

**Sea Grant Pacific Program -
1995 Accomplishments and Future Program
Needs**

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Introduction

Over the past decade the University of Hawaii Sea Grant College Program, through its Pacific Program, has played a significant role in assisting the U.S.-affiliated island nations with the management and sustainable development of their nearshore resources. The Pacific Program, which is one of the six core program areas of the University of Hawaii Sea Grant Extension Program (UHSGES), serves the three U.S. Flag States (Guam, the Commonwealth of the Northern Mariana Islands [CNMI], and American Samoa) and the three U.S.-affiliated Pacific independent nations (Federated States of Micronesia [FSM], Republic of the Marshall Islands [RMI], and the Republic of Palau [ROP].)

Since 1988, the Department of Interior's Office of Insular Affairs (OIA - formerly Office of Territorial and International Affairs) and the Department of Commerce's National Oceanic Atmospheric Administration (NOAA) have worked with the Pacific Program to provide assistance to the U.S. affiliated region in the areas of aquaculture, coastal resource management, environmental education, capacity building, and sustainable economic development. The program, through its extension agents and regional partners, has assisted each entity in strengthening their manpower and technical expertise to better manage and utilize their resources in a sustainable manner.

The Sea Grant Pacific Program's five program areas are listed below.

1. Coastal Resource Management
2. Sustainable Economic Development
3. Environmental Education
4. Micronesian and American Samoa Student Internship Program (MASSIP)
5. Pacific Aquaculture Development Program (PADP)

This progress report documents the Pacific Program's accomplishments during 1995, and identifies future program needs. Highlights of the Pacific Program follow.

Coastal Resources Management

Rationale

Coastal resources of U.S.-affiliated Pacific islands are increasingly stressed as populations expand, development pressures grow, and new technologies are introduced. While traditional methods of managing limited island resources were once effective, western influences have weakened indigenous practices. This has led to increasing depletion of natural resources such as mangrove forests and tropical reef fish, and has triggered a host of related resource management problems throughout the region. Coastal water quality is declining, especially near urban areas, due to the release of untreated or improperly treated sewage, disposal of solid waste, and siltation resulting from deforestation. Mangrove forests, seagrass beds, and fringing reefs are being destroyed by dredging and filling. In coastal communities, flooding and wave damage in natural hazard zones have led to loss of life and property. However, Island agencies suffer from a lack of adequately trained staff and relevant technical information to adequately address these challenges. The Pacific Program has made a long-term commitment to assist local governments with improving their ability to manage coastal resources, primarily through technical planning assistance, applied research, and training programs in resource management.

Accomplishments

- **Resource Surveys**
 - Coastal surveys were conducted in the four outer islands of Pohnpei and on ship grounding in Kosrae and Pohnpei. Results from the surveys provided input into local coastal resource management plans and protected area and marine park planning, and served as training programs for students and agency personnel in each state.

- **Training Programs**
 - Four American Samoa Coastal Management Program staff participated in two training programs on environmental permit review, coordinated with the University of Hawaii Environmental Center and the City and County of Honolulu Division of Land Utilization (DLU). All four participants have demonstrated markedly improved performance, and CNMI and Guam coastal resource management programs are interested in working with the group of programs to develop similar personnel training and talent-share programs for their staff.

- The Quantitative Underwater Ecological Survey Technique (QUEST) training program, a highly successful University of Hawaii-Hilo (UH-Hilo) training program in underwater survey techniques, is being adapted as a August 1996 regional workshop training in collaboration of the College of Micronesia-FSM (COM-FSM) in Pohnpei. The focus of this effort is to institutionalize programs in the Pacific region,

starting with COM-FSM, to provide local training centers in resource assessment and monitoring techniques.

- **Management Plans and Programs**

- *FSM:*

- The FSM extension agent is currently assisting Pohnpei State with the development of a state coastal resource management plan, aimed a better managing development, resource use, and conservation of coastal areas. The FSM agent is also working with the Pohnpei Watershed Management Project to combine concurrent planning efforts into one master resource management plan for Pohnpei.
 - Coral reef protection is the aim of efforts by the Kosrae State Mooring Buoy Task Force, working with the Pacific Program, Greenpeace, and the FSM State Government, with installation of 35 day-use moorings help mitigate negative impacts of boat anchoring on coral reefs. The FSM extension agent is also assisted in the installation of mooring buoys in Yap State.

- *Palau:* The Palau extension agent has assisted with the organization and coordination of a local task force for coordinating mooring buoy installation at major dive and snorkel sites.

- *American Samoa:* The Pacific Program is working with the American Samoa Coastal Management Program and the UH Department of Urban and Regional Planning to develop alternative coastal management strategies for continuing resource management efforts under reduced funding scenarios. Results will be compared to situations in Guam, CNMI, and Hawaii, and presented at the regional Pacific Basin Coastal Zone Management '96 meeting August, 1996.

- **Projects being organized for 1996**

- CD-ROM Archiving Coastline Aerial Photographs
 - Eroded Beach Reclamation Project in Chuuk
 - Monitoring Impacts of Construction Dredge Sites in Pohnpei

Future Objectives and Program Needs

1. **Coastal Protection Research** Coastal areas are under tremendous threat of erosion and destruction due to dredging for construction materials, changing land use, waste disposal and natural disasters such as typhoons. Across the Pacific insular region countries are searching for sustainable methods that will mitigate this destruction, while allowing them to obtain needed construction materials. The Pacific Program will

develop an applied research program that focuses on monitoring, managing and mitigating coastal erosion, including studies of alternative building materials and sources - **\$50,000**

2. **Extension Agents and Specialist Positions** The long-term effectiveness of the Pacific Program depends on having trained extension staff who are qualified to help island governments sustainably manage natural resources.
 - 2.1. Continue the FSM and Palau Extension Agent positions with the College of Micronesia-FSM and Palau Community College, respectively, and develop a position in the Marshall Islands, to continue on-island coastal resource management support, while developing strong counterparts for these positions through internship projects - **\$90,000**
 - 2.2. Develop a Coastal Resource Management Regional Specialist, who will coordinate specialized applied research projects and technical training related to erosion and sustainable use of coastal resources in the Pacific region - **\$50,000**
3. **Training Programs** Improving the information and skills base in island management programs is key to sustainable coastal management and development . Training programs will be continued to service the entire island community, including high school and college students, resource managers, private sector and government agencies.
 - 3.1. Support the development of a QUEST training program with the Palau Community College, similar to this year's effort in Pohnpei with COM-FSM, in order to build local institutional strength in resource management training; and assist COM-FSM in organizing a second phase program with minimal UH-Hilo assistance- **\$65,000**
 - 3.2. Expand the current coastal resource permit compliance training with American Samoa to include other islands in the region and include focus on community education and involvement in planning and enforcement - **\$25,000**

Sustainable Economic Development

Rationale

The U.S.-affiliated Pacific island states face significant challenges to economic development resulting from limited natural resources, fragile environments, financial dependency, and geographic isolation. Environmental and cultural tourism are seen to be promising avenues for future economic development for the region. Coral reefs are already popular for scuba diving and snorkeling, but other coastal ecosystems, such as mangrove forests, offer new opportunities for small-scale, sustainable ecotourism ventures. The Pacific Program assists island entities in improving the skills of local entrepreneurs and agency personnel and in strengthening local ecotourism attractions and businesses, in order to develop a sustainable, well-planned, low-impact tourism industry in the region.

