



HAWAII COMMUNITY FOUNDATION

PEOPLE AND THE SEA:
A REVIEW OF EXPERT OPINION OF WHAT IT WILL TAKE TO ENHANCE
THE CONSERVATION OF MARINE RESOURCES
IN THE MAIN HAWAIIAN ISLANDS

WRITTEN BY SCOTT ATKINSON
WITH AN APPENDIX CO-AUTHORED BY JAN DIERKING

EDITED BY AARIN CORREA

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This Document:

This document is the result of a study on the state of nearshore marine management in the Main Hawaiian Islands (MHI). The study was commissioned by the Hawai'i Community Foundation (HCF) to help the foundation develop its grant-making program for nearshore marine resources in the MHI. The study has drawn its conclusions from a review of relevant literature and the opinions of experts on Hawai'i's marine resources. Interviews have been the primary source, and the study does its best to reflect the recurring themes and shared views discovered during the process. This study is not meant to be definitive but rather a summary of expert opinion of how to strengthen nearshore marine management in Hawai'i. Some areas of the study may be noticeably limited because experts or literature were unavailable, or may have been overlooked. You will notice that the document is not highly referenced. We have purposely kept citations to a minimum (with the exception of published documents) to maintain the privacy of those interviewed. Finally, several experts stressed the importance of the biological connectivity between the Northwestern Hawaiian Islands (NWHI) and Main Hawaiian Islands. At HCF's request this study focused exclusively on the MHI, however this is not meant to indicate that the NWHI are not a priority for conservation management.

During the course of this study, common themes and ideas emerged. Similar issues and needs arose with such regularity that Hawai'i's marine resource conservation community seemed to be speaking with a common voice about marine management needs.

Also during the course of the study, it became evident that nearly every aspect of marine conservation management is being worked on in the state; however, major threats and obstacles remain. These threats and obstacles are of such magnitude that they greatly exceed the current level of resources and capacity being mobilized to address them. As a result, it appears that a key to successful marine management in the state is the strengthening and deepening of existing and planned conservation and resource management efforts. While there is a need for new initiatives, it is extremely important that the good work that is ongoing be supported so that it can have the greatest impact possible. The recommendations section of this study echoes this finding and discusses ways to extend and build from the existing foundation of marine conservation and management in the state.

We hope the marine resource management community of Hawai'i will find this study useful and a step in the process of enhancing individual and collective action and capacity to secure the future of marine resources in the MHI.

Acknowledgements:

All of the experts interviewed in this study are working extremely diligently to conserve Hawai'i's marine resources. Each in their own way has dedicated their lives, or a portion of it, to help ensure that Hawai'i's marine resources are here for all to use and enjoy. While this work can be extremely difficult, these people continue, because they believe that Hawai'i's marine resources can be more effectively managed and can maintain or regain their ecological integrity.

The author would like to thank all of the people interviewed for their warm and open acceptance, and for their understanding of his extremely steep learning curve. Everyone interviewed was exceptionally helpful and supportive. A full list of interviewees is provided in the Reference section. Some individuals were particularly helpful in providing recommendations on the design of the study. To them, a special thanks goes out. Others persisted in the face of several callbacks and were patient and responsive despite their unbelievably busy schedules. Again, a heartfelt thank you to you all.

A study like this can never be comprehensive and it is almost certain that we have missed important details and left out people who could have contributed excellent ideas. I would like to apologize in advance for any oversights. While this document is now complete, I hope its contents remain live and active in the discussions and strategies that you develop over time. This has been a rich and rewarding experience for me. I greatly valued meeting and talking with all of you and I hope the product you are about to read meets your expectations and contributes in some way to your ongoing efforts.

Aloha,

Scott Atkinson

Chapter 1: Hawai'i's Marine Resources at a Crossroads

The Biological Value of Hawai'i's Marine Resources:

The Hawaiian Islands are among the most unique and fragile ecosystems on earth. Isolated by thousands of miles of ocean, Hawai'i is an oasis for a startling array of life forms both on land and in the sea. Its rare and unique species are testimony to the incredible evolutionary force of isolation. The islands are famous the world over for their native terrestrial species, with as many as 90% of certain species groups existing nowhere else on Earth.

A lesser known fact is that Hawai'i's marine realm is also outstandingly rich and highly unique. Although often overshadowed by the more species-rich marine ecosystems of the Western Pacific, Hawai'i has one of the world's most outstanding marine environments. According to Clark and Gulko, 1999, in coral reef fish alone, these islands boast an unparalleled endemism of more than 25%. When corals, algae, macroinvertebrates, various types of reef fish and other species are included, we soon realize that, depending on the group, between 14 and 62% of Hawai'i's marine species exist nowhere else on earth (See Table 1). This extremely high endemism makes Hawai'i a global priority for marine conservation.

Species Group	Percent Endemism
Butterfly Fish	14 %
Reef-Building Corals	20%
Marine Snails	21 %
Angel Fish	25%
Sponges	25%
Gobies	40%
Parrotfish	40%
Damselfish	44%
Blennies	62%

Table #1. Endemism in Hawaiian Marine Species (from Clark and Gulko, 1999):

Endemism results from geographic isolation and speciation, when the genetic composition of populations changes over time in response to localized environmental conditions. High levels of endemism are not that common in the marine realm. Marine species are able to disperse relatively easily, maintaining some degree of genetic exchange between distant populations. For this reason, endemism is not typically an important criterion when determining marine conservation priorities. In the case of Hawai'i however, extreme isolation has resulted in such high percentages of endemism that the entire Hawaiian archipelago is a global conservation priority. If these rare and unique species are lost from Hawai'i, they will be lost from the entire planet, greatly diminishing our collective biological heritage.

Hawai‘i holds another important distinction. It hosts some of the most northerly coral reefs on the planet, which offer potential refugia for corals in the face of global coral bleaching events. Bleaching occurs when environmental conditions extend beyond the range of tolerance for coral animals and their symbiotic photosynthetic algae, known as zooxanthellae. [The zooxanthellae provide essential nutrients to the coral polyp however, if the local water becomes too hot, too polluted, insufficiently saline, or off balance in some other way, the polyps often purge their zooxanthellae.] If conditions remain out of the range of tolerance for corals and their zooxanthellae, in time the coral animal will die.

In 1997 and 1998, vast portions of the world’s coral reefs bleached in association with the raised water temperatures caused by the severe El Nino event. In some parts of the world as much as 80 to 90% of corals bleached (Wilkinson, 2000).

Given its northern location, Hawai‘i was fortunate to maintain its typically cooler water temperatures even in the face of the most severe El Nino period. As a result, Hawai‘i recorded relatively little coral bleaching. While the region is not immune to coral bleaching, some biologists have predicted that in the long-term Hawai‘i’s reefs will be among the most naturally resilient on Earth. This fact should not be underemphasized given predictions that El Nino events will increase in number and severity in tandem with global warming. The severe bleaching of 1997 and `98 sent a shock wave through the international coral reef conservation community, drawing into question our ability to protect healthy coral reef ecosystems in the long-term.

Cultural and Economic Importance of Hawai‘i’s Marine Resources

In addition to its global importance as highly unique among marine systems, Hawai‘i’s marine areas have always been a critical component of the archipelago’s history and culture. As a voyaging people, early Hawaiians maintained an intimate relationship with the sea that is at the very root of Hawaiian culture. The Hawaiian myth of creation places the origin of life in the sea with the first creature being a coral polyp. The people of this archipelago have always depended on the sea and its riches for their survival. Today, as many as two thirds of all people living in Hawai‘i engage in ocean recreation, and as many as one third fish. Experts have suggested that a majority of residents in the state include wild caught fish as part of their diet, and that on islands such as Molokai as much as 30% of the diet is comprised of subsistence foods from agriculture and fishing. Likewise, traditional feasts, such as weddings and baby luaus, require large quantities of fish and other marine species.

Marine related tourism is the mainstay of Hawai‘i’s economy, as its famous beaches attract up to 3 million visitors annually (nearly half of all people who visit Hawai‘i). Many of these visitors focus directly on marine recreation, including diving, snorkeling, surfing, and sailing. Hawai‘i is consistently cited in diving industry publications as one of the top ten dive destinations in the world, and supports a healthy population of local divers and snorklers. Marine related tourism generated gross receipts estimated at nearly \$800 million in 1998 and supports approximately 1000 small businesses and 7,000 jobs

across the state (Clark and Gulko, 1999). Pupukeya, Hanauma Bay or Molokini on an average day demonstrate that Hawai'i's marine resources, especially its coral reefs, are in great demand recreationally. These Marine Life Conservation Districts are visited by over one million people annually.

