
Policies and Priority Actions for Sustainable Mariculture Development in the Republic of the Marshall Islands

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Preface

This profile provides a comprehensive review of the status of mariculture in the Republic of the Marshall Islands (RMI), including current mariculture facilities, key issues, constraints, and opportunities. It further identifies actions to advance the sustainable development of mariculture in the RMI.

The profile is the result of a collaborative process. The concept was developed from meetings of the collaborative alliance of the USDA/IFAFS project on 'Bridging Gaps to Insure Long-term Viability of Small Scale Mariculture in Hawaii and the US Affiliated Islands.' The first meeting of the collaborative alliance was held in Kolonia, Pohnpei in February 2002. Four additional meetings have been convened since then. At the third meeting in Majuro in February 2003, private and public sector participants from the RMI identified the need for mariculture planning and policy.

In response to this need, a Mariculture Development and Management Planning (MDMP) process was initiated under the joint leadership of the Policy and Planning Division of the Marshall Islands Marine Resources Authority (MIMRA) and the Marine Science Program of College of the Marshall Islands (MSP/CMI). An intersectoral and multiagency Mariculture Steering Committee and Working Group were formed. At the first meeting of the working group in April 2003, the preparation of a profile of mariculture development in the RMI was selected as a first activity of the MDMP process.

This draft has been prepared by the Mariculture Working Group. The Steering Committee and the MIMRA Board will be invited to review the profile and provide guidance for next steps.

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List of Acronyms

ADB	Asian Development Bank
AMI	Air Marshall Islands
BPI	Black Pearls Inc.
BPOM	Black Pearls of Micronesia, Inc.
CARE	Community Afterschool Recreation and Education
CBFMP	Community-Based Fisheries Management Planning
CITES	Convention on International Trade in Endangered Species
CRC/URI	Coastal Resources Center/University of Rhode Island
CTSA	Center for Tropical and Subtropical Aquaculture
DOI	Department of Interior—United States
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization—United Nations
IFAFS	Innovative Future Agriculture and Food Systems
JICA	Japan International Cooperation Agency
MDMP	Mariculture Development and Management Planning
M ² EIC	MIMRA, MIVA, EPA, Internal Affairs, and CMI
MIMRA	Marshall Islands Marine Resources Authority
MIVA	Marshall Islands Visitors Authority
MOE	Ministry of Education
MPA	Marine Protected Area
MSP/CMI	Marine Science Program/College of the Marshall Islands
NMFS	National Marine Fishery Service
ORA	Ocean Reefs and Aquariums, Inc.
OFCF	Overseas Fishery Cooperation Foundation
RMI	Republic of the Marshall Islands
RRE	Robert Reimers Enterprises, Inc.
SPC	Secretariat of the Pacific Community
UHH	University of Hawaii—Hilo
UNDP	United Nations Development Program
USDA	United States Department of Agriculture

1. INTRODUCTION

The Marshall Islands consists of two parallel chains of 29 atolls and 5 low coral islands (Figure 1). The eastern (*Ratak* or 'sunrise') chain contains 14 atolls and 2 islands. The western (*Ralik* or 'sunset') chain contains 15 atolls and 5 islands. All together there are 1,225 islands and islets spreading across a sea area of almost 2 million km² encompassing 181 km² of land and 6,110 km² of coral reefs (Spalding *et al.*, 2001). In 1999, there were about 51,000 people in the RMI, with just under half of them residing in the capital, Majuro (Economic Policy, Planning and Statistics Office, 2002).

The standard of living in the outer islands (all areas outside of Majuro) has been steadily declining over the past 20 years due to expanding population and the fall of copra as the primary source of cash income. Concern over future levels of external funding and the capacity of the RMI government to continue providing subsidies for copra, have intensified the search for supplemental and alternative sources of income.

Living marine resources in both Majuro and the outer islands have long been exploited for subsistence purposes. Today both food security and the ability to derive local income from capture fisheries are at risk because pressures on marine resources appear to be accelerating as a result of increased local and foreign commercial fishing effort and a myriad of other environmental stressors.

Outer island communities may be forced to choose between unsustainable marine harvest practices or out-migration unless other options are found. Fortunately, most communities have the wisdom and foresight to take a different road, aided by the national institutions concerned with these issues. A number of outer island communities are now working actively to develop community-based fisheries management (CBFM) plans and establish Marine Protected Areas (MPAs) to protect their marine resources, fish stocks and fish habitats. Key components of these efforts are new initiatives to develop alternative sources of income with mariculture being among the most favored by the communities.

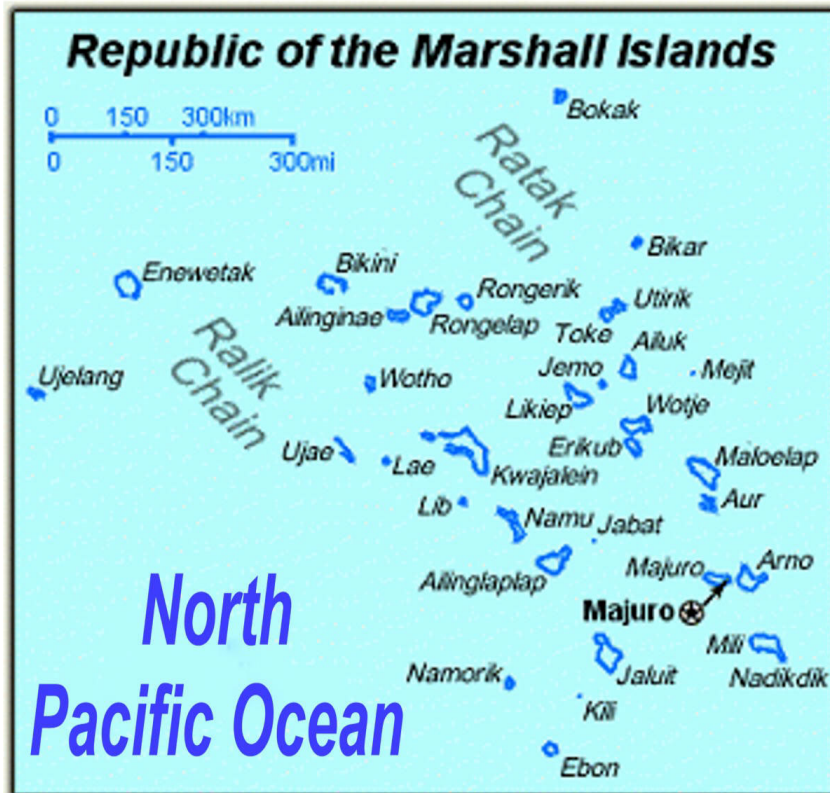
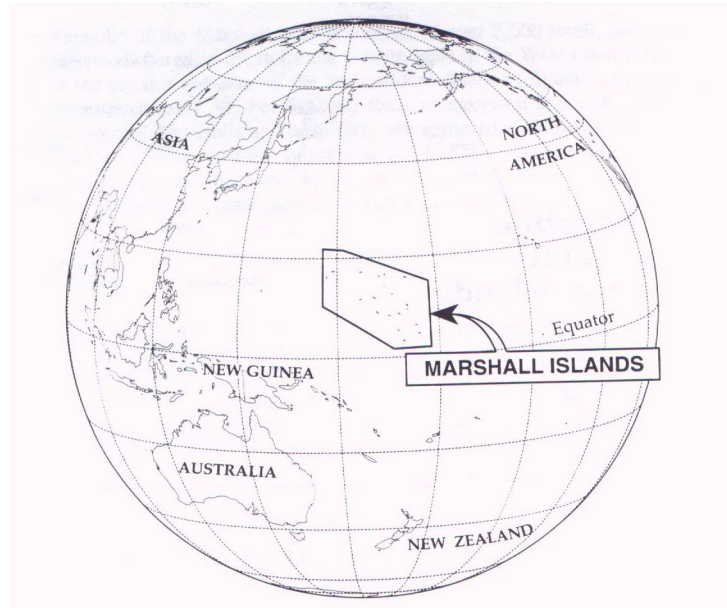
This profile expands on a preliminary country profile (Edwards, 2002) and provides guidance on priority development issues. The challenge is not only to realize growth in that sector, but to also ensure that opportunities are developed within a framework that includes long-term vision, successful links between Majuro and outer islands, consistent environmental policy, skilled labor, adequate infrastructure, and sound marketing and financial planning. Mariculture is one of the few feasible economic opportunities for the geographically isolated islands of the RMI but can only be successful if approached in a holistic fashion supported by a wide range of expertise and in accordance with active participation and ownership of local stakeholders.

Mariculture Vision

In 2003, the RMI Mariculture Working Group and Steering Committee created a list of statements that together make up the content of a vision for sustainable mariculture in the RMI:

- Education and awareness that empowers communities
- Links to ecosystem management, community-based fisheries, and preservation of biodiversity
- Outer island production that links with operations and transportation systems in Majuro
- Food security and gender equality
- Community-based and culturally-appropriate outer island development
- Income generation leading to reduced dependency on government programs
- Availability of start-up capital for reputable and profitable businesses that increase exports in a globally competitive market

Figure 1. Map of the Republic of the Marshall Islands



Source: Economic Policy, Planning and Statistics Office (2002).