Accomplishments

- **Regional Training Programs**

- *Regional:* In 1995 the Pacific Program worked collaboratively with several regional and local organizations to provide a regional training for 20 participants on techniques relating to tour guiding and interpretation of sites. A second program is planned for 1996 at COM-FSM, and training workshops have been requested in Palau, Kosrae, Yap, and Chuuk.
- *Pohnpei:* As a result of the above training workshop, the COM-FSM initiated a pilot "Tour Guide Certificate Training Program" for on-island tour guides and people in the visitor industry. Two COM-FSM staff counterparts were trained to implement the interpretation and safety sections of the certificate program. 16 participants were certified through the course.
- *Palau:* As part of the Palau Visitors Authority Tourism Awareness Week, the Palau extension agent developed and coordinated 6 high school classroom activities focused analyzing the impact of and planning development projects in their community; the successful activity will be incorporated into annual course teachings. The Palau agent also developed and presented the "Customer service and relations" portion of the Palau Conservation Society's Sports Fishing Workshop.
- **Site Development** Tour design, program promotion, and marketing assistance were provided for the startup of the first kayak tour company in Palau; which began hosting regular customers in conjunction with hotel packages in 1995.

- **Material Development** Palau program assisted in the development and editing of a Palau Diving Safety Video in response to a fatal dive accident in Palau in 1994. A Palau Sports Fishing Customers Guide was produced in collaboration with the Palau Conservation Society to develop an educational booklet on improving customer service within the new sports fishing industry in Palau. Brochures were produced for Jellyfish Lake, a popular tourist destination, to mitigate tourism impacts on its fragile ecosystem.

Future Objectives and Program Needs

1. **Training Programs** Cooperative efforts in 1995 were highly successful in piloting skills training programs and efforts in the region. In order to expand this important effort, the Pacific Program will continue and expand the Ecotourism Workshop Series to Kosrae, Chuuk, Yap, Palau, and American Samoa - **\$50,000**.
2. **Ecotourism Business Specialist** Projects in 1995 identified the need for providing specialized business development assistance to ecotourism ventures. The Pacific Program will develop a business development position with regional partners to focus on ecotourism - **\$30,000**

Environmental Education

Rationale

Long-term progress toward effectively addressing island environmental issues ultimately relies on local commitment to conservation of resources. In virtually every resource management plan for each of the Pacific island entities, environmental education is recognized as vital to an effort's success. Our extension agents and specialists provide technical assistance to public and community educators and collaborate with island, federal, and regional agencies and organizations on environmental education training programs, community awareness projects, and educational material development.

Accomplishments

- **Training Programs**
 - Operation Pathfinder '95, a collaborative effort between the Pacific Program and the Pacific Regional Educational Laboratory (PREL), provided a two training workshop to 34 teachers from seven island entities in the region, focusing on incorporating oceanography and coastal issues into classroom activities.
 - Ulithi Atoll Workshop, another collaborative effort with PREL and the Yap Department of Education, provided a teacher training workshop for 25 teachers from 3 Yap outer islands, focusing on atoll ecology and geology and incorporating environmental issues into the classroom.
 - Environmental Educator Retreat was held in Palau for 7 informal educators to coordinate activities and develop cooperative programs and projects in order to effectively use limited resources and funds.
- **Educational Programs**
 - American Samoa Community-Based Wetlands Education Program: Worked with the American Samoa Coastal Management Program to produce copies of wetlands management plan report and educational materials for distribution to schools and viewing on local television.
 - Kosrae Environmental Education Program: Supported an environmental education and projects focused on raising public awareness regarding sustainable use of coastal resources in Kosrae.
 - Palau Grouper Aggregation Program: Palau extension agent developed and coordinated the educational outreach component of this project, including community forums, presentations, and school activities.

- **Material Development** A compilation of curriculum units developed during the Operation Pathfinder teacher training workshop are being printed up for distribution in the region; a draft booklet is available. Slide presentations regarding ecosystem and dugong conservation are being developed in Palau.

Future Objectives and Program Needs

1. **Regional Environmental Education Specialist** Over the past two years, informal educator and teacher training programs have built strong links between educators in the region who are focused on environmental issues. The Pacific Program will continue the regional environmental education specialist position to coordinate this effort, in addition to other training programs and material development - **\$50,000**
2. **Training Program** The Operation Pathfinder educational training program, which educates teachers about environmental issues and provides them the opportunity to work together to develop class activities focused on these issues, has been tremendously successful and highly praised. The Pacific Program will continue this cooperative effort with PREL in Pohnpei in 1996 - **\$60,000/year**

Micronesia and American Samoa Student Internship Program (MASSIP)

Rationale

The Pacific faces an uphill battle in trying to convince their younger generation to return home to fill important economic development and resource management roles left vacant by an aging professional population. As a result, island resource management agencies are typically faced with hiring either islanders who lack qualifications for environmental positions or qualified non-islanders who lack local knowledge and connections. Additionally, few island college graduates include environmental science tracts as part of their studies, due to ignorance regarding the importance of sustainable management of their island resources. Those who do graduate with natural science degrees often do not return home because they lack employment contacts or miss career opportunities. This internship program addresses these issues through providing Micronesian and American Samoan undergraduate students with natural resource summer internships with local sponsoring agencies and organizations. This experience allows the students to return to their home islands as professionals, gain valuable practical work experience in relevant fields, and develop local contacts for future career opportunities. The first two years of this cooperative program with the University of Hawaii-Hilo (UH-Hilo) have been highly successful for both host agencies and students.

Accomplishments

- **1995 Internships** - Ten natural resource internships were completed in 1995 in six island entities. Upper-division undergraduates worked on projects ranging in topics from study of sea grasses in Palau, compiling a database of ecotourism attractions in Pohnpei, to conducting market-testing of giant clams in American Samoa. Students worked with faculty members at UH-Hilo to complete independent study programs for their internship in the Fall of 1995.
- **Partnerships with other programs** - Developed partnership with the U.S. Forestry - Institute of Pacific Island Forestry (IPIF) provided support for two of the internships. IPIF achieved their goal of developing and utilizing local expertise and plan to participate in the program next year.
- **Internship graduates** - Two former interns have graduated from UH-Hilo and returned to their home islands to work in development fields in Kosrae and Pohnpei.
- **Pohnpei internship** - A student on leave from college worked with the FSM extension agent and the FSM National government on coastal resource and management issues. She is returning to school to pursue an environmental course of study.