Nearshore environments in Hawai'i support both commercial and recreational fishers. An estimated 5,000 commercial fishers depend on the nearshore environment for their catch. These in turn support untold numbers of shops selling gear, supplies, and catch. While the direct value of the commercial catch from the nearshore environment may only approach \$5 million annually, numerous related industries also benefit from this fishery.

Surveys in the MHI have shown the nearshore recreational and subsistence catch to be equivalent or exceed the commercial catch (Hamm and Lum, 1992, cited in Gulko, et. al, 2001). There were an estimated 260,000 recreational fishers in 1998, which suggests that as much as one fourth of all Hawaiian residents fish recreationally (Clark and Gulko, 1999).

Fishing had significant social and cultural value to Hawaiians traditionally and is one means by which cultural identity is maintained in contemporary times. Traditional harvest systems in Hawai'i emphasized social and cultural controls with a strictly enforced code of conduct. Harvest management was not based on the amount of take of any one species but on the places and times where and when fishing could occur as not to disrupt basic ecological processes that supported fish production (Friedlander et. al. in prep. cited in Gulko, et. al, 2001). In modern times, the traditional social and cultural controls have been replaced largely by species-based management techniques and few areas are managed through traditional social controls.

Hawai'i's coral reefs also play a particular utilitarian function in protecting coastal areas and beaches from excessive storm impacts and erosion. Live reefs form natural sea breaks that help to reduce the velocity and impact of offshore waves. Under particularly severe weather and waves, reefs can help buffer the coastal zone from extreme impacts. When reefs die, they eventually break up thus reducing the natural buffer system that previously protected the coastal zone. While no specific estimates were uncovered by this study the possible difference in real economic terms could be enormous if the buffering function of reefs is reduced or eliminated.

The Uncertain Future

Many of the same factors that have created Hawai'i's incredible biological wealth have also left it vulnerable to myriad threats. Isolation, highly specialized species, unique and rare habitats, restricted habitable area, and a limited resource base coupled with anthropogenic factors, such as impacts from trade-route traffic, introduced species and a history of colonization, have imperiled Hawai'i's natural systems. Hawai'i now holds the distinction of being the extinction capital of the United States. Having lost a large percentage of its native species, the natural systems of these islands are truly in crisis.

That said, when we compare Hawai'i to other parts of the world such as the Philippines and Indonesia, our marine systems are in comparatively good condition. However, when we compare Hawai'i's marine systems to the near-pristine systems of the central and Western Pacific, including many reefs in Papua New Guinea, Kiribati, the Marshall Islands, we realize that Hawai'i is on a slippery slope of decline.

O'ahu provides perhaps the best example of what human activity can do to the marine realm in Hawai'i. The natural marine systems of O'ahu have been vastly altered by human activities, including overfishing, coastal development, the introduction of alien species, and stream alteration. In many areas of the island, the reef community structure appears to be completely altered from its natural state. Top level predators are for the most part absent and only small predators, herbivores, and small coralivores remain. In many areas, corals are covered in invasive algae, and live coral cover is as low as a few percent in sites that once harbored flourishing reefs. One need only visit Kane'ohe Bay or Waikiki to understand how severe the degradation has become. In both sites, huge areas of coral are covered in invasive algae, and ecosystems that were once dominated by coral are now dominated by alien algae. Even in the healthier areas, such as Hanauma Bay, populations of certain fish species have decreased by as much as 60 % and threats of overuse continue to jeopardize the persistence of the area's ecological viability. This is not to say that important areas do not remain on O'ahu. They do, and they can be managed for everyone's benefit. Many experts cited parts of Kane'ohe Bay and areas of the North Shore and 'Ewa as high priorities for conservation. But for the most part, human activities have completely changed the natural condition of O'ahu's marine ecosystems, drawing into question our ability to restore and maintain them. Restoration of O'ahu to any sort of natural state will require a massive effort that first arrests degradation and then moves to restore a minimum complement of the biotas, habitats, and ecosystem processes that characterize the natural systems of this island.

While not as affected by urban factors, other islands, such as Kaua'i and Hawai'i are impacted by anthropogenic forces such as agricultural development and overfishing. While they are generally in much better shape than O'ahu, their natural systems have been greatly disturbed. Experts generally felt that given the correct combination of management and time, areas throughout these islands can recover their natural biological character. However, to ensure this, effective marine management must be expanded in the short term.

Box 1: Marine Resources in the Main Hawaiian Islands at a Glance

1. Geographic isolation is believed to have resulted in the high endemism notable in Hawai'i's marine organisms. High endemism in the marine realm is not common as most marine species are wide ranging. Only extremely isolated places such as Hawai'i and Galapagos experience high endemism. When assessed across all phyla; Hawai'i has the highest known endemism in the world for marine species.
2. Coral reefs in the MHI constitute a full 15% of the coral reefs of the United States and represent the second highest concentration of U.S. coral reef habitat after the Northwest Hawaiian Islands.
3. Kane'ohe Bay hosts every major reef type present in the MHI: barrier reef, fringing reef, and patch reef.
4. Precious Corals can be found off the South Shore of Kaua'i, East Oahu, Southeast Molokai, Southwest Maui, Southpoint of the Big Island, and the North Shore of Lana'i.
5. Mangroves are non-native and have replaced numerous native coastal species.
6. According to the Coral Reef Assessment and Monitoring Program, the MHI host an average of 23% coral cover at the sites surveyed.
7. The restricted ranges of some corals suggest the possibility of extirpation from the MHI . For example, one species of coral is only found in a few patch reefs of Kane'ohe Bay.
8. Hawai'i's marine ecosystems are so unique that the Hawaiian Islands are classified as a unique ecoregion.
9. *Acropora*, which is dominant in much of the Western Pacific, is largely absent in the MHI and *Porites* are the dominant corals present.
10. Species Present: 400 species of marine algae (majority are red algae) – high endemism; 62 species of stony corals – majority occurring in the MHI; over 100 species of sponge; 1071 species of marine mollusks; 884 species of crustaceans; 278 species of echinoderms; 557 species of reef and shore fishes.
11. Many ecologists agree that nearshore reefs around the MHI, remain in relatively good to very good condition compared to other parts of the world. However, many areas of the MHI are extremely degraded and threats are significant and growing rapidly.
12. Due to their northerly location and current patterns around the islands, Hawai'i's coral reefs have largely escaped bleaching events that have impacted reefs in many areas of the Pacific in recent years.
13. Significant degradation of marine resources in the MHI began as long as 200 years ago as outside influence on the islands began to grow. In the case of Molokai, degradation began as much as 700 years ago with major modification of the extensive southern reef flat through the construction of fishponds.
14. The majority of Hawai'i 's population of 1.2 million people live within 3 miles of living coral reefs.

Chapter 2: Threats and Obstacles to Effective Marine Conservation in Hawai'i

The threats to Hawai'i's marine resources are well known and well documented. *Hawai'i's State of the Reefs*, (Clark and Gulko, 1999) and the recently published *Status of Coral Reefs in the Hawaiian Archipelago* (Gulko et. al. 2001), provide excellent overviews and many details regarding threats to Hawai'i's coral reefs and associated marine environments. As a result we limit our description of threats primarily to those emphasized by experts interviewed and encourage readers to refer to these other volumes for a detailed treatment of threats. Obstacles to effective marine conservation and management are less discussed in the literature but were widely discussed by experts interviewed by this study and are summarized below.