2. STATUS OF MARICULTURE IN THE MARSHALL ISLANDS

Mariculture has long been held to be one of the leading opportunities for economic development for the RMI, particularly due to its suitability for remote, pristine lagoons. However, its full potential has yet to be realized. The biological and economic feasibility of large-scale, commercial mariculture has been amply demonstrated by the long-term and profitable existence of two companies based on the capital island of Majuro producing black pearls, giant clams, soft and hard corals and a small volume of ornamental fish.

2.1. Site Availability and Species Feasibility

The lack of major storm activity in the RMI makes for sheltered lagoons and ideal locations for mariculture, especially on the leeward side of the atoll islands. Most aquaculture efforts in the past have focused on marine invertebrates such as black-lip pearl oysters, giant clams, trochus, and corals. Historically, a Japanese-owned sponge farm functioned in Ailinglaplap prior to WWII. With the exception of trochus, these animals are currently being grown commercially in the RMI. The emphasis on invertebrates is primarily due to their high value and low technology rearing methods, and because these particular species are photosynthetic and/or filter feeders that do not require manufactured feeds as adults. Hatchery production of these species is also simpler than, for example, marine fishes. The general shortage of land in the RMI combined with the absence of wetlands (other than coral reefs and some mangroves) rules out fresh or brackish water aquaculture.

Fish culture in the RMI has been limited. A shortage of finfish, the usual incentive for fish culture in other countries, has been absent as wild fish stocks have historically provided for the fish food needs of the Marshallese. This is now changing. With the ever increasing urban drift into the population centers of Majuro and Ebeye, fish stocks in these areas are becoming depleted and fresh fish prices are rising. The increasing number of Asian residents, visiting fishermen and a blossoming political relationship between the RMI and Taiwan are beginning to provide market incentives and possibly, donor assistance for fish culture. More emphasis on finfish culture is therefore expected in the future.

It is important to draw attention to two key features of mariculture in the RMI:

- There has been an emphasis on using locally occurring species. This means that comparatively less is known about the basic biology, culture, and ecology of these species as opposed to species such as tilapia or milkfish, which have a long history of global domestication
- All mariculture in the RMI relies heavily on wild stock at some point in the life cycle and is conducted in sensitive habitats. Thus, even for species with relatively well known culture technology such as giant clams, there is still much to learn from experimentation and broader research. While most species currently cultured are low risk with regard to negative environmental impacts, it is crucial to be vigilant and employ precautionary approaches so that critical and vulnerable habitat such as coral reefs and mangroves are not affected

Of the species tried and tested to date in the RMI, the following have been demonstrated to be economically feasible:

1. Black-lip pearl oyster farming to produce black pearls. Black pearls currently represent a US\$200 million annual global market. Despite a relatively long time period to reach profitability (8-14 years) and a current reliance on hatchery produced spat, this mariculture industry probably has the best potential for the RMI. Pearls are non-perishable, have high market value, and are easy to transport. Two of the three privately-operated pearl farms in Micronesia are in the RMI. A community-based farm at Namdrik was revived in 2004 and a small demonstration farm has been set up by the Jaluit High School as an educational and community-demonstration project.

- Giant clams and other marine ornamental invertebrates. Many marine ornamental invertebrates, including giant clams, are easy to produce using simple farming technologies. The main drawback to this kind of culture is a limited global demand and the need to ship the product live to the market. This causes problems not only for getting product from the outer islands to Ebeye or Majuro for trans-shipment, but also for getting the product to the end customer in the USA or Europe. Recent improvements in international airline carriers providing service to the RMI have made marine ornamental culture feasible. However, problems still remain with inter-island transport within the RMI.

2.2. Operations and Facilities

Operations in the RMI demonstrate that mariculture of pearls, giant clams, soft and hard corals and ornamental fish can be biologically and economically feasible. Large and medium sized private sector efforts also offer the means by which small-scale mariculture development can be jump-started. The larger companies have been generally supportive of the idea that small-scale mariculture development is desirable from a national perspective, but also because they stand to derive benefits from this in a number of ways. The larger companies can supply materials and supplies, offer technical assistance, as well as buy products produced by smaller farms to achieve the production numbers needed to bolster exports and revenues.

Public sector investments in mariculture in the RMI are also strong and have provided technical assistance to the industry and long-term educational support. This includes local government agencies (MIMRA and Ministry of Education), bilateral and international donor organizations (Sea Grant, CTSA, SPC, FAO, NMFS, OFCF, USDA, Land Grant, UNDP, etc.) and universities (such as CMI and the University of Hawaii).

The collaborative efforts of public institutions, technical advisors, and private sector partners have resulted in greatly increased capacity in the RMI to support mariculture development. The coming together of public and private efforts has also created an atmosphere that is conducive to long-term and environmentally sustainable development.

Table 1. RMI Mariculture Operations (*Activities not currently operating)

Activity	Species	Location	Time Period	Institution
Public and Educational				
Kwajalein Giant Clam Mariculture*	Smooth giant clam from Palau (<i>Tridacna derasa</i>)	Kwajalein	1989-??	Kwajalein Atoll Development Authority
Namdrik Black Pearl Project* (being revived)	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Namdrik	1990-1995	Namdrik Atoll Government, BPI, MIMRA, UHH
Giant Clam Hatchery/ Outer Island Farmers Program*	Fluted clam (<i>Tridacna squamosa</i>)	Ailuk, Aur, Jaluit, Likiep, Maloelap, Ujae, Wotje	1993-1995	MIMRA
Likiep Clam Farm	Elongated giant clam and giant clam (<i>Tridacna spp.</i> , mostly <i>maxima</i> and <i>gigas</i>)	Likiep	1993-present	MIMRA (now selling clams to Marshall Islands Mariculture Farm)
Arrak Experimental Pearl Oyster Hatchery	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Majuro	2001-present	CMI, Land Grant
Arrak Demonstration Pearl Oyster Farm	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Majuro	2003-present	CMI, Land Grant
Seaweed Cultivation	Seaweed (<i>Eucheuma cottonii</i>)	Majuro Jaluit	2002-present	MIMRA, FAO Local Govt.
Arno Clam Hatchery	Elongated giant clam (<i>Tridacna spp.</i> , mostly <i>maxima</i>) and potentially rabbitfish (<i>Siganus spp.</i>)	Arno	2003-present	MIMRA, OFCF

Activity	Species	Location	Time Period	Institution
For Profit Operations				
Giant Clam Aquaculture*	Giant clam (<i>Tridacna gigas</i>)	Mili	1988	Marshall Islands Aquaculture
Mili Giant Clam Farm	Giant clam (<i>Tridacna gigas</i> , <i>T. squamosa</i> , <i>T. gigas</i>)	Wau Island, Mili	1988-present	RRE
Marshall Islands Mariculture Farm	Giant clams (esp. <i>Tridacna maxima</i> and <i>crocea</i>), hard and soft coral, live rock	Wau Island, Majuro	1995-present	Ocean Reefs and Aquariums--ORA (purchased from RRE in 2003)
RRE Pearl Oyster Farm at Arno	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Arno	1995-present	RRE
RRE Pearl Oyster Farm at Jaluit	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Jaluit	2001-present	RRE
BPOM Pearl Oyster Farm at Arno	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Arno (relocated from Majuro in 2002)	1998-present	BPOM
Woja Pearl Oyster Hatchery*	Black-lip pearl oyster (<i>Pinctada margaritifera</i>)	Majuro (requires modifications to be operational)	1998-present	MIMRA (formerly BPOM until 2002)
Outer Island Pearl Oyster Development Project	Black-lip pearl oyster (<i>Pinctada margaritifera</i>), Giant clam (<i>Tridacna maxima</i>), a variety of soft and hard corals	Jaluit	2003-present	ADB, MOE, UHH, CMI

2.2.1. Black-lip Pearl Oysters

The black-lip pearl oyster (*Pinctada margaritifera*) has been the basis of the largest mariculture industry in the tropical Pacific for well over a decade now. Although black pearls are commonly associated with French Polynesia and the Cook Islands, pearl oyster culture has a long history in other areas of the Pacific.

Smith (1947) and Clarke *et al.* (1996) have written about the early pearling activities in Micronesia. It is believed that the first attempts at black-lip pearl oyster mariculture in the RMI began in the 1930s at Ebon Atoll (Smith, 1947). This operation was a joint venture between the Japanese government and a private company, which ended with WWII.

In 1984, a survey of pearl oyster shell in 6 Atolls conducted by a Japanese institution showed the importance of Namdrik in pearl oyster shell abundance. In recognition of this valuable resource, the Namdrik Local Government enacted the Namdrik Alele Local Government Pearl culture Ordinance in 1985. This ordinance prohibits the harvesting and marketing of pearl oysters by anyone without the prior approval of the council. The legislation has been strictly enforced with few violations.