- **1996 Internships** - Development of eight 1996 internships is underway. Training for students will begin at the end of March, 1996

Future Objectives and Program Needs

1. **MASSIP Office** In order to strengthen the effectiveness of this program, student interns need to have more project-specific training prior to their internships, as well as follow-up activities and projects that hones students' interests and skills throughout their undergraduate program. The Pacific Program and UH-Hilo will work together to develop one office at UH-Hilo that combines the responsibilities of setting up the internships in the islands previously handled by the Pacific Program in Honolulu and the UH-Hilo role of interviewing, selecting, advising and training the intern students. This office will work with agencies and organizations in the islands, faculty and students within the undergraduate and community colleges in the region, to develop stronger training programs prior to internships, project-specific internships, and follow-up activities, including academic programs and Hawaii -based internships for selected interns. Additionally, selected interns will be targeted as for training as counterparts with existing extension agent and specialist programs in the region. - **\$65,000/year**

Pacific Aquaculture Development Program (PADP)

Rationale

Since the Pacific Aquaculture Development Program's inception in 1987, the program's goal has been to create and support a viable aquaculture industry in the U.S.-affiliated pacific islands. During the six year period that OIA has provided aquaculture funding for projects, from 1989-1995, the aquaculture industry has grown in value, now exceeding over \$2M. Both Guam and the Republic of Palau, through the Guam Aquaculture Development and Training Center and Palau Mariculture Demonstration Center (PMDC -formerly Micronesian Mariculture Demonstration Center) have led the industry's regional development and are largely responsible for technology transfer to the remaining U.S.-affiliates. The most notable growth has been in the Federated States of Micronesia, Republic of the Marshall Islands, American Samoa, and the Commonwealth of the Northern Mariana Island where previously an industry did not exist. However, due to OIA support, a viable, but fledgling industry exists in each nation.

Today aquaculture can be considered an important component of commerce in these island nations. It is a growing industry that produces domestic and export products, nurtured by the region's superior natural resources, and excellent research and extension capabilities.

This report characterizes the accomplishments of PADP since project funds became available in 1989. To mobilize a new industry, it takes at least ten years. As a result of OIA's support over the past six years, moderate economic successes are now visible across the region in aquaculture. The scope, diversity and value of the 1995 aquaculture industry can be briefly described as follows:

Status of the Regional Aquaculture Industry - 1995¹

- Gross annual sales for the industry represented approximately \$2,148,800 in 1995. From 1989-1995, gross annual sales had increased 21% for the region.
- In 1995, the industry had expanded over 700% to create a moderate sized, and profitable aquaculture industry in all six island nations. The industry is composed of 65 facilities compared to only 8 in 1989.

¹ All industry employment and revenue data has been provided by Pacific Aquaculture Association members. UH Sea Grant is not responsible for any errors in this data.

- The regional industry in 1995 provided employment for 147 people comprised of private farmers, government hatchery technicians, researchers, wholesalers, Importer/exporters, extension trainees, and extension agents.

Federated States of Micronesia

- In 1989, the FSM had no aquaculture industry. By 1995, the industry provided employment for twenty-three people of which 63% are private farmers, 21% are government hatchery researchers, 8% are extension trainees, 4% are wholesaler, and 4% are extension agent.
- In 1995, the Pohnpei sponge industry generated over \$18,000 in gross sales from two private farms actively harvesting sponges. Five farms with 12 employees and one wholesaler compose the industry.
- The giant clam industry generated over \$15,000 in gross sales in 1995. The FSM National Aquaculture Center on Kosrae spearheaded a program in 1993 to market clams in restaurants on Kosrae, Pohnpei, and Chuuk. Simultaneously, a value-added product line of giant clam shell soap dishes, wasabi bowls, business card holders, and Center t-shirts was developed. In 1995, the Center developed an export market to Saipan with a local importer/exporter, Micronesian Clam Company, who is on the brink of penetrating the Japanese food market with Kosrae's aquacultured clams. The Center has been in operation since 1989 and generated revenue since 1992.

American Samoa

- In 1989, American Samoa had no aquaculture industry. By 1995, the industry provided employment for thirty-six people of which 84% are private farmers, and 16% are government researchers/extension agents.
- The giant clam industry generated over \$12,000 in annual gross sales during the last quarter of 1995 without reaching market saturation. Prior to this, no revenues had ever been generated in the aquaculture industry. The Faisua (giant clam) Hatchery, of the Department of Marine and Wildlife Resources, spearheaded a marketing campaign in 1995 to penetrate the domestic market. Based on 1996 first quarter receipts, the industry expects to double its size by developing export markets into the U.S. saltwater aquarium trade.

Commonwealth of the Northern Mariana Islands

- Until 1995, the Commonwealth of the Northern Mariana Islands had no aquaculture producers, although one giant clam importer existed. By 1995,

the industry provided employment for eight people: 6 farmers, 1 importer/exporter, and 1 researcher/extension agent.

- In 1995, the giant clam market in the Saipan restaurant industry was worth about \$45,000 in sales. The giant clams served were imported from Palau and Kosrae by Micronesian Clam Company.

Republic of Palau

- In 1989, the Palau Mariculture Demonstration Center (formerly Micronesian Mariculture Demonstration Center) was the sole aquaculture facility in the Republic of Palau. By 1995, the industry expanded from three employees to five with the addition of an exporter, Indo-Pacific Sea Farms, which also has a facility in Kona, Hawaii.
- From 1989 to 1994, PMDC increased its annual gross revenues by 39%, \$122,097 to \$170,000. Retail value in the U.S. aquarium trade market for PMDC's product line (giant clams, soft corals, and juvenile Trochus) would at least double this value. With the introduction of a locally based exporter in 1995, it's likely Palau's aquaculture industry value exceeded an estimated value of \$250,000.

Guam

- From 1989-1995, Guam's aquaculture industry increased its annual gross revenues by 13%, from \$1,639,610 to \$1,850,800.
- In 1989, Guam had a moderate sized aquaculture industry. By 1995, the industry provided employment for 37 people directly in aquaculture of which 56% are commercial farmers, 18% are government hatchery technicians, 14% are backyard farmers, and 8% are research and extension specialists. Approximately ten additional people are indirectly employed in aquaculture as suppliers of feed/equipment and marketing.
- Since 1989, the number of farm operations on Guam has increased over 200%, from 4 to 15 commercial facilities. At least eight new facilities are in various stages of development at this writing.

Republic of the Marshall Islands

- In 1989, the Republic of the Marshall Islands had no aquaculture industry, although a single private giant clam facility was operational in 1985. By 1995, the industry provided employment for thirty-eight people of which 80% are private farmers, 18% are government hatchery researchers/extension agents, and 2% are aquaculture consultant service providers. Two tropical fish

exporters, who employ a total of 23 people, also market locally produced giant clams into the U.S. aquarium trade.

- Total gross sales for the giant clam industry for 1995 was over \$38,000. The two black pearl farm operations are still in the research and development phase.