While there are many threats to nearshore marine ecosystems, the highest priorities cited by experts were: Alien Species, Overfishing, Coastal Development, and Water Quality. The most commonly cited obstacles tended to fall into one of three categories: Limited Awareness, Limited Capacity, and Limited Application of Biologically Appropriate Management. A more complete list of threats and obstacles cited by experts includes the following:

Threats:

1. Introduction of Alien Species and the Spread of Invasive Species (Marine Algae, Marine Invertebrates, Fishes, and Others)
2. Overfishing and Destructive Fishing of Nearshore Species
3. Coastal Development
4. Water Quality
5. Boat- and Ship-Based Pollution: The Shipping and Cruise Industries
6. Marine Debris

Obstacles:

1. Limited Awareness of the Importance of Marine Management and Little Demand for Effective Management
 - Diffuse Support Base versus Strong Minority Voices
 - Limited Political Will
 - The Sliding Baseline Syndrome (the idea that with each subsequent generation the baseline of what they consider natural is further and further from the true natural state).
2. Limitations in the Application of Biologically Appropriate Management
 - The Need for Comprehensive Ecosystem Management

- Limitations in Organizational Capacity to Implement Comprehensive Ecosystem Management
- Limitations in the Number and Extent of True No Take Areas
- Limitations in the Biological Appropriateness of Fisheries Regulations
- Complications of Species Specific Regulations
- Limitations in Regulatory Reach: Lack of Recreational Licenses and Lack of Gear Specific Commercial Licenses

3. Limited Capacity for Effective Marine Management

- Limited Enforcement of Existing Laws designed to Protect Coastal and Nearshore Marine Areas and Species
- Limitations in Funding including Funding through Annual Appropriation Cycles
- Limitations in Organizational Capacity to Effectively Manage Natural Resources including ability to Implement Comprehensive Ecosystem Management
- Jurisdictional Conflicts and Limited Communication/Coordination in Marine Conservation Efforts Both Within and Between Resource Trustee Agencies.

THREATS

Alien Species and Invasive Native Species

Over the past 50 years, Hawai‘i’s marine ecosystems have experienced a wave of alien species introductions including algae, mollusks, sponges and sea grass. In the past decade, managers and researchers have increasingly recognized the significance of this threat, as alien and invasive species are competing with native species for dominance in marine systems. Alien species invasions are of particular concern in areas with high rates of endemism, such as the Hawaiian Islands. Efforts to understand and manage alien marine species are relatively new in the state but are essential to addressing this major threat. There is a growing effort to address invasive marine species; however, it is generally felt that there is limited awareness, activity, and capacity in this area given the vast potential alien species have to decimate natural systems and the marine tourism economy of the state.

Consistently, experts identified invasive alien species (particularly algae) as one of the top three threats to Hawai‘i’s nearshore marine resources (along with destructive fishing practices and coastal development). It is not surprising that given its position as the center for marine research, commerce, and shipping in the MHI, O‘ahu is also the center for introduction of alien species. Since 1950, O‘ahu has experienced 19 introductions of alien macroalgae with four of these becoming particularly successful. A variety of mechanisms are responsible for marine introductions including intentional introduction for mariculture, introduction by research agencies, and accidental introduction by marine vessels. Some species have spread to all the MHI while others have remained only on O‘ahu. O‘ahu has experienced the introduction of at least four species of alien bivalves, at least five sponges, at least seven crustaceans, and many other types of organisms. Likewise, at least eleven *demersal* (bottom-dwelling) species of fish have been

introduced, and at least three have established themselves (Friedlander, et. al. in press). Ta'ape (blue lined snapper) has become the most widespread introduced demersal fish. Ta'ape was intentionally introduced in 1955 to O'ahu from French Polynesia. Its population and range have increased to such an extent that today it is found across the full length of the Hawaiian archipelago (Oda and Parrish, 1982, Randall et. al. 1993, Friedlander, et. al. in press). Ta'ape demonstrates habitat use and behavior that suggests potential for predation and resource competition with several native species (Friedlander et. al. in press). However, more research is needed to demonstrate these interactions.

Alien algae are of particular concern, as many areas of the MHIs have experienced phase shifts from coral dominated systems to mono-specific alien algal beds (see Alien and Invasive Algae web site www.botany.hawaii.edu/GradStud/smith/websites/alien-overview.htm, 2001). Long-term consequences of phase shifts from coral to invasive alga can include loss of productivity and biodiversity, changes in the community structure, and eventual erosion of the physical structure of the reef. Experts indicated that several factors in addition to introduction contribute to a species becoming invasive. Eutrophication is a particular concern, as increased nutrients in the water can encourage significant algal growth leading to the possibility of phase shifts. These nutrients come from both land and marine sources including agricultural products, sewage, waste water, and grey water from homes and industry. Additionally, decreases in herbivorous fish are believed to provide potential for species to become invasive as their natural grazers are reduced in number.

Waikiki and Kane'ohe Bay have experienced phase shifts, with alien algae now being the dominant organism in parts of these areas. Likewise, a massive algae bloom of *Hypnea musciformis* in Maui during the mid-1990s caused considerable concern for both ecosystem and human health. Government agencies have moved to address algae blooms by improving water quality through programs to reduce nutrient loading. Unfortunately, another algae bloom was underway in West Maui at the time of this writing, suggesting that factors contributing to alga blooms have not been adequately addressed.

Fortunately, not all islands have been affected by all species of introduced alga. Despite the large blooms of the alien red alga *Hypnea musciformis* in Maui, the nearby island Kaho'olawe and the islet Molokini have no recorded incidents of any alien algae species.

Native species of algae can also become "invasive", leading to blooms and coral overgrowth as occurred with *Dictyosphaeria cavernosa* in Kane'ohe Bay and *Cladophora sericea* on Maui (Alien and Invasive Algae website - www.botany.hawaii.edu/GradStud/smith/websites/alien-overview.htm 2001). It is important to note that native species generally only become invasive in association with some sort of major habitat disturbance, such as eutrophication, oil spills, or over fishing of herbivores, etc.

According to some experts, a major problem underpinning the introduction of alien species is limited coordination between the agencies tasked with management of alien species. The Department of Agriculture (DOA) is responsible for issuing permits for the introduction of non-native species (both plant and animal), while the Department of Land

and Natural Resources (DLNR) is responsible for managing for the ecosystem and other biological impacts of these introductions. According to experts, coordination and communication between these agencies is limited.

A number of experts also suggested that the algae problem is largely one of water quality. Eutrophication of water bodies such as Kane'ohē Bay are believed to be a major contributing factor in the expansion of alien and invasive native alga. Water quality issues are addressed below. Experts also indicated that overfishing of herbivorous fish can contribute to the invasiveness of native or alien algae. Experts have suggested that many species of algae could be better kept in check through natural grazing. One expert called the combination of fewer grazers and increased nutrients in coastal waters as the one-two punch that enables alien and native alga to become invasive.

Overfishing of Nearshore Species

Overwhelmingly experts reported that overfishing, facilitated by a number of gear types, is among the most significant threats to Hawai'i's nearshore marine ecosystems and resources. Hawai'i hosts an extensive commercial, recreational, and subsistence fishing community with as many as 5,000 commercial fishers targeting nearshore species and an estimated 260,000 recreational fishers in the state (Clark and Gulko, 1999). In Hawai'i there are no requirements for recreational fishing licenses and as a result, the number of recreational fishers remains only an estimate. However, surveys have indicated that nearshore catch by recreational and subsistence fishing is equal to or exceeds the catch of commercial fishers and also targets a wider variety of fish types. The most heavily exploited nearshore species include uhu (parrotfish), weke (goatfish), moi (pacific threadfin), palani (eyestripe surgeonfish), manini (convict tang), u'u (soldierfish) and he'e (octopus) (Clark and Gulko, 1999) .

Many experts highlighted two gear types as the most threatening to the coral reef ecosystem and coral reef fish populations: gill nets, and spear fishing on SCUBA.

Currently nearshore fisheries management is carried out through a number of primary regulations and strategies:

- Species-specific minimum size regulations,
- Species-specific bag limits,
- Gear restrictions and
- Managed areas, which primarily have species and gear restrictions.

Hawai'i allows both recreational gill netting and spearfishing on SCUBA, both of which are considered major threats to marine systems. Experts indicated that these gear types are overly efficient at catching marine species, and can remove so many individuals that a population may not be able to recover.

Spear fishing on SCUBA allows fishers to access fish in areas that would otherwise act as refugia from skin divers. Likewise, spear fishing on SCUBA at night allows fishers to catch fish while they are asleep. New technology in SCUBA diving such as rebreathers

and mixed gas allow people to stay longer and go deeper thus opening up previously unexploited areas. This increased access may result in overexploitation of reef fish, leading to declines in populations and changes in the reef ecosystem processes.