Based on the availability of pearl oyster shells, Namdrik became the center of focus for developing scientific and commercial pearl farming activities in the RMI. The Senator of Namdrik began to advance the idea of a pearl oyster industry in Namdrik Atoll following a visit to the Cook Islands in the late 1980's where he observed pearling activities. This interest led the Marshall Islands Marine Resources Authority (MIMRA) to approach the Inshore Fisheries Programme of the Secretariat of the Pacific Community (SPC) in 1989 to seek assistance. In response to MIMRA's request, one of MIMRA's staff was trained in pearl oyster survey techniques. With this training, MIMRA then conducted a survey in October 1989 of Namdrik lagoon. Based on this report (Alfred and Kilma, 1989), the SPC sent a consultant in November of 1990 to help initiate pearl culture activities in the RMI.

Spat collectors and a submerged longline for a pilot pearl oyster farm were installed at Namdrik lagoon. A draft pearl farming development plan and wild pearl oyster management plan were also prepared (Dashwood, 1991). The project suffered after the consultant completed this work due to lack of funds and attention. The local residents were unable to sustain the activities. Both MIMRA and SPC concluded that more study and support were needed to determine the viability and sustainability of pearling in Namdrik Atoll.

From October 1993 to 1995, a research firm in Hawaii—Black Pearls, Inc. (BPI)—lead a NMFS-funded project in association with MIMRA to explore the potential for commercial farming of black-lip pearl oysters at Namdrik and Majuro. BPI carried out studies of pearl oyster stocks and the availability of both natural and hatchery spat, trained local people, and developed a technical and business management plan for future operations. Three-thousand spat collection bags were put in place in Namdrik and high rates of recruitment were recorded. More than 2,000 young oysters (6-18 mo.) were collected.

BPI also took broodstock from Namdrik Atoll to their research facility in Kona, Hawaii with the aim of producing spat and bringing them back to Namdrik to augment the natural stocks there. Five remote hatchery runs were conducted with broodstock from Namdrik. Additional grants were obtained that allowed study of larval rearing issues and testing of hatchery operations using Majuro broodstock (Sims and Sarver, 2002).

The BPI project initiated pearl production in the RMI for the first time. Two hundred adult oysters were tagged and seeded at Namdrik for half pearl production in January 1994. When harvested in October 1994, it was found that some were of good quality. However, due to miscommunication between BPI and the community, activities were moved to Ejit Island in Majuro in 1997 with oyster spat being produced from a [MH1]container hatchery at Woja, in Majuro. The farm suffered massive mortalities because of a red tide organism in 1998.

In 1998, Black Pearls of Micronesia (BPOM) was set up as a joint venture of BPI, local businessmen and MIMRA. BPOM took over all the earlier BPI and MIMRA operations in RMI. In the same year BPOM relocated the farm to Bikirin Island some 13 km up the Majuro lagoon. BPOM also experienced chronic mortalities at the Bikirin Island farm and began farming in Arno in 2002. The farm in Arno has about 4,000 pearls seeded and the first harvest is planned for 2004.

Another local company—Robert Reimers Enterprises, Inc. (RRE)—began commercial black-lip pearl farming in 1995 with a pearl farm in Nam Lagoon at Arno Atoll using some 7,000 shells collected from Jaluit Atoll. To date, RRE has had 5 harvests at Arno and has about 11,000 shell under cultivation. Most of RRE's pearls have been sold loose in the local market to both residents and visitors, although jewelry making by RRE was begun in 2003 and has been expanded since as a successful value-added activity.. A major drawback to RRE's expansion efforts is a lack of pearl oyster spat. This led RRE to enter into a collaborative agreement with the Center for Tropical and Subtropical Aquaculture (CTSA) and the UH Sea Grant Program to carry out spat collection trials on Jaluit¹. Research was carried out from August 1998 to March 2000 to determine the time and place of optimum spatfall in Jaluit lagoon. Using results from this study, RRE established a second farm on Jaluit in 2001. The first harvest from this farm was in November 2003. Today, there are approximately 50,000 implanted pearl oysters at the BPOM and RRE commercial black pearl farms on Arno and Jaluit Atolls.

Most recently (early 2005), RRE was forced to relocate its farm at Arno to Jaluit when it became apparent the Arrak pearl oyster hatchery was not able to produce pearl oyster spat on a regular basis nor in sufficient quantity to merit maintaining the farm at Arno which was convenient due to its proximity to Majuro, but which depended on spat from other locations. Additionally, spat collection was attempted again at the RRE farm in Jaluit and a limited quantity of spat collected thus further indicating Jaluit as a more appropriate location for the farm.

¹ CTSA Regional Notes. 1999. *Black pearl industry continues to expand*.
<http://library.kcc.hawaii.edu/CTSA/notes/vol11/rnv011n1.htm>

Hatchery production has been seen as the most promising manner in which to obtain spat for pearl farming. BPOM farm on Arno has been largely dependent on hatchery production. From 1997-2000, BPI and then BPOM operated the container hatchery at Woja on Majuro. In 1998, BPOM received capital from a private investor and a new hatchery was completed near the container hatchery in 2000. Spat was produced and distributed to the two commercial pearl farms in RMI from this hatchery as part of a unique industry collaboration. However, in 2000, one of the major investors in BPOM pulled out his holdings in the company and the BPOM Woja facility closed for financial reasons. The hatchery at Woja was handed over to MIMRA in early 2003.

Given the dire situation, the Center for Tropical and Subtropical Aquaculture (CTSA) hired a pearl oyster hatchery specialist in 2002 to produce spat for the industry at the Woja facility on an emergency, short-term basis. For three months, attempts to spawn pearl oysters were unsuccessful. However, a week before the specialist's contract expired, there was a spawning although final spat production was low. It was found upon reviewing sea temperature records collected by NOAA, the sea level temperatures during June to August, 2002, were unseasonably high, peaking at over 30 degree C. This may have interfered with pearl oyster spawning. A pearl oyster hatchery manual was written by the CTSA consultant and pearl oyster specialists Maria Haws and Simon Ellis as part of this effort.

A collaborative agreement between MIMRA, CMI, UHH, and CTSA was then established. CTSA agreed to hire another hatchery expert. By this time CMI's multipurpose experimental hatchery at the Arrak Marine Science Center on Majuro Atoll had been modified to make it ready for pearl oyster spat production. The Arrak hatchery, which was primarily built for sea cucumber research, was modified by CMI Land Grant staff for the production of black lip-pearl oysters. In June 2003, a successful hatchery run was conducted by the CTSA hatchery expert and Land Grant aquaculture scientist.

The spat were distributed to the industry in RMI and to CMI for its demonstration pearl farm at Arrak. Unfortunately the Arrak hatchery has not proven its ability to supply spat regularly or in sufficient quantity to maintain the existing farms let alone start new farms. Only two successful spat cohorts have been produced in nearly two years and most spat from both production runs died shortly after being distributed to the farmers. CTSA will end support for this hatchery in June 2005.

Given the still urgent need of the farms for pearl oyster spat, it was clear that attempts had to be made to secure pearl oyster spat. The pearl oyster stakeholders group (RRE, BPOM, UHH, CMI and MIMRA) collectively decided to end support to the Arrak effort and focus on renovating the MIMRA Woja hatchery. A pearl oyster hatchery specialist was brought in April 2005, renovation immediately started, and the first spawn scheduled for July 2005.

2.2.2. Giant Clams

The first giant clam farm operations were established on Wau Island in 1985 with a focus on producing clams for food. Today, clams are produced primarily for the ornamental aquarium market. Species produced are vibrantly colored clams such as *Tridacna maxima*, which is naturally found in significant numbers throughout the RMI.

The only commercial giant clam operation in the RMI and Micronesian region overall was established in 1995 by RRE. It is the largest commercial giant clam farm in the world. In 2002, the farm cleared an estimated \$250,000 in clam sales exported primarily to the United States. In 2003, RRE's clam farm operations were sold to the US-based company Ocean Reefs and Aquariums, Inc. (ORA). The ORA operations in RMI are now called the Marshall Islands Mariculture Farm. The main farm on Majuro is supplemented by production at a satellite farm on Wau Island at Mili Atoll. Clam species produced by the Marshall Islands Mariculture Farm

include *Tridacna maxima*, *T. derasa*, *T. crocea*, *T. squamosa*, *T. gigas* and *Hippopus hippopus*. Limited coral and ornamental fish culture are also conducted at the farm

MIMRA operates a giant clam hatchery on Loto Island at Likiep Atoll that provides young clams (of several species: *T. maxima*, *T. squamosa*, and *T. gigas*) for restocking reef areas, supplying local farmers for grow-out and reselling, and for direct marketing to the Marshall Islands Mariculture Farm. MIMRA also provides training to interested farmers in propagation and management. The initial intention was to export clam meat to Asia. However, the extended grow out period (5 years or more) did not make this feasible and the objective changed to the ornamental aquarium market. At the hatchery on Loto Island there are 12 raceways. MIMRA employs 5 staff to operate the hatchery and farm. The hatchery has concentrated primarily on spawning and raising the species *T. squamosa* and *T. maxima*.