The approach PADP has taken to develop the aquaculture industry is to work with appropriate technology that compliments the lifestyle, and to some degree, the culture, of our clients. Additionally, PADP evaluates a species merit for culture based on economic gain and the availability of existing technologies to transfer to the region. Given the scarcity of scientific expertise in the region, training and extension components are included in all projects. Through these multi-tasked efforts, PADP and the island's aquaculture industry members have spearheaded the development of a new revenue generating industry for the region.

The following aquaculture research and extension projects were implemented in 1995 through the Pacific Aquaculture Development Program.

1. Aquaculture Workshop Series in the Commonwealth of the Northern Mariana Islands
2. Commercial Sponge Aquaculture Extension
3. Market promotion for the development of Asian catfish (*Clarius batrachus*) on Guam and Saipan.
4. Regional aquaculture extension, training, and marine stock assessments in the U.S. Affiliated Islands. - YR 2
5. Giant Clam Culture in American Samoa - Hatchery and Grow-out Operations - YR 3.
6. Introducing red tilapia culture as a means to expand market outlets and production.
7. Larval culture trials of groupers - YR 3
8. Intensive culture demonstration of *Penaeus stylirostris*
9. Evaluation of aquaculture effluent treatment utilizing a system of aquatic plant and limited term effluent retention for nutrient and turbidity reduction.
10. Pacific Aquaculture Association

Detailed Project accomplishments are included as Appendix 1.

Pacific Aquaculture Development Program - Funding Request for FY 96

The Pacific Aquaculture Development Program has been extremely successful in the development of a small and growing aquaculture industry in Micronesia. The most notable accomplishments have been in the Freely Associated States of the Federated States of Micronesia, Republic of the Marshall Islands, and the Republic of Palau. In only five years, aquaculture has become a new and important revenue generating activity for domestic and export markets for these nations. This is assisting them with their trade imbalance, which is heavily weighed toward imports. Without these revenue generating activities, the need for foreign economic aid will continue indefinitely.

Future Program Objectives and Program Needs:

1. **Marine aquarium species.** The ornamental saltwater aquarium trade represents a \$13M industry in the U.S. Growing environmental awareness and regulations is pressuring the industry to culture marine animals for the aquarium trade rather than harvesting wild stocks. In general, mass culture techniques for many freshwater ornamental species is well-known, while procedures to spawn and rear marine species (e.g reef fish) are mostly in the research and development phase. The U.S-affiliates have a great deal of expertise in aquatic animal and plant culture at public institutions such as the University of Guam Marine Laboratory, and Guam Aquaculture Development and Training Center, private farms (i.e. Robert Reimers Enterprises) and non-profits (i.e. Palau Coral Reef Foundation). Species under consideration, but not limited to, are colorful marine algae (*Caulerpa* spp.), marine shrimp (banded coral shrimp, cleaner shrimp or harlequin shrimp), high value marine fish (groupers, damsel fish), and "live" rock and sand. **\$200,000**

2. **Market development.** Market development and promotion of aquacultured products is in it's infancy in Micronesia. To continue to expand and diversify the region's food and aquarium markets, this area needs attention. The region's remoteness prevents them from being on the cutting edge of market development, which is essential to succeed in an international market place. This program recommends a three prong approach:
 - 2.1. Transportation links into and out of Micronesia are few and expensive. For the aquaculture industry to expand, reasonably priced cargo/freight charges must be negotiated for the industry to bring in equipment to an island aquaculture facility and to export products out. A PADP project will be developed to analyze this situation and suggest provisions for improvement. **\$30,000.**

- 2.2.** To sustain the economic growth of Pohnpei's emerging sponge industry, new export markets must be identified and developed. A project to address these issues is recommended with assistance from the UH Pacific Business Center Program. **\$25,000**
- 2.3.** To promote captive breed products from Micronesia, development of a regional presentation booth for a national aquarium industry trade show is needed. This forum would introduce a wide variety of aquacultured products to potential international buyers. This would allow the Pacific island facilities and their staff to develop a prospective client list for marketing their products, and to identify future marine species for culture. **\$30,000**
- 3. Extension and Training.** The long-term effectiveness of an aquaculture industry will rely on having trained extension staff who are qualified to help island governments sustainably manage and develop their aquaculture industry.
- 3.1.** Training courses at specific hatchery/farm sites will continue to teach culture techniques for new species to diversify the number of products available for market. Courses will be conducted on at least the following six topics: pearl oysters, soft corals, hard corals, giant clams, tilapia, and catfish. **\$35,000**
- 3.2.** Linking industry members with researchers working on reef species in the U.S. through a series of internships is an important capacity building activity. This will provide local producers with an opportunity to mentor the work of a research scientist at facilities such as Harbor Branch, Hawaii Institute of Marine Biology, or SeaPHIZ - a large commercial captive breed facility for marine species in the Midwest. This will also provide long-term collaborations with cutting edge research facilities who develop marine species culture techniques. This technology can then be transferred to the islands for commercialization and grow-out. **\$35,000**
- 3.3.** Human resource development will be the focus of three locations to develop or enhance on-island local extension expertise. PADP's goal is to phase-out the expatriate Regional Aquaculture Extension Agent position by 2001.
- 3.3.1.** Extension agent training in RMI - **\$10,000**
- 3.3.2.** Extension agent training in FSM - **\$15,000**
- 3.3.3.** Extension agent position in the CNMI - **\$20,000**

- 4. Disease Diagnosis.** As the food fish aquaculture industry expands on Guam and Saipan, there is a growing need to develop local expertise in food fish disease diagnostics and to establish protocols for the treatment and maintenance of high-health brood stock for food fish species. This expertise is required to quickly identify disease outbreaks and implement solutions to prevent livestock loss. Currently, all disease diagnosis are performed in Hawaii, which requires significant time that farmers don't have when there is a problem. **\$45,000**
- 5. Milkfish Baitfish Industry.** Guam aquaculture farmers are beginning to enter into joint ventures with owners of the Guam's tuna fishing fleet. The fleet owners are interested in culturing milkfish as bait for the tuna fleet. Economic projections indicate this could be a \$2 million dollar industry for farmers. Currently milkfish fry are imported from Taiwan for grow-out. However, GADTC has milkfish broodstock which are expected to spawn within the next twelve month. Fry would then be available to Guam farmers. Funds are requested to assisted with fry grow-out experiments on farm sites and production of an extension brochure. **\$35,000.**
- 6. Pacific Aquaculture Association.** The Pacific Aquaculture Association (PAA) continues to provides a critical link for PADP into each governments aquaculture development plans, technical expertise, and industry representatives. The PAA Board of Directors provide oversight into the development of their county's aquaculture industry and guidance on the development of PADP's annual work plan. The PAA Technical Committee provides important technical expertise and reviews of proposed projects for funding consideration. Funding to have the PAA Board of Directors meet twice and PAA Technical Committee meet once are requested. **\$25, 000**
- 7. Pacific Aquaculture Development Program office.** In order to continue to administer this program, and to foster future industry growth, PADP needs to maintain an office at UH Sea Grant. Program management and development are the prime responsibilities of the PADP Coordinator. With the help of the Sea Grant Pacific Program, and advice of the Pacific Aquaculture Association, the Coordinator mobilizes university, state, national, community, industry and other federal agency resources to achieve PADP's goals. At the same time, the Coordinator's office overseas the administration of the program, and monitors and evaluates progress of the research, marketing, and extension and training projects. Funds to operate the PADP office are requested: 1.0 FTE position, .5 FTE student help, communication, supplies, and travel. **\$78,000**

APPENDIX 1. Pacific Aquaculture Program Project Updates

1. Pacific Aquaculture Association

Entering its sixth year as a regional association, PAA is comprised of representatives from all six U.S.-affiliated nations. The organization is composed of a Board of Directors and a Technical Committee whose primary functions are to identify country specific and regional priorities for aquaculture, coordinate regional planning activities, and to technically review proposals submitted to PADP for funding consideration. The Board also evaluates the progress of on-going projects, and negotiates a final list of projects endorsed by PAA for funding consideration by PADP/OIA.