Gill nets catch fish and other marine species indiscriminately and therefore devastate populations of organisms found in nearshore areas. Bottom gill nets can also destroy coral and other marine habitat. Current gill net regulations try to limit impact by requiring fishers to periodically check nets, and by limiting the length of the net, the size of the eye and the time of deployment. Unfortunately, the reality is that many nets are left in place for long periods of time, and ghost or derelict nets continue to capture and kill marine creatures long after they have been lost.

One expert, an avid fisherman and conservationist, indicated that a gill net can be good or bad depending on how it is used. According to this expert, a small gill net properly deployed and checked can be species-specific gear and will not take an entire school of fish. A large gill net deployed improperly and not regularly checked can catch and kill numerous species including non-target species, turtles, sharks, and even monk seals.

Other fishing techniques and general overfishing were cited as threats as well. Some fishers use poisons or toxins to catch fish, although this practice is not believed to be widespread. Underreporting of commercial catch is also an issue of concern. Experts suggested that underreporting may range between 200-10,000% for certain fisheries.

Anecdotal evidence from fishermen and fisheries data suggests that numerous nearshore stocks are overfished. In 1987, Shomura reported that during the past century, fisherman and scientists have observed a steady decline in the living marine resources in the MHI. According to Shomura as well as Harman and Katekaru (1988 - cited in Birkeland and Friedlander, 2001) the major cause of this decline is overfishing. Other researchers have reported that overfishing has reduced many nearshore fish species to levels below their ability to replenish themselves (Smith, 1993, Friedlander and DeMartini, 2001). Long-term catch trends suggest that there has been a dramatic decline (approximately 80%) in coral reef fisheries. Today stocks of Hawaiian coral reef fish in the MHI are at most 20 to 25% of what they were a hundred years ago (Shomura, 1987, Clark and Gulko, 1999, Friedlander and Demartini, in press, Birkeland and Friedlander, 2001). Many interviewed by this study believe added restrictions are required if Hawai'i's nearshore marine resources are to persist in the long-term. Experts emphasized increases in the number of marine protected areas, and the development of a network of refuges throughout the archipelago, as the most successful approach to rebuilding reef stocks and bringing long-term yields back up to their previous levels (Birkeland and Friedlander, 2001).

Aquarium Fishing

Most of the marine ornamental fish originating in the U.S. are collected in Hawai'i. Hawai'i is well known for its high quality fish and rare endemic species. For nearly 20 years, public concern over collecting aquarium species has highlighted the need for increased study and regulation of this industry (Tissot, et. al, 1999). In 1973, the Division of Aquatic Resources (DAR) started requiring monthly collection reports to

better regulate the industry. Since the inception of these monthly collection reports the industry has more than quadrupled from 90,000 fish collected in 1973, to over 400,000 collected in 1995 (Tissot, et. al).

Aquarium fish collection has been shown to have a substantially negative effect on populations of ornamental species (Birkeland and Friedlander, 2001). The results of a study by Tissot and others indicated that aquarium fishing is having a significant impact on eight of ten commonly collected species (Tissot et. al, 1999). However, the researchers reported that additional knowledge is needed about the location and intensity of collection to be sure if the abundances of fish recorded are clearly the result of collection activities.

Experts believe that the current self reporting system underestimates the harvest of aquarium fish, highlighting the need for more effective methods of harvest assessment. Finally, experts recommended that additional conservation measures are needed in this fishery and that managed areas are likely to be an effective approach.

Although the industry collects more than 100 different species of fish, it is centered on approximately a dozen species, of which the Yellow tang accounts for up to 50% of the total of all collected fish. This high intensity collection of a small number of species draws into question the sustainability of the harvest. The industry also targets extremely rare or endemic species. Many of these species are naturally found in very small populations, and as a result entire populations may be at risk do to aquarium collecting.

More than 30% of the Kona Coast of the Big Island (currently the major center for marine ornamentals collection) has been set aside as Fisheries Replenishment Areas (FRAs). Long-term studies of the impact on these areas are underway. These areas also apply other fisheries regulations to non-aquarium fish, and some areas are put aside as complete “no take” zones.

Coastal Development

A large percentage of Hawai‘i’s coastal zone has been developed either for tourism, residential areas, or commerce. On O‘ahu a large percentage of the coastline has been altered through the filling of reef flats, coastal dredging, building of sea walls, construction of marinas, homes, harbors, and industrial areas. On other islands, coastal development ranges from almost negligible levels on Ni‘ihau, to significant levels on Maui’s Ka‘anapali Coast and Kona’s “Gold Coast.” As a result, experts indicated that very few natural estuaries or coastal wetlands remain undeveloped. Highly altered estuaries include Kane‘ohe Bay, Pearl Harbor, Waikiki, and Hawai‘i Kai. Remaining natural estuaries include Halawa Bay on Molokai, Waipi‘o and Waimanu valleys on Hawai‘i Island, and the Hanalei River on Kaua‘i.

According to experts at DLNR, research on beach erosion indicates that up to 25% of Hawai‘i’s beaches have been lost in the past 70 years. Hawai‘i lacks the aggressive beach management programs that other states have, which typically include both

restoration and regulatory components. However, DLNR is proposing a process to map erosion sensitive beaches and to develop a manual to inform the public and developers how to avoid coastal erosion. Some experts expressed concern about the impact of beach replenishment on coral reef and other sensitive nearshore habitats. As a result, improving the understanding of these habitats is important to help inform the process of beach replenishment.

In addition, several ongoing processes and projects should result in a considerably improved understanding of sensitive coastal habitats. These include an oil spill sensitivity map being prepared by National Oceanic and Atmospheric Administration (NOAA), organization of GIS information by the Marine Ecosystem Geographic Information System (MEGIS) group, work by the State Coastal Zone Management Program, and the work of USFWS Coastal Program.

A number of agencies have jurisdiction over different aspects of coastal areas. Responsibility for management for coastal resources and for management of shoreline development in conservation zones lies with DLNR, responsibility for water quality lies with the Department of Health (DOH), and responsibility for shoreline development in rural and urban areas with the counties. According to experts, some developers and county regulators are interested in the input of resource agencies in planning and shoreline management. For example, the USFWS has provided requested input in the planning processes of the City and County of Honolulu, Kauai, and Big Island. However, experts have also indicated that developers and regulators have generally not shown sufficient sensitivity to the importance of shoreline management.

Stream channelization in the coastal zone poses another threat to Hawai'i's marine resources. Throughout the MHI, a large number of streams have been channelized. A large amount of this channelization has been carried out by the Army Corps of Engineers, the state, or county governments, in many cases as part of flood control measures. Unfortunately, channelization results in greater fresh water runoff reaching the coastal zone. This fresh water runoff can lower salinity levels and negatively affect corals and other marine species. The "de-watering" of streams is also a problem for marine areas as it reduces or eliminates estuarine habitats at stream mouths, that are crucial to juvenile marine and amphidromous fish and invertebrates.

Coastal development and channelization also severely restricts the absorption and cleansing action of natural vegetation and soil. As a result, large fresh water outflows during high rains can kill corals, while water born sediment and pollution are deposited in greater quantities onto coastal and nearshore environments severely impacting these areas (see Water Quality section below).

Water Quality

Problems in water quality, most of which emanate from land-based sources of sediment, excessive nutrients, toxins, or other pollutants is a major contributing factor in the decline of Hawai'i's nearshore marine resources. In recent years, offshore aquaculture has added

to the possible sources of pollutants that can negatively impact water quality. In the MHI, high nutrient levels are known to encourage algae growth, whereas stony corals are thought to dominate in areas that are low in nutrient levels. Massive algae blooms on Maui in the mid-1990s and today are believed to be directly linked to high nutrient loads from non-point sources such as injection wells, cesspools, and agricultural lands. Development, runoff, and historical sewage disposal into Kane'ohē Bay may all be contributing factors in the phase shift from a coral-dominated ecosystem in much of the bay to an algae-dominated system.

High sediment loading into the nearshore environment is a persistent problem throughout the MHI. Decades of agriculture, ranching, coastal development, military activity, and overgrazing by alien species have caused massive sediment problems throughout the MHI. Sediment runoff was estimated by the USFWS in 1996 at more than 1 million tons per year (cited in Gulko, et. al. 2001). The problem is particularly severe on Molokai, Lana'i, parts of O'ahu, and Kaho'olawe. Fortunately, some experts estimate that sediment loads will decrease in the future as large-scale agricultural practices are changing in the state.