A new hatchery to raise giant clams (and other targeted species) was constructed on Arno Atoll in early 2003 with the financial assistance of the Overseas Fisheries Cooperation Foundation (OFCF). This hatchery has already had a successful run of spawned giant clams. The facility will serve as a research station and has the objective of enhancing giant clam populations in the Marshall Islands. Hatchery-reared juveniles and transplanted wild adults will be used to establish giant clam sanctuaries.

2.2.3. Other Species

2.2.3.1. Trochus

Historical information says that the Japanese seeded Ailinglaplap and six other atolls with trochus in the 1930s. This stock was overexploited via unregulated wild stock harvesting since the 1980s in particular, and is now viewed as severely overfished. Trochus was commercially harvested in significant quantities until the stocks were depleted from the atolls of Kwajelein, Enewetak, Arno, Majuro, Jaluit, Mili, and Ailinglaplap. In 1983, the national government issued an ordinance and a moratorium on harvesting until the stock could regenerate.

There was a plan for restocking the overexploited reefs with hatchery-produced seed from the MIMRA hatchery in Likiep. The hatchery aimed to produce trochus juveniles from 1992-1996, although the project never materialized. Several conservation measures have been put forward since including introduction of trochus to unpopulated atolls and also re-seeding depleted atolls with mature broodstock.

2.2.3.2. Corals

Starting in 1997, RRE began expanding their product line to include cultured soft and hard corals. Using simple fragmentation techniques most species of photosynthetic corals can be cultured from a mother colony. This has provided a lucrative sideline to the giant clam business. Soft and hard corals are also being cultured on a very small scale as part of the demonstration project at the Jaluit High School.

Corals are more sensitive to the rigors of shipping than giant clams, which makes it more feasible to culture and export directly from Majuro rather than ship them in to the capital from the outer islands for export.

2.2.3.3. Seaweed

An exotic seaweed (*Eucheuma cottonii*) cultivation project was initiated by MIMRA in 2002 with the help of the United Nations Food and Agriculture Organization (UN-FAO). *E. cottonii* is a red seaweed that has achieved moderate success in Kiribati, and offers several advantages for alternative income on outer islands. It involves small-scale farming operations, low establishment costs, and short maturation times (approx. 10 weeks). Disadvantages include potential for invasion, high volume necessary to achieve reasonable weight of the final product, low buying prices, and marketing difficulties.

The objectives of the project include to introduce *E. cottonii* farming, identify suitable cultivation sites, adopt appropriate cultivation methods, screen the performance of the introduced species, provide training and technical assistance to local farmers, and to ensure participation by all stakeholders.

The project timeline was Jan 2003 to March 2004 and involved initial surveying of six atolls. Majuro Atoll was selected and seaweed plots were introduced in a cross-section of depths and substrate types in the lagoon near the islands of Rongrong and Jeltar, and the community of Woja on Long Island. CMI carried out site-specific monitoring of environmental impacts during the course of the pilot project including oversight of the initial quarantine protocol (Lal 2003). Jaluit Atoll Local Government and MIMRA started a similar small-scale seaweed cultivation project in Jaluit around the same time, although neither CMI nor FAO are involved.

2.2.3.4. Tuna

The Rongelap Atoll Local Government has entered into an agreement with a private sector company to start the commercial rearing of yellowfin tuna in ocean-based cages in Rongelap Atoll. The initiative is being put forth as a means of local income generation. There are significant technical and environmental issues to be considered in this initiative, notably the intent to catch juvenile tuna rather than raise them in a hatchery.

2.2.3.4 Sponges

Sponges have been cultivated successfully in Pohnpei using the species *Coscinoderma matthewsi* since the 1990's when the University of Hawaii Sea Grant Program and CTSA sponsored research and development efforts there. Limited sponge surveys were also done in the RMI as there had been pre-WWII sponge farming on at least two atolls. The precise species was not relocated, perhaps due to the rather limited nature of the surveys, but a renewed effort at finding the species may be merited, particularly at Ailinglaplap. Ebon has a species of sponge which is common and used locally for washing and may be a possible candidate for culture.

2.3. Education, Research and Extension

Capacity for mariculture in the RMI has been greatly enhanced through a long history of efforts directed at formal education, training, research and extension. For example, the clam farm at Likiep run by MIMRA, the RRE pearl farms in Arno and Jaluit, the ORA clam farm in Majuro, and the Woja pearl oyster hatchery in Majuro all started due to sustained extension efforts.

In the late 1980's and up to 1998, the University of Hawaii Sea Grant program with core funding from DOI directed a Pacific Aquaculture Program with activities that included RMI. The USDA Centre of Tropical and Subtropical Aquaculture (CTSA) has supported many research and extension projects in the RMI as well as a Regional Extension Agent for the U.S. affiliated Pacific Islands (1989-2002). This position was with the College of Micronesia Land Grant until 2002 when it was transferred to RMI. CTSA hired a pearl oyster hatchery specialist to work primarily at the CMI Marine Science Station. Recently, MIMRA has hired a pearl oyster hatchery specialist for the Woja hatchery; part of his duties is to train Marshallese to take over hatchery operations.

With respect to educational institutions, the College of the Marshall Islands has offered courses in environmental sciences since it became an independent institution in 1993. CMI established a Marine Science Department in 1999 and in 2001 the Department expanded to offer courses in tropical marine ecosystems, oceanography, integrated coastal management, and aquaculture. Students graduate with an Associate of Arts degree with a specialization in marine science. The first class graduated in 2002. Of the seven graduates, six have received scholarships to study at four-year institutions and six have worked at six-month internships at MIMRA that included supporting the community-based fishery management planning program and MPA efforts. The CMI Marine Science Department has a well-qualified staff of 5 faculty (2 doctorates and 3 master degrees). A Ph.D. aquaculture scientist is located at the CMI Arrak campus.

Beginning in January 2001, CMI and Land Grant initiated a research and extension program at the Arrak Marine Research Station (formerly called Marshall Islands Science Station). This modern facility includes a multipurpose hatchery, tanks, raceways, laboratories, classrooms, wet labs, a demonstration pearl farm, SCUBA and boating capabilities. It has been intensively used by CMI and partners for training, research and hatchery operations to support the industry. MIMRA, EPA and private sector partners all provided support to these efforts and participate in them, but support was widely withdrawn in 2005 due to performance issues at Arrak. Two aquaculturists are located at Arrak and conduct aquaculture and marine science research as well as supervise labs for CMI students in the Marine Science Department. Initial research aimed at stock enhancement of sea cucumbers and hatchery production of marine ornamental cowries. Presently research is fully concentrated on pearl oysters to support and boost the local industry.

In terms of public education and vocational training, the Ministry of Education is partnering with the University of Hawaii at Hilo, the Pohnpei Agriculture and Trade School (PATS) and CMI to provide mariculture training to the regional high school at Jaluit Atoll. High school teachers received an intensive month training course at the Pohnpei Agriculture and Trade School (PATS) located in the Federated States of Micronesia. Students, teachers and community members at Jaluit were also trained in coral culture and techniques required to become spat farmers for pearl oysters and giant clams. Spat will be sold to pearl and giant clam farmers when of sufficient size.

The Ministry of Education currently hosts two other mariculture activities. One is with CMI to develop an educational module at the Arrak Marine Research Station. The other is the ADB in its Outer Island Development program. In this program, a few outer island teachers have been trained in mariculture and a small demonstration pearl farm and a giant clam aquarium were set up in Jaluit in August 2003.

Sea Grant is currently providing support for marine science curriculum development at CMI. It also provides support for CMI Marine Science faculty to conduct marine resource surveys on outer atolls. The surveys collect base line data on the status of coral reef habitats and other marine resources as the basis of a long-term monitoring effort and to inform management decision-making. Prior to these recent efforts, very few scientifically rigorous marine surveys had been conducted in the RMI and no long-term monitoring efforts existed. It has become clear that without basic information on the nature and status of Marshallese marine resources, management and community awareness raising efforts were greatly impeded.

The on-going marine resource surveys have been linked to outer island efforts to develop Community Based Fisheries Management plans, of which MPAs are one management option. Siting and sizing of MPAs, along with management regimes, are being informed by the survey results. The surveys include participation by CMI students from outer islands and local community members.

Most technical support for aquaculture development has been provided by a team of specialists from a consortium of universities working with the Marine Science Department of CMI and MIMRA since 1996. Approximately \$600,000 in grant funding has been channeled to the RMI by the team comprised of CMI, University of Hawaii Hilo, University of Hawaii Manoa, Fisheries Industry Technology Center/University of Alaska-Kodiak, Pohnpei Agriculture and Trade School/ Marine and Environmental Research Institute of Pohnpei and the University of Rhode Island. One of the most significant projects led by the consortium was supported by USDA under its Innovative Future Agriculture and Food Systems (IFAFS) program was initiated in November 2001 with completion scheduled for January 2005. This project promotes sustainable mariculture development in Hawaii and the US Affiliated Islands through a collaborative alliance of partners lead by the Pacific Aquaculture and Coastal Resources Center at the University of Hawaii-Hilo. The RMI is one of the primary areas of focus. The project involves activities in six key areas: demonstration sites, education and training, hatcheries, best management practices, policy and planning, and marketing and business development. This project was successfully concluded in 2005 and many of its efforts are continued under

other funding, including the USDA theme area, “Outreach and Extension for Socially Disadvantaged Farmers”.