Accomplishments

- The PAA published two issues of *AquaNews* - a regional newsletter describing PAA activities and research projects.
- The PAA Board of Directors held one meeting in Honolulu to review projects for PADP's work plan and develop a funding strategy to continue the program if OIA receives no FY 96 funds.
- The PAA Technical Committee reviewed 30 proposals submitted to PADP for the 1996 funding cycle. The Board of Directors is now identifying funding priorities by country given the fact there is a highly probability that OIA will receive no technical assistance funds in FY 1996
- PAA Board of Directors and Technical Committee members worked closely with PADP to implement FY 95 research and extension program.

Partnerships/Collaborating Agencies

American Samoa Department of Marine and Wildlife
 Marshall Islands Marine Resources Authority, RMI
 National Aquaculture Center, Kosrae, FSM
 Marine Resources Division. Department of Resources and Development, FSM
 National Government
 College of Micronesia - Cooperative Extension Service, Land Grant Program
 Guam Aquaculture Development and Training Center, Department of Commerce
 Marine Laboratory, University of Guam
 Northern Mariana College - Land Grant Program
 Division of Fish and Wildlife, Department of Natural Resources, CNMI
 Palau Mariculture Demonstration Center
 Marine Resources Division, Palau

Matching Support/Funds

External technical reviewers from the following institutions donated between 2-25 hours each to review proposals for PADP at the request of PAA:

1. College of Agriculture and Life Sciences, University of Guam
2. Pohnpei Natural Products
3. Sea Grant Extension Service, University of Hawaii
4. Aquaculture Development Program, State of Hawaii
5. Pacific Program, National Marine Fisheries Office - Honolulu Laboratory
6. Department of Genetics, University of Hawaii
7. Robert Reimers Enterprises, RMI

2. Aquaculture Workshop Series in the Commonwealth of the Northern Mariana Islands

Status: Ongoing

Completion date: April 1996

A 1990 feasibility study for aquaculture development in the Commonwealth of the Northern Mariana Islands (CNMI) indicated there was potential for developing a small industry within the Commonwealth. This industry could assist with diversifying the economy, generating government revenue, and reducing imported protein sources. One of the study's recommendations was to establish a technical training program that includes aquaculture workshops and short courses.

Demonstrated by the growing number of inquiries for information and technical assistance with aquaculture projects, the Division of Fish and Wildlife (DFW) determined it was time to begin addressing these requests in a more systematic manner. To begin doing so, the DFW proposed conducting a series of aquaculture workshops for the Commonwealth's populace by tapping into the Pacific Aquaculture Association's network of regional aquaculture extension agents and project personnel.

Accomplishments

- Delivered eleven aquaculture workshops on Rota, Tinian, and Saipan on the following topics:
 1. Potential for fish farming in the CNMI
 2. Freshwater fish farming
 3. Integrated fish farms
 4. Farming fish for the aquarium trade
 5. Shrimp culture and farming techniques
 6. Hands-on construction of a demonstration farm site
 7. Solar back-up systems for aquaculture facilities
 8. Business plans for aquaculture farming
 9. Permit requirements for aquaculture farming in the CNMI
 10. Farming giant clams
 11. Saltwater aquaculture opportunities in the CNMI
- Participation by over 160 Commonwealth community and agency members in the CNMI Aquaculture Workshop Series.

- Outstanding media coverage of the aquaculture workshop series heightened awareness of aquaculture within the CNMI. No less than five television newscasts on the workshop have occurred, and 9 newspaper articles published in local CNMI newspapers, and one in Guam's *Pacific Daily News*. A one hour television show summarizing the workshop series is in the process of final editing now, and is slated to be aired on local television in March.
- A hands-on workshop constructed three demonstration aquaculture tank facilities; one each on Saipan, Rota, and Tinian. Water is now flowing through each system and as of late January, red tilapia fry from GADTC has been stocked for growout in each. These tanks will be used as teaching stations for farmers on each island.
- The low-cost tank construction design used in the demonstration tank facilities has been successfully transferred to Guam by the University of Guam Aquaculture Extension Agent. Over 20 new backyard farmers on Guam are using this new technology.
- Recognizing the need for technical expertise to build an aquaculture industry in the Commonwealth, and by capitalizing on the workshop series' positive momentum in generating interest in aquaculture, the NMC created, advertised, and filled an aquaculture research position in October 1995 using Land Grant funds. Mark Brotman, the DFW Workshop Coordinator, was selected for this position.
- With the establishment of this position, the College has dedicated approximately 1 acre of campus lands to begin developing an aquaculture research station and training facility. Land Grant funds are being used initially to support this endeavor. The College is searching for additional government land to create a large integrated aquaculture/agriculture park.

Partnerships/Collaborating Agencies

Department of Lands and Natural Resources

Division of Fish and Wildlife, CNMI

Coastal Resources Management Program, CNMI

Northern Mariana College, CNMI

Land Grant

Business Incubator

Guam Aquaculture Development and Training Program

University of Guam

Marine Laboratory

College of Agriculture and Life Sciences

University of Hawaii Sea Grant Extension Service
U.S. Army Corps of Engineers - CNMI
Pan-Pacific Education and Communication Experiments by Satellite
(PEACESAT)

Matching Support/Funds

All eleven workshop presenters donated three days of salary from their home institution plus travel and preparation time to the workshop series.

Videography services provided at no charge for six workshops by DFW and four workshops by NMC.

NMC offered an Aquaculture Workshop Certificate of Completion signed by the President of NMC and Secretary of the Department of Lands and Natural Resources

PEACESAT provided communication support for biweekly teleconferences and electronic mail services between the DFW workshop coordinator, individual workshop presenters, and the PADP office.

Future

Immediate needs for the development of CNMI's aquaculture industry include the following:

1. .5 FTE to support the development of an aquaculture extension agent position to provide ongoing support to the Commonwealth's new farmers. The College is unable to use the services of the Aquaculture Researcher in extension activities because of the grant restrictions tied to the use of USDA-HATCH funds.
2. Travel funds for the extension agent to provide technical assistance to new farmers on Rota and Tinian.