Boat- and Ship-based Pollution

Several of the experts interviewed expressed considerable concern about the possible impacts of the boating and shipping industries. Cruise ships were more regularly cited as a possible threat than were container or tanker vessels, perhaps because this is a relatively new industry to Hawai'i and is growing rapidly. Concerns run the gamut from hull fouling/ballast water and the introduction of alien species, to gray water pollution washing up into nearshore areas, to possible fuel spills due to ship and boat groundings. According to cruise industry representatives, the ships themselves are in compliance with all regulations regarding waste disposal and ballast exchange. Cruise ships also do not perform a significant amount of ballast water exchange to maintain stability, so threats from ballast water are likely lower in these vessels than in container or tanker vessels. According to cruise industry representatives, the companies that run or plan to run cruises in Hawai'i want to work hard to comply with all environmental regulations, and want to reach out to the public at large to show themselves as good corporate citizens.

The shipping industry also poses considerable threat both in terms of introduction of alien species as well as in pollution. While gray water levels are much lower in the shipping industry, the potential for significant environmental damage due to oil and chemical spills is much greater. The shipping industry was not contacted as part of the study and therefore did not comment on their compliance with waste and spill safety regulations. Some of the experts interviewed feel ship- and boat-based pollution and potentials for oil and chemical spills are threats that should be more carefully assessed. Fortunately, the NOAA has updated and digitized oil spill sensitivity maps for the state in an effort to better understand the possible impacts of spills (and has recently published a new set of Atlases with this information). Likewise, experts have cited the need to modify environmental regulations related to spills that were largely developed without concern for coral reef habitat, to include more sensitivity related to these habitats.

As the direct result of a law suit filed by the Earthjustice Legal Defense Fund, the Environmental Protection Agency recently conducted a study of the most polluted water bodies in the state as an initial mechanism to improve pollution control and cleanup.

Marine Debris

Marine Debris was regularly cited as more of a threat in the NWHI than in the MHI. However, experts do consider marine debris a threat that must be addressed in the MHI, especially derelict fishing nets that either continue to ghost fish, entrapping and killing wildlife, or that wash up on reefs and nearshore areas. Other debris includes plastics, wood, rubber, metals, and cloth that originate from land based sites such as waste disposal sites and storm drains. Some areas in the MHI are particularly impacted by marine debris due to current patterns that cause an accumulation of debris in these areas. Also, species such as marine turtles and monk seals are impacted by marine debris both in the MHI and in the NWHI. According to experts, marine debris has increased at times due to wind shifts and changes in current patterns associated with El Nino.

DAR has undertaken a preliminary study of the amount of debris present (especially discarded fishing nets) in the MHI. Clean up efforts along a small section of the Kaua'i coastline in October 2001 yielded over 20 tons of nets, and not all was removed. In some remote sites along the Island of Hawai'i, as much as 30 tons of derelict fishing gear has been reported. Early in 2002, DAR will work with other agencies and the local communities to organize additional clean ups of this debris, however, according to DAR officials none of these efforts will truly eliminate the problem. The University of Hawai'i Sea Grant also organizes an annual statewide clean up as part of a national effort sponsored by The Ocean Conservancy.

OBSTACLES:

Experts interviewed identified a wide range of obstacles to more effective marine conservation. Their recommendations on ways to overcome these obstacles are discussed in Chapter 3: Recommendations.

Limited Awareness of the Importance of Marine Management and Little Demand for Effective Management

According to the vast majority of experts interviewed, the single biggest obstacle to effective marine resource management is a lack of awareness of its importance, limited demand by the public for effective management, and prevailing attitudes that are ambivalent to or reject marine management.

Many experts said that the public's attitude is that there is not a problem with marine resources, or that regulations don't have a role in solving the problem. Other experts said that the difficulty of managing a common property resource has led the fishing

community to have the attitude that if they don't take it, someone else will, so they might as well take it.

Experts have also said that many parts of society don't fully appreciate how marine resources affect their lives in terms of helping to support the economy and culture of the state, and therefore do not demand proper management.

Other experts said that they would like to institute more effective ecosystem management and more no-take MPAs, but that interest groups including fishers and gear suppliers often resist both no-take MPAs and fishing regulations.

One expert said that the conservation and management community is really bucking the tide in terms of getting more areas into protection because of public opposition or public ambivalence.

Experts feel proper resource management would both improve or maintain many economic sectors including tourism and fishing and would provide more fish for cultural and recreation use. However, they feel that people do not widely recognize the long-term economic benefits of these measures. HCRI is funding an economic assessment of coral reefs as a part of its FY 01 funding. This study has just begun and will assist in providing some basic information about the economic values placed on coral reefs once completed.

Diffuse Support Base versus Strong Minority Voices

According to some experts, the lack of awareness of the importance of effective marine management manifests itself in limited or diffuse support for conservation. Experts said that when asked specifically, the public generally supports marine conservation. While this support base is present, it is diffuse. In other words, individuals might support conservation if asked, but tend not to go out and actively campaign on the behalf of conservation issues. Interest groups on the other hand, are well organized and lobby on issues of concern to them. For example, on the gill net issue, there was a strong lobby both by fishermen and by gear dealers not to limit gill net use. Conservation organizations believe that the majority of non-gill net fishers supported restrictions on gill nets; however, they did not actively make their position known.

It is also important to note that a recent study by Malama Hawai'i showed that people generally feel that Hawai'i's environment is generally healthy, and therefore does not need the same level of support as other interests such as schools, the economy, etc. Resource managers know that this is not the case given the high level of degradation in marine resources in the MHI. As a result, it appears that efforts to raise awareness of the plight of Hawai'i's environment are needed.

Other people might also support gill net restrictions if they understood the issue and recognized the effect that gill nets have on their lives, economically, recreationally, and culturally. However, since the perception is that gill nets and restrictions on gill nets do not impact their daily lives, there is no concern among the general public to support gill net restrictions. In the end, while the vast majority of conservationists interviewed feel

gill nets must be restricted, and many in the fishing community agree, the gill net task force recommendations are believed by many interviewed to be insufficient to solve the problem caused by the use of gill nets. To date DAR has not implemented these recommendations. However, draft regulations will be presented to the gill net task force at the beginning of 2002. DAR plans to hold public information meetings on the new gill net rules by spring 2002, and go to public hearing in the summer. Also, the West Hawai'i Fisheries Council has recommended closure of significant amounts of the West Hawai'i shoreline to gillnet use, in addition to the new statewide proposals.

Experts suggested that the problem of harnessing diffuse support could largely be addressed by raising awareness on particular issues and organizing grass roots support for enhanced conservation. Please see Chapter 3: Recommendations.

Limited Political Will

According to experts, a lack of public awareness also manifests itself as limitations in political will for effective resource management. Limited political will translates into limited financial support for resource management, and a lack of support for changes in laws and regulations that will improve management.

In many cases, experts noted that environmental protection measures are viewed by political decision-makers to be at odds with economic interests including tourism, coastal development, and manufacturing. As a result, this limited awareness of economic benefit translates into decisions that negatively impact these resources further.

Some experts believe that a limited awareness and understanding of natural resource issues exists in the legislature, (which plays a major role in approving many marine management laws, appropriates funding for resource management agencies, and until recently was mandated to approve or disapprove many regulatory changes). Also, one expert indicated a belief that there are limited opportunities for resource experts to provide input into decision making. In their opinion this in turn limits decision makers' ability to use the best available knowledge and science to help them make appropriate resource management decisions.

According to several experts, the legislature is a particularly important target for raising awareness. They are often involved in marine management statutes. In addition, experts suggested that the Governor's office is an important target for raising awareness regarding the economic importance of marine resources in Hawai'i.

The Sliding Baseline

Experts interviewed suggested that Hawai'i is experiencing a phenomenon known as the sliding baseline syndrome, and this may have a negative impact on perceptions of the need for marine conservation in the state. The idea behind this concept (also known as the "shifting baseline syndrome" (Pauly, 1995, Sheppard, 1995)) is that each individual envisions a pristine or good condition environment to be synonymous with the conditions of the resources when they were young, or when they first observed them. The reality is that marine areas in the MHI are not pristine and not in their natural state.

