byproducts for the Production of Value-added Feed Ingredients

Funding level: \$150,000
Project start date: August 1, 2006
Duration: 2 Years
Participants: University of Hawaii at Manoa (Lead Institution), Oceanic Institute

Island communities in the Pacific often have to import feed ingredients or complete feeds to maintain their local animal production units. The cost of transportation to ship feedstuff to the islands frequently becomes more costly than the worth of the finished animal product. Therefore, the aquaculture industry in the Pacific faces the challenge of producing cost-effective feeds that utilize locally available feedstuff as feed ingredients. The overall objective of this project was to generate value-added products to use as effective, economical, and sustainable aquatic feed ingredients by putting abundant agricultural byproduct wastes through a biological treatment process. Three scientists at two institutions conducted the project with the following objectives: 1) development of a controlled engineering process at lab scale for the biotransformation of island agricultural fruit processing waste into useful, high-protein content; 2) evaluation of the effects of processed product as a feed ingredient on growth and survival of shrimp; and 3) assessment of cost-effectiveness of using processed product as aquatic feed ingredient.

Risk Assessment to Identify Potential Shrimp Virus Impacts in Hawaii and Development of

Biosecurity Protocols

Funding level: \$100,000
Project start date: August 1, 2006
Duration: 1 Year
Participants: University of Hawaii at Manoa: Hawaii Institute of Marine Biology (Lead Institution), Oceanic Institute, University of Arizona, Hawaii Department of Agriculture: Aquaculture Development Program, U.S. Marine Shrimp Farming Program

It is well recognized that viral diseases have had a profound effect on commercial shrimp farming globally, and that biosecurity measures are needed to protect shrimp production facilities. In Hawaii, both Taura syndrome virus (TSV) and infectious hypodermal and hematopoietic necrosis virus (IHHNV) have affected farms in the past 12 years, and a recent outbreak of white spot syndrome virus (WSSV) was well-publicized on Kauai. The focus of this collaboration between eight researchers representing five organizations was to address health management and biosecurity issues facing Hawaiian shrimp aquaculture by performing a risk assessment involving potentially infectious commodity shrimp, farmed shrimp, and local decapod crustaceans. Specific project objectives were to 1) expand the survey and sample wild decapod crustacean populations for the presence of WSSV, IHHNV, TSV, and YHV; 2) sample local commodity shrimp from grocery and bait shops for WSSV, IHHNV, TSV, and YHV, as well as IMNV when the shrimp originates from Brazil; 3) conduct bioassays feeding infected commodity shrimp to wild caught decapod crustaceans representing standing stocks of local populations to test transmissibility of viral pathogens; 4) conduct bioassays feeding natural or experimentally infected crustaceans to SPF shrimp to test for transmissibility; and provide diagnostic support, pathogen testing, and disease surveillance services to local producers to establish baselines of pathogen prevalence in cultured shrimp populations; 5) use research results obtained from Objectives 1–4 to identify where existing biosecurity measures are sufficient for individual farms and where refinements may improve biosecurity; 6) collaborate with local farmers in an analysis of current best management practices/standard operating procedures within the industry; and 7) transfer the technology.

Development of DNA Markers for Pacific Threadfin Aquaculture

Funding level: \$195,884
Project start date: August 1, 2006
Duration: 2 Years
Participants: University of Hawaii at Manoa (Lead Institution), Oceanic Institute