3. LEGISLATION AND INSTITUTIONAL ARRANGEMENTS

Mariculture development and management in the RMI is guided by traditional land tenure, national policy and legislation, local government bylaws, and institutional arrangements that allow government bodies to coordinate decision making as well as to proactively integrate nongovernmental interests. This section summarizes the governance structure in the RMI as it relates to mariculture and provides examples of current collaborative planning processes that have links to mariculture.

3.1. Traditional and Customary Rights

All land in the RMI is private land, at least for that portion above the high water shoreline. This is the norm in many Pacific island nations. However, the ownership of the land under the water is not quite as clear. The Attorney General asserts that the land below the high water mark belongs to everyone. Some landowners dispute these public property rights and claim ownership of the seabed. In practice, half the distance across the lagoon is a common claim. Less common is the assertion of landowners that they own out to the horizon on the ocean side of the atoll. Other landowners may claim rights to coral pinnacles in the lagoon, but do not claim the seabed between the shore and the pinnacle. A minority of landowners feel they should control all forms of access to marine areas in front of their property, irregardless the nature of the activity taking place.

Ownership property rights do not necessarily need to be resolved before mariculture development takes place as long as proper protocol for permissions are followed. This is not the “one stop shopping” some investors may prefer, yet it is the “Pacific” way. Legally, all terrestrial land and seabed use leases are permitted by the local government. In practice, local governments will be reluctant to issue any permits unless proponents can demonstrate that all affected landowners as well as the Iroij or Leroij —Atoll Chiefs— have given their blessing. Moreover, permitting revenues are generally expected to be shared by the consenting parties. The exact protocol in each case may differ dramatically among atolls and communities. It will also be necessary to meet additional requirements under MIMRA and/or EPA (see below). Customary protocol will in most cases clarify the parties to meet with first. But generally it is the landowners.

Strong traditional and customary rights should be seen as opportunities for effective mariculture development. Landowners and traditional leaders can use their status in the community to promote mariculture and gain support in terms of a local workforce and reinforce a favorable economic and political climate. Mariculture proponents, however, need to be sensitive to the potential of the industry impinging on cultural norms and daily activities that may at times conflict with the rigorous demands of such a production activity.

3.2. National Government

Governance pertaining to mariculture on a national level exists in the form of policy, agencies and their mandates, and specific requirements under a number of legislative Acts. In contrast with fisheries, existing legislation can be interpreted as enabling for mariculture development rather than prescriptive. This is a desirable path to continue with as it promotes industry innovation and adaptive management.

3.2.1. Policy

There is no independent national policy on mariculture in the RMI. However, there are two national policy and planning documents that are relevant. They include the National Fisheries Policy (1997a) and the National Fisheries Development Plan (1997b). Both of these contain direction pertaining to mariculture but neither one

significantly addresses the type of instrument (regulation, economic incentive, and/or information) necessary to achieve the stated objectives. This is necessary to be able to formulate actions. The development plan is essentially an extension of the policy although culture fisheries are not elaborated upon. Therefore, this section is limited to discussing the latter.

The National Fisheries Policy (1997) sets out strategic direction for the development of industrial, island and atoll, and culture fisheries. Overall objectives of fisheries development include:

- to improve economic benefits from fisheries sectors within sustainable limits;
- to strengthen institutional capacity to facilitate the responsible development and management of fisheries resources;
- to support legitimate, responsible, private sector enterprise as the primary vehicle for fisheries development, and;
- to support the preservation of coastal, reef, and lagoon resources for nutrition, food security, and small-scale sustainable income earning opportunities for the community.

While all of the aforementioned objectives are appropriate for guiding mariculture development and management in the RMI, the latter objective referring to “*nutrition, food security, and small-scale sustainable income earning opportunities*” captures the needs-based notion of alternative livelihoods. This particularly apt for guiding mariculture development in the outer islands.

The National Fisheries Policy recognises that “culture fisheries demonstrate potential to make a valuable contribution to economic development in the Republic” and mandates MIMRA to encourage applied research and culture fisheries development activities initiated by the private sector, agencies, and donors. MIMRA is further charged with sourcing technical and advisory support for community groups or local enterprises, including those associated with foreign partners, to establish commercial fisheries activities based on the culture or enhancement of marine resources found in the RMI.

The Fisheries Policy also indicates that to develop the potential for culture fisheries, MIMRA will prepare “Guidelines Relating to the Culture and Translocation of Marine Organisms in the Republic of the Marshall Islands.” These Guidelines will include a Protocol that will detail government policy in relation to the introduction of marine organisms not currently found in the Marshall Islands. No new species will be permitted to be imported, and no exports of live marine organisms will be allowed, unless the procedures detailed in the Protocol are followed. The Guidelines are also to include environmental considerations relating to culture projects.

MIMRA is also called on to strengthen the provision of information to potential or existing investors, Local Government Councils, and community groups in order to promote the development of culture fisheries in the country lead by the private sector.

3.2.2. Agencies and Enabling Legislation

MIMRA was established under the Marshall Islands Marine Resources Authority Act (1988), and is the primary agency responsible for the conservation, management, and sustainable development of marine resources in the Marshall Islands. The MIMRA Act was complemented with the Marine Resources Act (1997) to give MIMRA more autonomy in performing its responsibilities effectively. MIMRA is governed by a Board of Directors that includes the Minister of Resources and Development, Secretary of Foreign Affairs, Attorney General, and two other positions appointed by the President.

The MIMRA and Marine Resources legislation establish and reinforce MIMRA’s authority with respect to capture fisheries and aquaculture. They led to the formulation of the National Fisheries Policy described previously.

Coastal waters are the sea and seabed of the atoll lagoons in the RMI as well as 5 miles seaward of the low water mark on the ocean side. The Local Government Act designates the coastal waters as areas where the local government has authority in addition to any overlapping jurisdiction by the national agencies. However, the low water boundary apparently only applies to the RMI baseline on the ocean side; the atoll lagoons encompass all land and water up to the high water mark. As discussed previously, the inclusion of intertidal lagoon areas under local government jurisdiction do not necessarily diminish landowner influence on development.

Other legislation relevant to activities surrounding mariculture include the National Environmental Protection Act (1984), Coast Conservation Act (1988), and the Planning and Zoning Act (1987).

3.2.2.1. National Environmental Protection Act (1984)

The RMI Environmental Protection Authority (RMIEPA) is a national statutory body under the Office of the President, established under the National Environmental Protection Act (NEPA 1984).

Main functions of the Authority as stated in the NEPA include the following:

- to study the impact of human activity including population growth and redistribution, cultural change, exploitation of resources and technological advances on the environment
- to improve and coordinate consistently with other essential considerations of national policy, governmental plans, functions, and programs and resources, so as to prevent, as far as practicable, any degradation or impairment of the environment;
- to regulate individual and collective human activity in such manner as will ensure to the people safe, healthful, productive, and aesthetically and culturally pleasing surroundings, and;
- to attain the widest possible range of beneficial uses of the environment without degradation or impairment thereof and other undesirable consequences to the health and safety of the people.

Mariculture development in the RMI in terms of EPA interest is encapsulated in the last objective where it recognizes the importance of the *“widest possible range of beneficial uses of the environment without degradation.”*

3.2.2.2. Coast Conservation Act (1988)

The Coast Conservation Act places the responsibility of planning and management of development activity within the coastal zone with the EPA. Under the Act, development activity is any activity likely to alter the physical nature of the coastal zone in any way. The coastal zone is defined as the area lying within twenty-five feet landward of the mean high water line and two hundred feet seaward of the mean low water line. This definition is broad enough to include most of the usable land area available in the RMI, whether for mariculture facilities on terrestrial land or anchored to, or in some way affecting the seabed.

3.2.2.3. Planning and Zoning Act (1987)

This Act requires every Local Government Council to establish a Planning Commission and subsidiary Planning Office. The Act is specifically directed at the local governments of Majuro and Kwajalein, two of the most heavily populated atolls of the RMI. The objective of zoning is to promote harmonious interrelationships of land use, preservation of the natural landscape and environment, and identification of appropriate locations for recreational areas and parks. Traditional land tenure systems in the RMI continue to present the biggest challenge to implementation of the Planning and Zoning Act. Such an Act would have significant positive implications for mariculture in terms of clarity of future land uses in surrounding areas.

3.2.3. Regulations

There are no regulations for mariculture activities issued under the Marine Resources Act or any other statute. To establish a mariculture facility or project requires the approval from the Director of MIMRA and clearance from the Manager of the EPA as to possible environmental impacts. In the case of the latter, there is legislation requiring an EIA, but it is not consistently applied.