Unfortunately, the baseline condition of marine resources slides with each generation or with each new observer. The problematic part of this phenomenon is that each subsequent generation of observers comes to expect less and less from their marine resources.

As time goes by and marine resources decline, individuals may no longer be aware of the characteristics of a natural environment. As the baseline slips, it becomes increasingly difficult to interest people in environmental protection and restoration. A critical component of any educational campaign should be to ensure that people become aware of what natural systems can and should look like before the baseline slips too far.

Overall, experts strongly suggested that a lack of awareness of the importance of marine conservation underpins all other threats and obstacles to effective long-term conservation management in the state. This includes a lack of support for biologically appropriate management, limited funding for proper management and enforcement, insufficient laws and regulations, and several other threats and obstacles summarized in this study. Based on this initial assessment, a lack of awareness and a lack of support for effective resource management appear to be a root cause of continued resource degradation in the state. Raising awareness and changing attitudes will be key to effective long-term management.

Limitations in the Application of Biologically Appropriate Management

The Need for Comprehensive Ecosystem Management

In Hawai‘i marine management is primarily done on a species-by-species basis, and does not take into consideration the ecosystem processes that serve to maintain species populations. According to one senior marine manager, even attempts to change size limits and bag limits on a species-by-species basis, while useful, will not solve the problem of declining marine resources. Many experts felt strongly that ecosystem management is essential to effectively manage Hawai‘i’s marine resources.

Increasingly, conservation managers around the world are recognizing the need to shift from species- and site-based management approaches to ecosystem-based management. All ecosystems are comprised of interconnected natural communities and multi-species interactions that are linked together by ecological processes (TNC, 2000). The complex mosaic of habitats, biotas, physical features, and ecological processes that interconnect these features are all important to the continued functioning of the natural system. To manage from an ecosystem approach, agencies must consider not only the needs of one element of the ecosystem such as a particular species, but also the integrated needs of the entire set of ecosystem components, including multi-species interactions.

While the move to manage ecosystems has taken hold in many conservation arenas, in the case of fisheries management, stock management based on individual species remains the norm. Individual species populations are typically managed by assessment of their size, and in many cases regulation of catch limits or gear type is the management regime of choice. Increasingly, fisheries managers are recognizing the inadequacies of this type

of management and moving toward ecosystem approaches, particularly in the coral reef environment. While this recognition exists in Hawai‘i; experts report that to date there have been few steps taken by Hawai‘i’s resource management agencies to implement ecosystem level approaches to resource management. Some experts emphasized that effective management strategies for marine ecosystems do not yet exist. As a result, they feel it is critical to focus some effort on designing an effective ecosystem approach.

Marine Protected Areas (MPAs) have been widely recommended as the best way to manage for ecosystem features, and are a particularly important tool for managing coral reef areas and coral reef fishes. As a result, many experts interviewed feel that the management of Hawai‘i’s nearshore ecosystems would benefit greatly from an ecosystem approach and an increased number of appropriately sited MPAs. Several experts emphasized the importance of no-take MPAs in protected ecosystems.

Limitations in Organizational Capacity to Implement Comprehensive Ecosystem Management

A number of organizational programs and agencies in Hawai‘i are devoted to the conservation and management of marine resources. Several groups are pursuing outstanding efforts to protect important resources and raise attention about the need for more effective management of marine resources. This review indicated that most conservation organizations and agencies have focused on specific environmental issues, resources of concern, or the interface between cultural and resource issues. A range of important approaches has been pursued; including advocacy, grassroots organizing, education and outreach, and research. In addition, many local groups have focused on watershed management, which incorporates a move towards broader ecosystem management. However, this study identified only a few ongoing initiatives that take an ecosystem approach to marine management, although it is important to stress that if resources and support are available many groups are very interested in pursuing this type of management.

Limited Number of “No Take” Areas

Current estimates by some experts suggest that less than 0.3% of the coral reef area of the MHI is in full no-take (Gulko, et. al., 2001). In other words, it is legal to fish or collect resources in some manner, in the remainder of the MHI. Where they exist, “no take” areas have proven to be effective in increasing fish stocks. However, in areas that are not full “no take,” experts report that fish populations have not increased significantly. In fact, some experts have suggested that some of the current Marine Managed Areas (MMAs), such as Marine Life Conservation Districts (MLCDs), that allow some take have fish standing stocks similar to areas that are complete open access. (Birkeland and Friedlander, 2001). This suggests that managed areas that allow some type of take may be no better at managing resources than open access areas.

Currently managed marine areas in Hawai‘i include the following types:

Marine Life Conservation Districts (many allow some take, some are full no-take)
Natural Area Reserve (one marine) (this area allows limited take only)

Fisheries Management Areas (certain resource harvesting is allowed)
Marine Laboratory Reserve (one) (some take is allowed)
Marine Parts of National Parks (marine resources are under state authority and some take is allowed).
The Hawaiian Islands Humpback Whale Sanctuary (full no take for marine mammals, take is allowed for other species)
Community-Based Marine Areas (marine resources are under state authority and take is allowed. However, local communities have worked to limit take).

As shown above, very few marine protected areas constitute full “no take”, no harassment areas. Hanauma Bay is a full “no take” area, as is Molokini off the coast of Maui, but both areas have an altered ecology due to a high level of tourism. Shallow water ecosystems have been altered due to trampling and diver impacts; however, this has not been observed in studies on the deeper reefs in any of the MLCs. In addition, although fish feeding was previously allowed and is likely to have had ecosystem level impacts, it has been banned in these areas for the past few years, thus providing an opportunity for these areas to recover to more natural ecological conditions. Many experts cited the creation of additional no-take MPAs or fisheries replenishment areas as largely constrained by limited awareness and public attitudes.

Limitations in the Biological Appropriateness of Fisheries Regulations

Many of Hawai‘i’s current fisheries regulations do not adequately address the biological needs of the species under management. One example of this is the minimum allowable catch size. For example, moi (pacific threadfin, *Polydactylus sexfilis*) can be caught at 7 inches. Unfortunately, moi do not become reproductive females until at least 11 inches (Friedlander, 2001). As a result, moi are being caught before they have a chance to reproduce. Despite bag limits, size limits, seasonal closures, and an active stock management program, catches of moi have declined dramatically over time (Friedlander and Zeiman, in press). Fortunately, DAR is currently making changes to the take minimum size limits of various species (including moi) to more adequately respond to the biological needs of the species (see Chapter 3, Recommendations).

Complications of Species Specific Regulations

Several experts interviewed cited the complexity of Hawai‘i’s fisheries regulations as a major problem. Every species has a different regulation on take size and bag limit. While fishermen interviewed said that responsible fishermen do in fact follow these regulations, they have also said that less responsible fishermen find them too complicated and may not pay much attention to them. Other fishers simply may not be aware or interested. This again leads us to the constraint posed by individual species management. Given the complexity of fisheries regulations and the limited capacity for awareness raising and enforcement, experts suggested that it simply might be too difficult to manage effectively through these means. DAR officials have indicated that their agency is working to address the issue of complexity in their review and rewrite of the current fisheries regulations.

Limitations in Regulatory Reach: Lack of Recreational Licenses and Lack of Gear-Specific Commercial Licenses

In Hawai‘i there are no requirements for recreational fishing licenses. As a result, it is impossible to provide an accurate estimate as to the numbers of recreational fishers or recreational catch. It is therefore impossible to effectively regulate recreational fishing. Experts however, estimate that recreational fishing has a more significant impact on nearshore marine ecosystems than commercial fishing, because more people are involved in this fishery and it likely has the highest take and on a more diverse set of species. Experts have pointed out that requiring a recreational fishing license would not only help improve understanding of the recreational fishery and its impacts, but also increase the availability of management funding from the federal government.

Likewise, permits for commercial fishing are not gear specific due to constraints in the existing laws. This limits DAR's ability to effectively manage commercial fishing. Catch reports are believed to be significantly under-reported, which makes regulation and management extremely difficult.

Box 2 The Coral Reef Ecosystem: Important Information for Management

In Hawai‘i, coral reef ecosystems are among the top priorities for nearshore marine conservation. There are many excellent volumes that provide overviews of coral reef ecology both generally and specifically for Hawai‘i’s. One of the best resources is *Hawaiian Coral Reef Ecology* (Gulko, 1998). While we are not able to give a comprehensive overview, we summarize some fundamental aspects of coral reef ecology that play a major role in how these systems can be most effectively managed. Much of the following information on coral ecology also comes from an interview with Chuck Birkeland and Birkeland et. al. (2001).