3. Commercial Sponge Aquaculture Extension - YR 2

Status: Ongoing

Completion Date: September 1996

The development of a small, viable, and growing wool sponge industry in Pohnpei has been jointly spearhead by several federal agencies² during the past six years. Currently, five private farms are cultivating *Spongia officinalis*. Harvesting has begun on two farms with the product being sold to Pohnpei Natural Products (PNP) who completes the final processing and packaging for market distribution. Farm gate prices for the sponges are from \$2-\$8 per piece depending on the size. To stabilize and expand the industry, PADP developed a two year program in the following areas.

To combat the problem of farmers losing interest in sponges due to the 2-3 year lead time necessary to grow sponges to commercial sizes, a strong extension component was needed to provide technical support and training. By partnering with the College of Micronesia, this proposal provided on-the-job sponge extension training for two local persons. PADP's goal is to institutionalize one sponge extension agent position at the COM-FSM.

Simultaneously, to expand the industry, this project will identifying new sources of wild sponge stocks to domesticate for culture on Nukuoro Atoll, and Mokil Atoll, two outlying atolls of Pohnpei State,. Similar stock assessments were conducted in two outer-island atolls in the RMI last year under the Regional Aquaculture extension agents program funds. Based on the results of this survey work and interest by prospective farmers in Kiti Municipality on Pohnpei, at least two - six new sponge farmers will be trained in these locations.

Accomplishments

- Waldon Lohn and Ander Semens, have been hired as sponge extension trainees through the College of Micronesia - FSM. Waldon has been on board since June 1994, and Ander joined the sponge trainee program in January 1996.
- Waldon Lohn attended the World Aquaculture Society (WAS) Conference and Trade Show in 1995 in San Diego, California with Dick Croft, Pohnpei Natural Products. Waldon visited the PADP office in Honolulu and several

²U.S. federal agencies supporting the sponge industry development include PADP (OIA-DOI), Center for Tropical and SubTropical Aquaculture (CTSA - USDA), Saltonstahl-Kennedy (NMFS-NOAA), and Sea Grant College Program. Local government counterparts include the College of Micronesia - FSM, Cooperative Extension Service and the FSM Marine Resources Division, Department of Resources and Development.

aquaculture facilities in Hawaii while en route to the Conference and participated in the WAS field trips to large scale fin fish and abalone farms. This was Waldon's first trip outside of Pohnpei.

- As a training activity, Waldon has begun to prepare quarterly reports for this project in Pohnpeian and English. It is anticipated that Ander will begin this activity next quarter.

Partnerships/Collaborating Agencies

College of Micronesia - FSM

Pohnpei Natural Products

Pohnpei Division of Marine Resources

Robert Bernardo, Tepak Island, Pohnpei - Sponge farmer

Palus Lohn, Tepak Island, Pohnpei - Sponge farmer

John David, Tepak Island, Pohnpei - Sponge farmer

Tommas Dano, Tepak Island, Pohnpei - Sponge farmer

Palus Primo, Tepak Island, Pohnpei - Sponge farmer

Matching Support/Funds

- College of Micronesia - FSM has administered this project and hired the two sponge trainees through their system.
- Dick Croft , Owner of Pohnpei Natural Products, and Regional Sponge Specialist, has donated hundreds of hours of his expertise to supervise this project and to develop a commercial sponge industry throughout Micronesia.
- Pohnpei Division of Marine Resources has provided in-kind support for scuba tanks and air fills to conduct this project.
- Five local sponge farmers on Pohnpei have provided their families time and energies to maintain the farm sites.

Future

One goal of this project has been to institutionalize one sponge extension agent position at the College of Micronesia using Land Grant funds. PADP has received favorable response from the office of the President at COM to support a position. However, until the decentralization of the Land Grant program is complete among the three Micronesian Colleges, existing College funds are unavailable to support such a position. PADP is monitoring the decentralization process closely, and anticipates that funds will become available within FY 1997. Bridging funds may be required from OIA to keep one of the existing trainee positions intact until Land Grant funds become available.

4. Market promotion for the development of Asian catfish (*Clarius batrachus*) on Guam and Saipan.

Status: Ongoing

Completion Date: December 1996

The Asian catfish is one of the primary species cultured on Guam with a sustainable supply of seed stock at the GADTC facility. Catfish provides one of the highest returns among aquaculture products. The species high stocking densities result in high production levels per area. In 1982, catfish production was 138 kilograms and peaked in 1990 at 26,305 kilograms, transforming the catfish industry into a major product in the local seafood market. To meet the high production levels, there is a need to expand the existing catfish markets to maximize opportunities. Alternative markets to target for development with this proposal will be the tourist market on Guam, and export markets on Saipan.

Accomplishments

- Dana Edwards, a Marketing Specialist II, was hired on January 3, 1996 through the Research Corporation of the University of Hawaii (RCUH). This GADTC-based position reports to Anne Bailey, PADP Coordinator, and Carl Kittle, GADTC Hatchery Manager.
- Catfish larvae have been reared and sold to farmers for growout, and market sized fish will be available within one month for market promotion.
- A consumer taste test was completed in January 1996 with Department of Commerce staff with catfish offered raw as sashimi. The panelists agreed the sashimi was flavorful, although the animal itself was quite ugly.

Partnerships/Collaborating Agencies

Furosato Japanese Restaurant
Island Fresh Fish Market

Matching Support/Funds

Department of Commerce supports GADTC's operating costs and the salary of five staff members using local funds.

5. Regional aquaculture extension, training, and marine stock assessments in the U.S. Affiliated Islands. - YR 2

Status: Ongoing

Completion Date: July 1997

A collaborative effort of federal and local agencies has supported a regional aquaculture extension agent position for nine years. Principal partners have been OIA, Center for Tropical and SubTropical Aquaculture (USDA), University of Hawaii Sea Grant Pacific Program, College of Micronesia-FSM Cooperative Extension Program (COM-CES), and marine resource offices within the US affiliates. Currently, this position is based at the COM-CES office in Pohnpei. This position is the primary point-of-contact for aquaculture expertise in the region. It is anticipated that this position will be filled by local aquaculture extension agent by no later than 2001³. This position services all U.S. affiliates with the exception of Guam.

This project provides funding to assist with the development and promotion of commercially valuable freshwater and marine aquaculture products through intensive, site-specific training courses coordinated and offered by the regional aquaculture extension agent. Training courses will continue to be conducted on the culture of giant clams, pearl oysters, and sponges at the private and regional hatcheries. New training course initiatives include freshwater ornamental aquarium species on Pohnpei, and the culture of saltwater aquarium species such as soft and hard corals, algae, and live rock. Funds will also support local island trainees to attend these course. Additionally, on a request basis, the extension agent will complete marine stock assessments of two outer atolls in the FSM and RMI to identify wild populations of giant clams, pearl oysters, and sponges for future aquaculture activities.