Pacific threadfin (*Polydactylus sexfilis*), also locally known as moi, is becoming an important species for the aquaculture industry in Hawaii. Its delicate flavor and high retail price have significantly enhanced expansions of moi aquaculture development, particularly the recent development of large-scale, offshore-cage growout operations. With moi aquaculture moving toward large-scale operations, the industry must move to the next level. To secure its competitiveness and future health, the industry must maintain improved broodstock populations with faster growth performance, greater disease resistance, more successful reproduction, and

higher quality of fish meat than current populations. Genetic improvement has been an effective means to increase production efficiency and product quality in many domesticated species. The long-term goal of the two researchers from two institutions collaborating on this project was to develop and test DNA-based genetic analytic technology for Pacific threadfin aquaculture. Specific objectives were to 1) establish a genomic and skeletal muscle cDNA library of Pacific threadfin; 2) identify at least 50 microsatellite loci and develop PCR protocols for optimal amplification of the markers; 3) collect fin clip samples from the OI and AFRC broodstock populations and analyze polymorphic DNA markers in these samples; 4) develop a microsatellite DNA-based method of parental assignment; 5) collect fin clip samples from the wild populations (Oahu and Hawaiian Islands) and characterize their genetic diversities using established DNA microsatellite markers; 6) develop DNA-based testing protocols for monitoring Pacific threadfin broodstock and wild populations; and 7) distribute educational materials on microsatellite DNA for local industry and marine biologists through a one-day workshop aimed at providing basic training on DNA-based technology for aquaculture and wildlife conservation for local Pacific threadfin farmers and marine biologists.

Culturing the Harlequin Shrimp (*Hymenocera picta*) for the Marine Aquarium Industry

Funding level: \$73,740
Project start date: August 1, 2006
Duration: 2 Years
Participants: Oceanic Institute (Lead Institution), University of Hawaii at Manoa: Sea Grant Extension

The marine aquarium industry relies almost exclusively on wild-caught fish, invertebrates, and live rock to meet market demands of aquarium hobbyists. For the industry to expand, appropriate technologies are needed to culture desirable organisms in captivity in order to minimize the dependence on wild stocks and provide hobbyists with a reliable supply of healthy specimens at low cost. The harlequin shrimp (*Hymenocera picta*) is popular among saltwater aquarists and commands a high market price of about \$30 per specimen. Unfortunately, almost all harlequin shrimp sold in pet shops around the world are collected from shallow tropical waters of the Pacific Ocean, including Hawaiian waters. Extracting *H. picta* from the wild is not a sustainable, long-term strategy and collateral damage to coral reefs may be associated with this practice. Therefore, three researchers from two institutions collaborated on this project to meet the following objectives: 1) collect and disseminate information about the culture of *H. picta*; 2) improve culture techniques for *H. picta*; 3) evaluate alternative diets for *H. picta*; 4) explore potential genetic and environmental effects on the post-settlement dietary preference for *H. picta*; 5) characterize the biochemical and mineral composition of prey items; and 6) produce and evaluate a formulated, artificial diet for adult *H. picta*.

Pacific Regional Aquaculture Information Service for Education (PRAISE) and

Publications, Year 2

Funding level: \$80,870
Project start date: August 1, 2006
Duration: 1 Year
Participants: University of Hawaii at Manoa (Lead Institution), Center for Tropical and Subtropical Aquaculture

Acquisition and dissemination of marine science information and data about the Pacific region, especially as it relates aquaculture, is essential to the education and development of our industry and its researchers. An important component of dissemination is improving communication within the aquaculture community and increasing access to research materials. The goal of this project is to supply the aquaculture community in Hawaii and the U.S.-affiliated Pacific Islands with relevant information, using the Internet, traditional print formats, and other media. Educational support is the main focus of the Pacific Regional Aquaculture Information Service for Education (PRAISE), and information dissemination is the main focus of the CTSA Publications Specialist. Five individuals from two organizations collaborated on Year 2 of this project with the following objectives: *PRAISE*: 1) provide education support through expansion of the Gray Literature Project; 2) identify and implement a new interactive communication system to promote Pacific aquaculture; 3) continue to provide established services; and 4) transfer of technology. *Publications*: 1) inform industry members, educators, and other key individuals of pertinent aquaculture information, and update them on the status of regional aquaculture through various media; and 2) inform the aquaculture community and interested parties of the progress of CTSA and other Regional Aquaculture Center (RAC) projects in relation to our mission through the dissemination of our own and other publications.