Populations of animals on coral reefs can be removed from reefs quickly and often do not return. Coral reef species are vulnerable to overfishing because their life history strategies tend to favor multiple reproduction through longevity and large-size. Because coral reef systems generally have large numbers of predatory species, young have low survival rates. As a result, a strategy of multiple reproductions is important to survival. To reproduce effectively a number of times however, an individual fish must live for a long time and reach a sufficient size to produce a high number of eggs. Often first reproduction is delayed, thus prolonging the time needed to enable fish to reproduce multiple times. Removing large fish removes critical reproductive adults. Removing all or most of these adults may completely eliminate the species from a reef system. Many families of reef fish are hermaphroditic, starting off life as one sex, and changing when they reach a certain size. As a result, fishing out the largest reef fish can radically effect not only the social structure and reproductive potential of the targeted fish species, but also a wide variety of other species that may be effected by the reef territory held by those reef large fish.

In turn, overfishing of certain species or guilds on coral reefs can have ecosystem level impacts. For example overfishing of herbivores can lead to an overabundance of marine algae that can inhibit coral recruitment thus having cascading effects on the food chain and precipitating changes in populations of other species or guilds. As a result, coral reefs cannot be managed effectively on a species by species basis, but must be managed as ecosystems.

“No take” reserves are one of the best mechanisms to manage coral reef ecosystems, because they allow for the natural ecosystem processes to proceed without needing detailed knowledge or management of specific species, multi-species interactions, or ecosystems functions. Given that biologists don’t understand all of the species needs and ecosystem processes on coral reefs, “no take” reserves are the only way to ensure effective management of the system overall.

Given that fishers desire access to coral reef fishes for livelihood, cultural, and recreational reasons, there is a need to balance these interests with the needs of the ecosystem. Many marine conservationists are increasingly suggesting that areas managed as no-take zones can help to support ecosystem processes overall and can help to support fishing in other areas through spillover (Roberts and Hawkins, 2000). There is now ample evidence that spillover from reserves does in fact occur with many species and some evidence that this can improve fisheries outside of reserves. As a result, there is potential for “no take” areas to serve as fishery replenishment zones and to help meet the dual purposes of ecosystem management and improving fish catch in adjacent areas. Given the ecology of coral reefs, “no take” reserves are increasingly viewed as a critical tool in maintaining both biodiversity and marine resources that are important for human use.

Limited Resources and Capacity for Effective Marine Management

Limited Enforcement of Existing Laws Designed to Protect Nearshore Marine Areas and Species

Unfortunately, this study was unable to interview officials from the Division of Conservation Area and Resources Enforcement (DOCARE). We would have preferred to provide direct information from DOCARE itself; however, this study can only make inferences about enforcement capacity within the state based on the opinions of experts interviewed. Several experts interviewed indicated that in their opinion there are extreme limitations on the resources and capacity to effectively enforce the state's regulations on marine management. This is compounded by the fact that the regulations are complicated and the number of DOCARE agents is insufficient to fully cover all the marine managed areas of the state. One expert suggested that citizen volunteers could be placed at key MLCDS to help raise awareness and provide educational materials. When it was suggested that these individuals could also provide surveillance on regulations and contact DOCARE agents if a violation was observed, the expert indicated that it was unlikely that DOCARE agents would be able to respond in a timely manner if contacted. While anecdotal, this reinforces the perception that DOCARE does not have sufficient resources to effectively enforce marine regulations. Most experts interviewed felt this stemmed from three primary causes. 1. DOCARE is insufficiently funded, and therefore there are too few agents. 2. DOCARE Agents are tasked with both terrestrial and marine enforcement, however the vast majority of their time is devoted to terrestrial issues. 3. DOCARE agents may not always want to enforce fisheries regulations because fishing is seen as providing a livelihood, even in the case of high tech fishing methods such as spear fishing on SCUBA. As a result, few people want to interfere with someone making a livelihood.

Limitations in Funding including through Annual Appropriation Cycles

The current situation of limited financing was highlighted by several individuals as an obstacle that must be overcome to effect considerable change. Currently, the state of Hawai'i is ranked around 47th or 48th (estimates by experts varied) in the nation in terms of its budget for marine/aquatic resource management, yet Hawai'i has one of the longest coastlines of any state. According to a senior DAR Official, DAR is responsible for management of all of Hawai'i's nearshore marine resources, yet has an annual budget of only \$5 million (including both its state and federal appropriations, of which state appropriations are less than half). As a result, the agency is missing several key staff positions that it feels are critical to marine management.

Estimates indicate that the marine conservation NGO sector generates less than \$300,000 annually. That said, even with limited budgets, both the state and the NGO sector have managed to generate a great number of conservation initiatives and accomplish a significant amount.

Relative to the needs, marine science in the state of Hawai'i is much better resourced than conservation or marine management. Considerable research funding is generated by the Hawai'i Institute of Marine Biology (although much of HIMB's funding actually comes

from DAR), the Oceanic Institute, and the University of Hawai‘i. However, only a small amount of this money is focused on marine conservation. Experts suggested that there are also insufficient funds for training a new generation of researchers, particularly ones with a focus on marine management.

The Hawai‘i Coral Reef Initiative (HCRI) has been a welcome source of federal financing for marine research, providing increasing funding each year for the past several years, now totaling nearly 1 million dollars annually. HCRI is designed to support coral reef research. In coming years, HCRI is planning to support more conservation and management related activities; however, the focus will remain on management-oriented research. HCRI is jointly managed by the University of Hawai‘i and DAR, which facilitates ties between these research and management agencies.

Annual Appropriation Cycles

Several experts cited annual appropriation cycles as a major obstacle to effective conservation and research. Understandably, this obstacle is most significantly felt among government agencies and academic institutions that depend on annually appropriated federal or state funds. Several projects have been started that would ideally need longer than one year to be fully effective. While short-term funding helped to initiate several projects, some were cut in subsequent years resulting in less than optimal outcomes. One example includes studies on alien algae. One year of funding enabled researchers to identify areas that are impacted by alien algae, but follow up research on the relationship between land-based sources of pollution and nutrients has not been possible since funding was not approved for the following year.

Fortunately, NGOs and Universities are largely able to access funding over longer periods of time. Foundations and private individuals tend to fund for longer periods of time, providing the opportunity for longer term conservation work. Currently there are few foundations interested in marine conservation operating in Hawai‘i, so to access more flexible funding it will be critical to develop partnerships with national foundations.

Limitations in Organizational Capacity to Effectively Manage Natural Resources

Numerous experts emphasized capacity limitations in terms of funding, human resources, organizational and strategic planning skills, and several other aspects of natural resource management.

Specific limitations in capacity that were mentioned by experts include shortfalls in:

1. Knowledge of marine resources in the state (within the general public and among policy makers) and limited data basing and dissemination of this information.
2. Strategic planning for resource management, including the setting of biologically meaningful targets and indicators for biodiversity conservation.
3. Predictive Capacity (modeling of future impacts and coastal and habitat sensitivity).
4. Monitoring Capacity to understand change over time and the causal relationships between resource condition and management actions.

5. Human resources, including the development of skilled conservation practitioners to work at all levels, including government and NGOs.
6. Financial Support to all levels, including government (focus on state) and NGOs.
7. Capacity to enforce compliance with Hawai‘i’s marine resource regulations.
8. Capacity to adequately encourage voluntary compliance with regulations
9. Capacity to develop a positive and proactive attitude at all levels of society
10. Capacity among various stakeholder resource groups to effectively participate in management
11. Capacity to address multi-cultural issues in resource management
12. Capacity to adequately resolve conflicts between interest groups.

In general, capacity limitations in parallel with limitations in awareness of the importance of marine conservation were the most commonly mentioned obstacles or constraints to effective marine management.

Jurisdictional Conflicts and Limited Communication/Coordination in Marine Conservation Efforts

According to many experts, there is insufficient communication between and among several government agencies as well as between and among non-governmental organizations (NGOs). Many felt improved communications and collaboration would improve the situation of resource management.