The EPA is responsible for ensuring compliance and enforcement of the Earthmoving Regulations (1989), Environmental Impact Assessment Regulations (1994), and Marine Water Quality Regulations (1992) and for the development of a Coastal Zone Management Plan for the Marshall Islands. Under the Coast Conservation Act, the EPA is mandated to draft regulations for the sustainable development of the coastal zone and coordinate with other relevant stakeholders in the development of a Coastal Zone Management Plan.

3.2.3.1. Earthmoving Regulations (1989)

Projects that involve earthmoving need to obtain major or minor earthmoving permits. Earthmoving is any activity that affects the terrestrial land or seabed of the RMI. Most forms of mariculture would be considered as earthmoving because it might involve the construction of facilities and/or the placement of infrastructure in the marine environment. The permit process is currently being reviewed to check for effectiveness and practicality of triggers for EIA. Permits are subject to referrals for EIA, which are mostly associated with major earthmoving projects.

3.2.3.2. Environmental Impact Assessment Regulations (1994)

The Environmental Impact Assessment Regulations were established to implement EPA obligations under Part IV of the National Environmental Protection Act and Section 11 of the Coast Conservation Act. The EIA regulations establish standard procedures for the preparation and evaluation of an EIA for proposed public and private development activities that may affect the quality of the environment of the RMI. The EIA regulations are designed to integrate the EIA process into early planning of projects to ensure timely consideration of environmental factors and to avoid delays, as well as to identify at an early stage the significant environmental issues facing the RMI.

EIA Implementation has been limited due to inadequate technical capacity to carry out (proponent) and review (EPA) statements. In most cases, the requirements have unfortunately been waved.

3.2.3.3. Marine Water Quality Regulations (1992)

The Marine Water Quality Regulations are established to identify appropriate uses of the marine waters of the RMI, to specify the water quality standards required to maintain designated uses, and to prescribe regulations necessary for achieving and maintaining the specified marine water quality. The regulations state that no waters shall be lowered in overall quality unless it has been demonstrated to EPA that such a change is a necessary result of economic or social development, is in the best interest of the people of the RMI, and will not permanently impair any marine resource or beneficial use assigned to the waters in question.

3.4. Links to Community-Based Fisheries Management and Ecosystem Management

3.4.1. Community-Based Fisheries Management Program

At the national level, a collaborative and multi-institutional working group on mariculture and ecosystem management was formed in 2001. The M²EIC working group is comprised of MIMRA, MIVA, EPA, Internal Affairs, and the College of the Marshall Islands; hence the acronym. M²EIC and its member institutions have

been actively involved in recent efforts to promote mariculture development, community-based fisheries management planning, and marine conservation.

MIMRA under its Marine Resources Act has the power to delegate its authority to Local Government Councils (LGCs) to manage local fisheries, including subsistence fisheries. In 2002, MIMRA began implementing a Community-based Fisheries Management (CBFM) Program. This involves a significant effort to build the capacity of the LGCs and outer-island communities to develop and implement CBFM plans. The Secretariat of the Pacific Community (SPC) provided initial support and a well-tested participatory process for developing the fisheries management plans. MIMRA and the M²EIC collaborative group have been working extensively with several outer island communities to develop CBFM plans that are adopted by community and local government leaders.

A key impetus for the movement to develop CBFM plans was that many outer island communities had observed troublesome trends such as habitat degradation, reduction in target species for subsistence fisheries and encroachment by foreign fishers introducing destructive fishing practices. For example, the Jaluit Atoll Conservation Area Resource Plan was inspired by the communities' concern for the overexploitation of environmental resources of Jaluit. The goal of the plan is to provide all stakeholders with an environmental resource management framework, which will serve to maintain healthy marine and terrestrial environments for future generations.

A critical aspect of the CBFM plans is the introduction or development of economic development activities that help relieve pressures on fisheries stocks, offer alternative sources of income, and that are compatible with preserving critical environments such as coral reefs. Many of the CBFM plans establish MPAs, which result in a loss of fishing grounds. It is believed that if mariculture is possible in the MPAs without causing damage, that local communities will support establishment of larger, or a network of MPAs. Since many of the mariculture species such as giant clams, corals, and pearls have been demonstrated to be environmentally neutral, incorporation into MPAs is viable. Additionally, many of the outer island communities also view mariculture of these species as a means to restore depleted populations of giant clams and pearl oysters. Cultivation of soft and hard corals is not only attractive in an economic sense, being one of the most highly priced aquarium products grown in the RMI, but communities also favor this because it promotes awareness of the biology and culture of corals and provides an economic incentive to protect reefs.

The outer island communities have long had interest in mariculture. Improved communication and transportation, coupled with the clear success of commercial mariculture ventures on the most populated islands where many of the outer island leaders reside, have increased both interest and the probability of successfully developing outer-island mariculture. Good management of mariculture requires an informed public and active participation of the LGCs. Hence the need to consider mariculture within the CBFM plans.

3.4.2. Strengthening Coastal Fisheries Legislation

A national coordinator under MIMRA is conducting a review of existing regulation that affects coastal fisheries in some form. The process is intended to address a perceived lack of regulation with respect to introduction of non-indigenous species and inadequate guidelines related to water quality.

It is expected that the regulatory review will result in recommendations for local government ordinances in addition to changes to existing national legislation.

3.4.3. Biodiversity Forum

3.4.3.1. National Biodiversity Strategy and Action Plan

The RMI signed the United Nations Conventions on Biological Diversity in 1992. Ratification soon followed in 1993. In 1997, the Republic of the Marshall Islands with the assistance of UNDP prepared a National Biodiversity Strategy and Action Plan (NBSAP) as part of its obligations under the Convention on Biological Diversity. The NBSAP provides key actions and strategies for addressing the threats to biodiversity in the RMI. It has involved wide consultation with many sectors of the community and has resulted in a strategy and plan, with a high level of community ownership. Conservation of native species particularly for the protection of marine biodiversity is a key area of concern in relation to intentional or accidental release of non-native species into the environment.

With support from the South Pacific Biodiversity Conservation Program (SPBCP), the RMIEPA is currently implementing the NBSAP in the outer island of Jaluit. The project has produced a marine survey, an assessment of the feasibility of community ecotourism, and is currently developing a resource management plan.

3.4.3.2. National Biosafety Framework

A number of biosafety issues are highlighted in the NBSAP-the most urgent being quarantine. The introduction of exotic species or native species that have been modified outside the country and reintroduced pose a serious threat to the sustainability of marine and land biodiversity. In the Marshall Islands, MIMRA is responsible for the quarantine of imported marine species.

The RMI recently acceded to the Cartagena Protocol on Biosafety in January 2003 and has received assistance for the development of a national biosafety framework. Currently, there is a lack of capacity for assessing risks and dealing with technical biosafety issues. Elements of the new framework will include legislative and administrative systems, risk assessment and risk management and public participation mechanisms. The national biosafety framework for the RMI will need to be integrated into future mariculture policy and development plans.

3.4.4. Resource Inventory and Earthmoving/EIA Review Process

The EPA has embarked in late 2004 on a process to review and adapt existing regulations and management planning frameworks for coordinating development in the RMI. It stems from perspectives that current requirements and permitting processes are not only unworkable and often disregarded, but they exist in the absence of resource management plans for individual atolls. Such efforts need to recognize the extent to which mariculture can be a viable economic sector, both in Majuro and on outer islands.

The scope of work in this process includes an assessment of the current regulatory framework; preparation of a resource inventory using satellite images and surveying of Majuro, Ebeye, Wotje and Jaluit; classification of land via a rapid habitat survey for indicator species and ecosystem health over broad geographic areas; economic and resource analyses called for in the Coast Conservation Act; and development of a national resource management framework with accompanying local resource management plans.

4. DEVELOPING AS AN EXPORT INDUSTRY

There are several broad areas that need to be considered for the Marshall Islands to develop a viable mariculture export industry. Some of the dominant concerns can be addressed under transportation, marketing, and financing. Some training in small business development for mariculture in the outer islands was provided by the Pacific Business Center through the University of Hawaii in late 2003.

4.1. Transportation

The goal of reliable transportation is to get cultured products from outer atolls to Majuro and onward to international markets in a timely and cost-effective manner. Many potential sites for outer island mariculture are in relatively isolated locations.

Transportation for passengers and cargo between the outer atolls and Majuro is currently provided by four national government-owned vessels; four privately-owned vessels; and three small vessels each owned by the Local Government Councils of Wotje, Maloelap, and Enewetak. Of the latter, only the Enewetak vessel is used for ocean transport. An ADB study undertaken to prepare a project for outer island transportation infrastructure estimates that the present fleet of ships costs more than twice as much to operate compared to the revenue received (Beca International 2001). The dominant concern regarding domestic boat transportation is reliability of scheduling and cost/availability of fuel. Some atolls do not have ships coming to their islands for several months at a time.