Demonstration of Seedstock Transportation and Spawning Synchronization in Sturgeon

Funding level: \$12,000
Project start date: August 1, 2006
Duration: 1 Year
Participants: University of Florida (Lead Institution), University of Hawaii at Hilo

Sturgeons are an excellent candidate species for aquaculture. Sturgeon yield not only prized caviar but a high valued meat, thereby offsetting the high costs of land, labor, and energy that constrain many small farmers in Hawaii. However, many interested farmers have difficulty developing successful sturgeon enterprises. Major obstacles for industry development are obtaining livestock and conditioning broodstock. This project focused on long-distance shipping of sturgeon seedstock and synchronization of brood fish for spawning. Two researchers from two universities collaborated to meet the following objectives: 1) develop transportation guidelines for sturgeon embryos (seedstock) with special emphasis placed on the importance of temperature during shipment; 2) establish final maturation and spawning protocols for Russian sturgeon (*A. gueldenstaedti*) in Hawaii, including short-term storage of semen for spawning synchronization; and 3) conduct a one-day workshop on sturgeon aquaculture practices with dual emphasis in

acquisition and shipping of sturgeon livestock and in the rearing of sturgeon for meat, caviar,

and broodstock.

Improving Outputs in Commercial-Scale Production of Swordtails in Hawaii

Funding level: \$70,000
Project start date: August 1, 2006
Duration: 1 Year
Participants: University of Hawaii at Manoa: Sea Grant Extension, University of Hawaii at Hilo: Sea Grant Extension

Freshwater ornamental fish producers in Hawaii indicate that continued development of new technologies, or improvement to the production efficiency of already developed technologies, will help the industry to continue to grow. In a recently completed survey, the swordtail was found to be a major contributor to the overall value (ranked 2nd) and volume (ranked 1st) of Hawaii's freshwater ornamental industry. It has been rationalized that a focused effort on improvement of the overall production efficiency and development of all female homozygous lyretail populations would be one means to expand and diversify the industry. This project was the first year of a three-year project focused on achieving the goal of elevating swordtail production in Hawaii to the point at which it becomes a major driver in the expansion of the freshwater ornamental fish industry. Three researchers with the University of Hawaii had the following objectives for the first year of this project: 1) improve overall production of swordtails statewide; 2) test and validate production techniques for all-female swordtail individuals; 3) establish two additional varieties of homozygous lyretail strains; and 4) transfer technology in the form of on farm testing, workshops, technical handouts, and newsletter articles.

Improved Stocks and Management Practices for Commercial Tilapia Culture in Hawaii and the Pacific Region, Year 2 — Hawaii Component

Funding level: \$52,730
Project start date: August 1, 2006
Duration: 1 Year
Participants: University of Hawaii at Manoa: Sea Grant Extension (Lead Institution), University of Hawaii at Hilo (Sea Grant Extension, Pacific Aquaculture and Coastal Resources Center)

Tilapia stocks in the region have gone unmanaged for maintenance of genetic quality, and have deteriorated to the point of showing suboptimal growth, survival, and fry production. Also, external sources of stockable fingerlings are distant, expensive, or unreliable for access. The goal of this project was to improve the quality and availability of stocks for commercial tilapia culture in Hawaii and the Pacific region. In Year 2 of this project, four researchers from two universities set out to 1) complete the first growth comparison trials, begun in Year 1 of the Hawaii component, with extension to approximately 400g final fish size; 2) obtain at least two additional in-state stocks and to perform further experimental comparisons of growth potential; 3) distribute fingerlings of imported *O. aureus* stocks (*O. niloticus* is not permitted for distribution from the farm) to interested businesses for on-site testing, under terms to be

established with community input, avoiding interference with markets; and 4) integrate the work on importation, quarantine, growth comparisons and stock maintenance protocols into a manual on best management practices, and 5) offer public workshops covering this information during the last half of the project.