Selected Accomplishments

- .. Completed one giant clam training course at the FSM National Aquaculture Training Center (NAC) on Kosrae and the Robert Reimers Enterprises (RRE) Wahoo Island Giant Clam facility on Mili Atoll, and three courses at the American Samoa Giant Clam Hatchery.
- .. Coordinated two pearl oyster training courses at the RRE pearl oyster farm on Arno Atoll. A seed technician from the Cook Islands assisted with the course.

³ Local counterpart trainees in sponge aquaculture are currently funded by an OIA grant (GEN 86). See project description under "Commercial Sponge Aquaculture Extension - Yr 2.". This is also the goal for all on-island extension agents supported by the University of Hawaii Sea Grant Pacific Program.

- Assisted with the sponge farm training sessions on Pohnpei conducted through the "Commercial Sponge Aquaculture Extension - YR 2" proposal.
- Coordinated a sponge training workshop on Ulithi Atoll in Yap State with Pohnpei Natural Products. Several sponge farms were set-up during this two week visit with assistance from a PEACECORPS Volunteer stationed with the Yap Marine Resources office.
- Presented three guest lectures at the aquaculture course offered by COM. Topics covered "Aquaculture opportunities in Micronesia", "Sponge aquaculture on Pohnpei", and "Giant clam culture at the NAC".
- Coordinated and assisted with sponge stock assessments on Alingalaplapp and Ebon atolls in the Marshall Islands. Pohnpei Natural Products, a private sponge culture firm on Pohnpei, assisted with the survey-work. These atolls were selected because the Japanese had conducted sponge culture trials in these locations prior to WWII. No *Spongia officinalis* stocks were located on Ebon, however, small stocks were found on Alingalaplapp. MIMRA will follow-up this work with a proposal to PADP to work with the community to establish sponge farms on Alingalaplapp Atoll.
- Provided technical assistance on the development of a black lip pearl oyster (*Pinctada margaritifera*) farm on Nukuoro Atoll.
- Provided support to train two Nukuoran pearl farm members in scuba diving. These skills are required to collect pearl oyster brood stock, deploy spat collectors, and monitor the implanted pearls.
- Conducted a four week training course on pearl oyster culture on Nukuoro Atoll (from October 10-November 6, 1995) with assistance from a seed technician from the Cook Islands. The technician seeded 3000 pearl oysters with round nuclei, and 100 with half pearl nuclei
- Coordinated the participation of Virgil Alfred, Aquaculture Officer from the Marshall Islands Marine Resources Authority (MIMRA), to participate as a trainee in the Nukuoro pearl oyster training course. MIMRA is coordinating the development of a pearl oyster farm on Namdrick Atoll in the Marshall Islands.
- Provided sponge culture information to Kapingimarangi Atoll Municipal Government. Depending on field trip ship schedules, this atoll may be surveyed for sponge stocks under the "Commercial Sponge Extension Trainee - YR 2" project.

Partnerships/Collaborating Agencies

Marshall Islands Marine Resources Management Authority (MIMRA) Likeap
Giant Clam Hatchery
Alingalaplup Atoll Municipal Government
Ebon Atoll Municipal Government
Robert Reimers Enterprises (RRE) Wahoo Island Giant Clam Farm
RRE Arno Pearl Oyster Farm
Nukuoro Atoll Community Council
Kapingamarangi Municipal Government
PEACECORPS Volunteers
Yap Marine Resources Division
Australian Embassy
College of Micronesia
American Samoa Department of Marine and Wildlife Resources

Matching Support/Funds

The Australian Embassy for FSM supported travel and salary costs for a seed technician from the Cook Islands to implant pearl oysters on Nukuoro Atoll.

The Australian Fisheries Patrol Boat provided a boat and associated charter costs to transport the training course team (seed technician, extension agent, and MIMRA representative) to Nukuoro Atoll from Pohnpei. The team returned to Pohnpei on the field trip ship.

Seven Nukuoro Atoll Pearl Farm members and the atoll community donated on-site logistical support to the team for one month.

Ebon and Alingalaplup Atoll communities donated logistical support to the survey team for two weeks and knowledge of the Japanese sponge culture trials and their participation in it as young people.

RRE donated logistical support for the giant clam and pearl oyster training courses including transportation from Majuro to the atoll farms. RRE also supported the seed technician's fee and travel costs from the Cook Islands to Majuro.

Yap Marine Resources donated logistical support for the sponge specialist from Pohnpei Natural Products while on Ulithi.

The Ulithi Atoll municipal government provided release time for 10 individuals to attend the sponge farm workshop.

The American Samoa Department of Marine and Wildlife supports the salary of all hatchery staff, and provides extension services to the farmers.

Future

Support for this project needs to continue as it performs a very important function of knitting together technical expertise into training courses on viable aquaculture species.

6. Giant Clam Culture in American Samoa - Hatchery and Grow-out Operations - YR 3.

This is the final year of a three year program to stabilize the hatchery into a revenue generating facility.

Accomplishments

- Completed repairs to the raceways from damage caused by blasting activities at the adjacent sewage treatment plant and renovated the salt water intake pipe system.
- Created and published five bilingual extension pamphlets on giant clam farming topics.
- Established 15 new giant clam farm sites on Tutuila island. Provided farmers with 300 clams for grow-out and monthly extension support through on-site visits.
- Successful spawning and larval rearing of *Tridacna derasa*, *T. maxima*, and *Hippopus hippopus* occurred.
- A report entitled "Market analysis - giant clams as food products in the American Samoa domestic market." was completed by the Pacific Business Center Program. This study included a promotional sale, taste test, market test, and feasibility analysis. Results indicate that it can be profitable to farm giant clams for the domestic market in American Samoa.
- Sponsored a Samoan undergraduate student from UH-Hilo participating in the MASSIP project (GEN 87) in an eight week internship. The intern was the on-site liaison between the PBCP consultant and the giant clam hatchery personnel. She participated in all aspects of the market analysis project.
- Hatchery staff members participated in three giant clam training courses offered by the regional aquaculture extension agent during his visits to American Samoa.

Partnerships/Collaborating Agencies

University of Hawaii Pacific Business Center Program
 Center for Tropical and SubTropical Aquaculture, USDA
 Micronesia and American Samoa Student Internship Program (GEN 87)

Matching Support/Funds

The following businesses and restaurants participated in the market survey: Alamai Samoa Corp., 4&1 Stop, Aiga Basket, S&S Pouessi, Louise Grocery Store, PJK Fish Market, Pago Pago Bay Restaurant, Rainmaker Hotel

The Center for Tropical and SubTropical Aquaculture (USDA) provided support for one-half of the marketing study costs with PADP providing the balance.

MASSIP provided airfare for the student intern to participate in the marketing project.

Department of Marine and Wildlife Resources, American Samoa Government provides operational support for the hatchery and salary for the Hatchery staff.

Future objectives

1. Continue extension support for the giant clam farmers.
2. Develop export markets for giant clams in the food industry in Western Samoa.
3. Diversify products available from the hatchery for ornamental aquarium trade.
4. Develop export markets for giant clams in the aquarium trade.
5. Train a local manager to take-over the expatriate position.