All atolls except the island of Lib have airstrips used for domestic flights by Air Marshall Islands (AMI), with some of the larger having more than one. The relatively large atoll of Ailinlaplap, for example, has service to three airstrips on different islands within the lagoon. The Dornier and Dash-8 planes currently in operation can carry up to 19 and 34 passengers respectively, and also provides a once per week round trip service to Kiribati. The passenger load determines the available cargo space on any given flight. The schedule in effect at the end of the summer of 2004 showed 16 flights leaving Majuro for various atolls every week, including 2 bi-weekly flights to Kili and Jaluit. AMI has in some instances canceled or delayed flights due to mechanical issues or severe weather, but is generally considered reliable. Wet shipments are a concern for AMI as there have been cases of seawater leakage from poor packaging practices.

Air Nauru services a number of countries throughout the region, including Kiribati, Fiji, Solomon Islands, Samoa, Nauru, and Australia. Continental and Aloha airlines provide almost daily service to other Micronesian countries and to Hawaii.

4.2. Marketing

The Marshall Islands has a wide range of products that are or can be cultured. There are established market contacts for specific products and a “clean” image of RMI and its facilities. However, coordinated marketing efforts are lacking. There is also no substantive branding of Marshall Islands products. MIMRA is in the planning stages for the development of a centralized marketing facility. One objective of this facility is to integrate individual product line strategies that have been developed by the private sector.

4.3. Financing

In concert with its policy of devolution of management authority to Local Government Councils, the RMI government has a program for economic development in the fisheries sector. As part of this program, MIMRA sets aside revenue to be used in a trust fund to underwrite income generating demonstration projects. A capital investment fund whose earnings would provide a continuing source with which to sponsor a small-scale development fund for use by the outer atolls has been proposed. An outer island trust fund had been proposed in 1991 by the Ministry of Interior and Outer Island Affairs, but was never acted upon.

5. PRIORITY ISSUES AND ACTIONS

The list of issues and suggested action items below are largely drawn from the results of a National Mariculture Workshop held in February 2004. At this workshop, the RMI Mariculture Steering Committee and Working Group, with other contributors identified and discussed mariculture key issues and constraints to development, as well as possible solutions. Some actions already underway may not have been expressed in an explicit policy context prior to being implemented. Therefore, there has been an iterative process since the workshop to refine and add issues and actions to this list that encourage the continuation of current efforts.

Recommendations include the use of regulatory, economic incentive, and information-based instruments to achieve policy objectives. Regulatory actions include streamlining the permit process and developing functional EIA and non-indigenous species requirements. Economic incentives are implicit in marketing actions that instill certain product images for the RMI, although more explicit ecolabeling or similar market labels are encouraged over time. The policy instrument most recommended, however, is information. Actions based on information are a catch-all for anything non-regulatory or unrelated to incentive schemes linking a change in behavior to increased profits. They largely include actions that involve coordination and/or education, or “encourage” certain behavior.

1. Role of government. Participants to the National Mariculture Workshop identified the need for improved government planning, oversight and support of mariculture development. However, a primary obstacle is the lack of funding and staff to provide the government services needed to promote mariculture and to fulfill the administrative roles and responsibilities of government agencies. Another recurrent theme at the Workshop was inadequate institutional coordination and clarity of roles and responsibilities between MIMRA, EPA, and local governments in areas such as mariculture regulation, protected area management, and restocking.

Possible actions:

1. Coordinated and directed grant writing efforts aimed at external donor organizations. The steering committee is focusing on its fundraising function and it is expected that their efforts will address the need for financial assistance for many of the action items below.
2. Explore alternative sources of income such as earmarking revenues from tuna licensing, or creating a trust fund for sustainable mariculture development and outer island income generating demonstration projects.
3. MIMRA will prepare “Guidelines Relating to the Culture and Translocation of Marine Organisms in the Republic of the Marshall Islands” in accordance with its commitment in the National Fisheries Policy (1997).
4. Provide training on how to evaluate environmental impact assessment (EIA) statements that proponents would be required to prepare. For EIAs to be adequately prepared by proponents, regulatory agencies need to clearly outline the criteria to be addressed and to make this broadly available. Criteria development and subsequent regulatory staff training will require financing. Mariculture regulators and the private sector should not bear the financial burden of basic EIA criteria development. Rather, mariculture should be part of an integrated framework of EIA criteria development for proposed projects across various economic sectors.
5. Continue discussions targeted at assessing the potential for culturing a variety of organisms in the RMI. For example, finfish aquaculture for rabbitfishes and groupers. Such efforts may also assist in options for restocking. In general, finfish aquaculture should include both hatchery and growout. However, there is some concern that initial discussions have focused on the potential for tuna cage

farming in Rongelap that may only involve growout. MIMRA in association with the Taiwanese government are convening an international aquaculture conference in Majuro. These kinds of events are to be continued as they are very important for facilitating sharing of information and promoting investments in mariculture for the outer islands.

6. MIMRA will facilitate the Taiwanese offer of assistance to conduct a National Aquaculture Assessment for the purposes of identifying areas of future Taiwanese collaboration.

2. Community involvement, local benefits, education and technical training. The goals for mariculture of outer island communities and many other stakeholder groups mainly center on the needs of local communities, in particular economic opportunities in terms of income generation and possibly alternate food sources. In order to successfully introduce mariculture to outer islands, extension, training, and outreach are required. A trained and skilled local workforce is also needed for expansion of mariculture on Majuro. Another concern is foreign ownership of mariculture enterprises. What are the advantages and disadvantages of foreign ownership? Should mariculture enterprises be majority-owned by residents of RMI?

Possible actions:

7. Continue the successful High School education program centered around technical training to develop mariculture skills for youth. It is currently focused on Jaluit Atoll with plans to expand the program to Wotje. More high school teachers need to undergo technical training similar to that received at the Ponape Agriculture and Trade School.
8. CMI should continue to improve their senior course in “Principles of Aquaculture.” It has been taught by several instructors in a format designed to maximize field experience with cultured groups of organisms found in the RMI. To broaden marine science education beyond the college community, CMI recently began offering a marine certificate program. It focuses on applied skills with limited theoretical knowledge targeted to support field operations. It has a mariculture component that concentrates on technical aspects of growout operations for black-lip pearl oysters, giant clams, and corals. There exists significant flexibility on how these courses are taught, and efforts should be made to place graduates in appropriate agency, education, or private industry positions upon graduation.
9. Seek external financial assistance to conduct a series of community outreach workshops designed to both educate local communities in the process of mariculture planning and provide technical knowledge needed for operations. These workshops could be similar to the participatory efforts used to develop the CBFM plans and should be linked to that process as an integral part of the larger effort.

3. Linking mariculture with MPAs, marine conservation, outer island economic development, and restocking. Restocking of giant clams in parallel with MPA management and local fisheries management planning were topics that are key concerns to many Mariculture Working Group members.

Possible actions:

10. Begin implementation of the marine mariculture components of the community-based fisheries management plans for Arno, Jaluit, Likiep, and Mejatto (MEIC process). This will include assessing which of the various possibilities (type, scale, operational model) of mariculture is most feasible for each of the four islands according to biological, social, cultural, logistical, economics and marketing perspectives and developing plans for pilot efforts at each island (e.g. giant clams). Mariculture needs to be presented as an integral part of CBFM planning.

11. Utilize appropriate quarantine protocols for any non-indigenous species that may be cultured in the RMI. No species shall be introduced in the absence of demonstrated success in quarantining such species elsewhere, and no species shall be introduced without having an adequate and workable EIA process in place (see item 3). Note that non-indigenous seaweed was piloted in the RMI last year with only modest attention paid to quarantine and EIA. Moreover, research needs to take place on the negative impact of existing non-indigenous species on currently cultured indigenous species.
12. The Marshall Islands are known for their unique natural beauty and marine diversity. Mariculture in the RMI has an environmentally pristine and clean image. Outreach actions, such as preparation of colorful informational brochures and construction of a website could build on this positive image to market and promote environmentally responsible mariculture and link it with any environmentally responsible tourism initiatives in association with MIVA. Moreover, ecolabeling for cultured products should be pursued in association with a recognition of reliable products from the RMI. An industry association could assist in moving this process forward.
13. Mariculture facilities in the outer islands can use their accommodation facilities for potential tourism initiatives. If associated with interpretive tours of facilities themselves, such initiatives could conceivably be considered on the path towards ecotourism.

4. Issues related to production, the efficient use of facilities, and profitability

Possible actions:

14. Land ownership and land tenure issues are a concern to commercial mariculture operations and will become a greater issue as the industry expands. Security of land tenure arrangements and clarity on land availability for mariculture growth are critical for long-term business planning and smooth operations. One of the actions identified at the National Mariculture Workshop was to create policy on land tenure issues and foreign investment. MIMRA and the Mariculture Working Group could facilitate a dialogue with the relevant national agencies with the goal of clarifying land tenure issues and defining policy.
15. Many at the National Mariculture Workshop voiced concerns that some existing facilities, such as hatcheries, are in poor condition and lack necessary tools and equipment. Various public and educational facilities in particular are not used to their full potential. There is a need for improved planning and coordination with commercial mariculture operations. A possible action is for the Mariculture Steering Committee to facilitate a dialogue on strategies and planning for the effective use of demonstration sites and hatcheries. MIMRA has begun a process to review existing facilities that are under their mandate (e.g. Woja Hatchery, equipment for future spat runs), although it needs broader representation to be fully effective.
16. Improve reliability of domestic air and sea transportation in terms of timing, fuel availability, space allocation, and packing efficiency. The Ministry of Transportation and Communications needs to identify specific concerns with MIMRA and commercial mariculture operations and work towards effective solutions with AMI and local governments.
17. Capacity building on outer islands is needed to support mariculture projects initiated on these remote islands. Possible actions include training of outer island extension agents. FAO funding was recently requested for this. Replication of efforts such as the MOE/ADB funded training of high school teachers in aquaculture also present an opportunity to establish local capacity for a variety of marine resource management efforts including mariculture.

6. CITED REFERENCES

- Alfred, R. V., and N. Kilma. 1989. *Survey of the Pearl Oyster Resources in Namdrik: Summary Report*. Prepared for the Marshall Islands Marine Resources Authority, Majuro, RMI.
- Clarke, R. P., D. J. Sarver, and N. A. Sims. 1996. "Some history, recent developments and prospects for the black-lip pearl oyster, *Pinctada margaritifera* in Hawaii and Micronesia." Fisheries Pap. no. 26, Information Pap. no. 36. In *26th Regional Technical Meeting on Fisheries*, Noumea, 5-9 August, 1996 Conference Proceedings. Noumea: Secretariat of the Pacific Community. 21p.
- Dashwood, J. 1991. *The Namdrik Pearl Oyster Project: Inshore Fisheries Research Project Country Assignment Report*. Prepared for the South Pacific Commission, Noumea, New Caledonia. 22 p.
- Economic Policy, Planning and Statistics Office (EPPSO). 2002. *Republic of the Marshall Islands Statistical Yearbook 2002*. Majuro, RMI: Economic Policy, Planning and Statistics Office. 231 p.
- Edwards, F. 2002. *Mariculture Country Profile: Republic of the Marshall Islands*. Prepared for the Marshall Islands Marine Resources Authority, Majuro, RMI. 21 p.
- Lal, A. 2003. *Seaweed Cultivation in the Marshall Islands: Environmental Impact Assessment Progress Report*. Prepared for Marshall Islands Marine Resources Authority in association with College of the Marshall Islands. Majuro, RMI. 6 p.
- Marshall Islands Marine Resources Authority (MIMRA). 1997a. *Republic of the Marshall Islands Fisheries Policy*. Majuro, RMI. 8 p.
- Marshall Islands Marine Resources Authority (MIMRA). 1997b. *National Fisheries Development Plan*. Majuro, RMI. 50 p.
- Sims, N. A., and D. J. Sarver. 2002. *Feasibility of Commercial Black Pearl Culture in Namdrik Atoll, Marshall Islands: Final Report*. 30 p.
- Smith, R. 1947. *Fishery Resources of Micronesia*. Fishery Leaflet no. 239. Wash., DC: US Department of Interior.
- Spalding, M. D., C. Ravilious, and E. P. Green. 2001. *World Atlas of Coral Reefs*. Berkeley: University of California Press.

7. OTHER REFERENCES

- Center for Tropical and Subtropical Aquaculture (CTSA). 2003. "CMI hatchery churns out black pearl oyster spat for industry." *Regional Notes* 14(3): 1, 6.
- Center for Tropical and Subtropical Aquaculture (CTSA). 1998. "Aquaculture extension and training support in the U.S.-affiliated Pacific islands, 29-34." In *Center for Tropical and Subtropical Aquaculture 1998 Annual Accomplishment Report*. Honolulu: Center for Tropical and Subtropical Aquaculture. 104 p.
- Cheshire, C. L. 2003. *An Approach to Export Development: A Proposal for the FSM*. Prepared for UNDP/UNOPS Pacific SMILE Programme. Pacific Business Center Program, University of Hawaii, Manoa. 12 p.

- Cheshire, C. L. 2001. *Business, Family and Business Development in Micronesia*. Pacific Business Center Program, University of Hawaii, Manoa. 15 p.
- Crawford, M. J. 1993. *Republic of the Marshall Islands: National Environmental Management Strategy, Part B Action Strategy for Strengthening Environmental Management 1992-1996*. Prepared under the supervision of the National Task Force on Environmental Management and Sustainable Development. Apia, Western Samoa: South Pacific Regional Environment Programme. 70 p.
- Hambrey, J., M. Phillips, M. A. K. Chowbury, and R. B. Shivappa. 2000. *Guidelines for the Environmental Assessment of Coastal Aquaculture Development*. Maputo, Mozambique: Secretariat for Eastern African Coastal Area Management. 213 p.
- Hart, K. G. 1997. *Project for Utilization of Non-Perishable Marine Resources in the Outer Atolls of the Marshall Islands: Final Report*. National Oceanic and Atmospheric Administration, Wash., DC. 36 p.
- Haws, M., and K. Hopkin. 2003. *Progress Report-Year 1: Bridging Gaps to Ensure Long-term Viability of Small Scale Mariculture Ventures in Hawaii and the U.S.-Affiliated Islands*. Supported by Innovative Future Agriculture and Food Systems Program, USDA. Pacific Aquaculture and Coastal Resources Center, University of Hawaii-Hilo. 40 p.
- Haws, M. 2003. *Third Semi-Annual IFAFS Project Work Plan with Summary of Year 1 Accomplishments*. Pacific Aquaculture and Coastal Resources Center, University of Hawaii-Hilo. 41 p.
- Killelea-Almonte, P. (ed.). 1992. *The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): Proceedings of a Workshop held for those involved in the trade of giant clams*. Center for Tropical and Subtropical Aquaculture Pub. No. 108. 43 p.
- Leung, P., Y. C. Shang, K. Wanitprapha, and X. Tian. 1993. *Production Economics of Giant Clam (*Tridacna* species) Culture Systems in the U.S. Affiliated Pacific Islands*. Publication No. 114. Honolulu: Center for Tropical and Subtropical Aquaculture. 44 p.
- McCoy, M., and K. Hart. 2002. *Community-Based Coastal Marine Resources Development in the Republic of the Marshall Islands*. Prepared for the Asian Development Bank, Manila, Phillipines. 126 p.
- National Biodiversity Team of the Republic of the Marshall Islands (NBT/RMI). 2000. *The Marshall Islands—Living Atolls Amidst the Living Sea*. Santa Clarita, CA: St. Hildegard Publishing Company. 345 p.
- Overseas Fisheries Cooperation Foundation (OFCF) and Marshall Islands Marine Resources Authority (MIMRA). 2003. *Detailed Implementation Plan for the Project on Inshore Fisheries Resource Study and Management in Atoll Areas*. Majuro, RMI. 25 p.
- Pacific Business Center Program. 2000. *Aquaculture Farm Business Plan*. Pacific Business Center Program, University of Hawaii-Manoa. 22 p.
- Private Industry Council (PIC), and Center for Tropical and Subtropical Aquaculture (CTSA). 1992. *Giant Clam Project: Final Report*. Majuro, RMI. 29 p.
- Republic of the Marshall Islands (RMI). 2002. *Vision 2018: Marshall Islands Fisheries Sector Master Plan—Strategic Economic Development Plan 2003-2018*. Majuro, RMI. 52 p.
- Republic of the Marshall Islands (RMI). 2002. *Vision 2018: Marshall Islands Agriculture Sector Master*

- Plan—Strategic Economic Development Plan 2003-2018*. Majuro, RMI. 55 p.
- Republic of the Marshall Islands (RMI). 1997. *Marshall Islands Marine Resources Act 1997*. Majuro, RMI. 32 p.
- Rosentrater, L. 1996. *Aquaculture Feasibility Study: Environmental Resources on Two Outer Islands*. Prepared for Marshall Islands Marine Resources Authority. Micronesia and South Pacific Program, University of Oregon. 17 p.
- Sims, N. A., and D. J. Sarver. 1997. *Remote Hatchery Production of Pearl Oyster Spat for Commercial Black Pearl Farms in the Marshall Islands: Final Technical Report*. Black Pearls Inc., Holualoa, HI. 46 p.
- Tanzania Coastal Management Partnership (TCMP) Support Unit, and Mariculture Working Group. 1999. *Tanzania Mariculture Issue Profile*. Working Document 5009 TCMP. Rhode Island: Coastal Resources Center, University of Rhode Island. 102 p.
- United Republic of Tanzania. 2001. *Mariculture Investor's Guide*. Rhode Island: Coastal Resources Center, University of Rhode Island. 78 p.
- University of Rhode Island, Conservation International-Mexico, and Sinaloa Aquaculture Institute. Nd. *Executive Summary: Promoting Good Management Practices for Integrated Mariculture Management in Sinaloa, Mexico. A Collaborative Action Plan*. 9 p.