7. Red tilapia trial culture and marketing to develop alternate marketing sectors for tilapia

Status: ongoing

Completion date: September 1996

The gray/black tilapia is one of the five primary fish species currently produced on Guam. Currently, tilapia production constitutes over two-thirds of the total production in Guam. The Filipino markets have been targeted because they favor the natural, dark colored variety. Retailing at \$2.00/pound, the market is near saturation requiring little or no further development. However, a large percentage of the local population maintains an image of tilapia as a trash fish. To overcome this perception and expand market opportunities, Guam decided to introduce a red variety of tilapia which had received wide market acceptance in Hawaii and a premium price of \$4.00+/lb. Hawaii cleverly marketed red tilapia as "Hawaiian perch" and "Hawaiian Sunfish" with excellent results.

This project's goal, therefore, will be to introduce a red tilapia hybrid to local farmers for culture, to access new markets, and to expand Guam's existing aquaculture markets.

Accomplishments

- Red tilapia fry (*Oreochromis nilotica* X *O. mossambica* cross) were imported from Taiwan in June 1995.
- Grow-out density trials at six GADTC tanks and two farm sites were completed.
- Dana Edwards, a Marketing Specialist II, was hired on January 3, 1996 through the Research Corporation of the University of Hawaii (RCUH). This GADTC-based position reports to Anne Bailey, PADP Coordinator, and Carl Kittle, GADTC Hatchery Manager.
- As of January 20, 1996, red tilapia fry (F1) from the imported brood stock from Taiwan have been distributed to five farm sites on Guam and one on Saipan.
- Local marketing trials have begun in Guam's fish markets, restaurants, and farmers markets.

Partnerships/Collaborating Agencies

Kuon Hung

Matching Support/Funds

Department of Commerce supports GADTC's operating costs and the salary of five staff members using local funds.

Island Fish Market

Future

8. Larval culture trials of groupers - YR 3

Status: ongoing

Completion Date: July 1996

This is the final year of a three year program to develop the expertise to culture groupers as a food fish and for the aquarium markets. This project is a follow-up to the 1994 project entitled "Preliminary spawning and larval culture trials for groupers from Palau and Guam". This project focuses on refining larval culture techniques of groupers, and establishing adequate broodstock at GADTC.

Accomplishments

- Broodstock of *Ephinephelus microdon* and *Cephalopholis miniata* were collected in Palau and shipped to Guam in the YR 2 project. No spawning was recorded from either species in 1995.
- Grouper broodstock of the specie *E. merra* was collected from local Guam waters, and regular spawning activity occurred during 1995. Fertilized eggs were collected every two weeks for a two day period, and larval rearing trials conducted.
- Wing Kai Wong, GADTC Biologist, successfully completed one month of on-site training at the Chao Ching Fishery Breed Co., LTD facility in Taiwan from June 20 to July 21, 1996. Kai observed grouper spawning, hatching and larval rearing techniques to produce 3 cm fingerlings, Taiwan's market size.
- Kai has applied the techniques he learned to spawns of *Ephinephelus merra*, but the primary problem has been with timing the oyster spawning trochophores to use as a first feed for grouper larvae. Recent efforts have focused on GADTC's oyster handling system, and the collection of local oyster broodstock.
- All larval rearing trials conducted during 1995 and 1996 used *E. merra* larvae. Survival ranged from 6-16 days post hatch. Oyster larvae appear to offer the best hope for first feeding (small enough that the grouper larvae can eat them) while artemia and copepods will be used as feeds for older fish larvae.
- Mass cultures systems to produce the smaller strain of rotifers (ss-type rotifer) used as a feed source for grouper larvae has been completed as of June 1995.

Partnerships/Collaborating Agencies

Chao Ching Fishery Breed Co., LTD , Taiwan
University of Hawaii Sea Grant Extension Program

Matching Support/Funds

Department of Commerce supports GADTC's operating costs and the salary of five staff members using local funds.

Future

This is the final year for grouper larval rearing support on this project by PADP. If the larvae can be successfully reared to fingerling size, PADP may assist with demonstration grow-out experiments, and market development.

9. Intensive culture demonstration of *Penaus stylirostris*

This project will demonstrate production potential of *Penaus stylirostris* in intensive culture. Limited land areas available for aquaculture on Guam make it necessary to intensify culture techniques which will produce yields large enough to justify penaeid culture on a commercial basis. On Guam, the GADTC facility is fortunate to have a specific free pathogen free population of *P. stylirostris* known to adapt well to intensive culture. Guam farmers are currently stocking around 25 post larvae (PLs) per square meter. This project will conduct stocking trials of 50, 65, 75, 85, 100, and 150 PLs per square meter and analyze the economics of these rates.

Accomplishments

- Three stocking trials of two ponds each are underway at GADTC. Stocking rates of 50 and 100 PLs per square meter, 75 and 150 PLs per square meter, and 65 and 85 PLs per square meter.
- The first trial has been completed with stocking rates of 50- and 100 PLs per square meter. This translates to a projected target production of about .75 and 1.5 kilograms per square meter. Actual results were 0.8 and 1.45 kilograms per square meter.
- The GADTC recently had an outbreak of IHHN virus. This outbreak has been controlled and *P. stylirostris* disease free stocks are available at the hatchery. Postlarvae for stocking the 65 and 85 PLs per square meter, and the 75 and 150 PLs per square meter trials became available in February 1996.

Partnerships/Collaborating Agencies

Dr James Brock, Veterinary, Hawaii State Aquaculture Development Program

Matching Support/Funds

Department of Commerce supports GADTC's operating costs and the salary of five staff members using local funds.

Future

Results of this research will be shared with farmers in an extension publication. No new work is anticipated in this area.

10. Evaluation of aquaculture effluent treatment utilizing a system of aquatic plant and limited term effluent retention for nutrient and turbidity reduction.

Status: Project will commence June 1996 **Completion Date:** June 1997

This project will address a major regulatory issue concerning the discharge of effluent from aquaculture operations. Regulatory constraints are the major entry barriers to developing new farms on Guam. While this problem is not unique to Guam, the treatment of aquaculture effluent to meet discharge requirements using plants such as duckweed to reduce nitrogen and various minerals from waste waters has been received favorably by the commercial aquaculture community.

This project will complete a model environmental protection plan for the construction and operation of an aquaculture pond. The operational phase will examine the efficiency of duckweed based effluent treatment system. Reduction of the nutrient load to meet waste water discharge quality standards and optional uses of by-products to recapture some of the system's cost will be evaluated.

Accomplishment

- This project proposal based on the availability of new fish ponds which were designed to have water treatment in an effluent pond. The farm with this design has not been constructed to date due to problems getting permits. A zoning change is still needed before construction of the ponds can begin.
- In view of the above situation, discussions have been held between GADTC staff and PADP. It has been agreed to delay the start of this very important project until June 1996 with the one year implementation to follow.

Matching Support/Funds

- Department of Commerce supports GADTC's operating costs and the salary of five staff members using local funds.