Some indicated that there are several Government agencies with different but overlapping mandates and jurisdictions, yet they have insufficient coordination to ensure effective management. For example, the Department of Health is responsible for water quality, but the DLNR is responsible for ecosystem management. Numerous ecosystem management issues are a direct result of water quality and likewise ecosystem impacts can tend to effect water quality. Experts recommended some sort of improved communication to ensure effective cross-agency management of this and many other similar issues. Another example is the issue of alien species. Several different agencies have jurisdiction over alien species including introductions and management. According to experts, there is limited communication between these agencies about alien species issues, and as a result, management is not as effective as it could be.

Experts also indicated that current management efforts are disjointed or uncoordinated initiatives rather than a strategic set of interventions. While experts greatly support most management efforts that are underway, some commented that these initiatives could benefit from a more targeted and strategic approach. The need for outside oversight and periodic effectiveness reviews was mentioned as well.

Chapter 3: Recommendations to Improve the Condition of Nearshore Marine Systems in the MHI.

This study has tried to capture expert opinion both on the additional conservation projects that need to be undertaken in the short term and the efforts needed to build capacity for long-term conservation. Collectively, these recommendations represent the opinions of a broad group of experts on nearshore marine resources management. However, they do not represent all opinions. As a result, one of the main overarching recommendations is to stimulate and maintain an open process of communication and strategic discussion about the ideas summarized in this document.

A Major Theme: Addressing Immediate Needs in Conservation Management While Developing a Long-Term Comprehensive Strategy for More Effective Management

A major theme that overarches all the recommendations collected in this study is the need to address immediate high priority or urgent issues while developing a comprehensive strategy that sets a solid foundation for long-term improvements in management. This approach will be critical in the state as there are some things that can and should be addressed right away and many others that will take long-term measured attention and collaborative strategic planning to fully address. For example, right now experts are aware of a number of high priority initiatives that could be undertaken right away. These include more research and monitoring on alien species, enhancing capacity within the NGO sector for effective institutional management and fundraising, assessing the replicability of community-based conservation approaches, developing citizen marine conservation action committees on each island, developing arguments for conservation through socioeconomic research and monitoring, assessing and developing opportunities for enhancement of protection regimes, and several others. Efforts that will require long-term collaborative planning approaches for conservation include developing an ecosystem prioritization and a comprehensive ecosystem-based conservation strategy, raising awareness in specific sectors of the importance of marine conservation, and building capacity in targeted sectors for more effective ecosystem-based management. In addition to this general theme there were numerous specific recommendations.

RECOMMENDATIONS

Below we provide a short synopsis of the current activity under each recommendation area that was gleaned from expert interviews and literature. The synopsis is then followed by a list of summarized recommendations made by experts. In some cases, most, if not all experts have made the same recommendations. In some cases, only one or a few experts made a particular recommendation. While we do not provide an accounting of how many experts made a particular recommendation, we do indicate the general level of expert enthusiasm for particular recommendations. In some cases, recommendations made by only one or two experts were subsequently cross-checked with other experts for general applicability.

Recommendations from experts fell into several readily distinguishable categories, each with several individual supporting recommendations:

- Create Awareness and Demand for Conservation Management at all Levels of Society from the Public to Decision Makers
- Encourage Comprehensive Marine Ecosystem Planning and Implementation (including Specific Marine Protected Area Recommendations)
- Improve Communications and Collaboration Among Stakeholder Groups
- Build Capacity for Effective Natural Resources Management
- Address Alien and Invasive Species
- Expand Community-based Coastal and Nearshore Marine Management including the Documentation of Indigenous Knowledge
- Effectively Manage Nearshore Commercial and Recreational Fishing
- Address Coastal and Upland Development and Land-based Effects on the Sea
- Additional Recommendation from the Consultant: Develop Sustainable Financing Mechanisms to Support a Massive Scaling Up of Marine Conservation Activity in the State.

Create Awareness and Demand for Conservation at All Levels of Society from Public to Decision-Makers.

Overwhelmingly, experts interviewed reported that creating awareness and demand for conservation is the highest priority activity to be undertaken to improve marine conservation management. As discussed in the obstacles section of this document, numerous experts independently identified a lack of awareness, attitudes that are ambivalent or opposed to marine management, and limited political will as key constraints to effective management of marine resources.

Current Status

Based on the interviews conducted, it appeared that many people have been thinking about the need for more effective environmental awareness and education. There are several ongoing programs that are delivering excellent education. However, experts indicated that none of the current initiatives are of the scale that will be needed to create change in attitudes. They suggested that a much larger and more strategic initiative should be developed to target different levels of society.

The Division of Aquatic Resources (DAR) and other organizations are currently in conversations about how to put such an initiative together. They have noted a need to build a bridge between many different stakeholder groups, including academia, the community, the government, and other interested parties. DAR has recognized its limited capacity to design such an initiative and has decided to engage public relations and marketing experts to develop a communications strategy focused specifically on coral reefs and the need to protect them. It is hoped that different organizations will join with DAR to implement components of this strategy once complete.

There is also an initiative underway by the Secretariat for Conservation Biology which is attempting to build a bridge between many different stakeholder groups, including academia, the community, and the government. This work is discussed further in the recommendation section on improving communication and coordination. However, we mention it here as it has potential to play a role in raising awareness and bringing greater attention to needs in marine resource management.

Recommendations

The development of targeted and effective awareness efforts is complex and must be pursued with care and purpose. However, based on expert comments several recommendations have emerged. As in the case of the communications strategy under development by DAR, each of the following recommendations should be pursued with the assistance and advice of professional public relations and communications experts who know how to effect change through awareness efforts and who understand the situation in Hawai'i.

Conceptual recommendations from experts included:

- a. **Develop campaigns and communications strategies with professional public relations experts who know how to get messages out, and target specific results.** (DAR's emerging coral reef communications strategy is a good example of this.) While general campaigns to raise awareness are important, there is also a need for campaigns that target specific results. These campaigns and awareness efforts should be logically linked to upcoming or proposed changes in management that will result in more effective marine management. In other words, some of the awareness campaigns that are pursued should be designed specifically to create demand for change and/or to create an environment for the creation of more effective marine resources management strategies.
- b. **Clearly articulate the biological and social objectives that must be achieved to improve the condition of nearshore resources as a guide to developing an effective communications strategy.** Experts stressed that it is important to remember that the conservation community is only one set of stakeholders. Other users of marine resources depend on the existence of marine resources. This is to the advantage of the conservation community. However it is important to remember that people's motivations for management may stem from the desire to use resources not to conserve them. Environmentalists must remember this and work toward the overlap between environmental concerns and use concerns.
- c. **Precede any proposed regulatory changes with significant public awareness and outreach campaigns.** All proposed changes in regulations or management strategies must be prefaced with well

thought out communications efforts. Budgets for resource management in the state are very small and often outreach and education is not affordable. However, experts feel these are essential to effecting change. If you can't effect change you might as well not bother doing the research and developing the proposed measures. Preparation and follow through with education and outreach is absolutely essential.

- d. Do not pursue resource conservation education and outreach from the environmental angle only. Pursue a much larger vision than environmentalism.** We must couch appropriate resource management in a way that appeals to a number of stakeholder groups, garnering the largest amount of support possible. Messages that emphasize the goal of protecting our current way of life and the future for our children may be some of the most effective messages, but we should test these and other messages in focus groups to ensure that we can get our points across.
- e. Develop mechanisms that allow people to come to their own conclusions regarding the need for environmental measures such as take limits or fisheries replenishment zones.** Providing people with the information they need to come to their own conclusions is the best and most effective approach. Ellyn Tong and the Western Pacific Fisheries Coalition have done an excellent job of this through their series of posters. These posters never tell people what they should do to protect fish. They simply show that fish don't reproduce until a certain size and that they produce more eggs if they are larger. The conclusion to leave small fish and some large fish can be made by people independently. The key is to get enough of these types of messages out that a large-sector of society can make its own conclusions and that these conclusions will help support improvement in the condition of the resource.
- f. Highlight the economic value of marine resource including working with the tourism industry to help them recognize their potential losses as marine resources decline and to increase their demand for improved environmental protection.** Inform the public and decision-makers of the economic value of the intact marine environment to the state. NGO/industry partnerships and private-public partnerships may be a good way to move forward. According to experts there is a need to build up awareness and demand for improved conservation in the tourism industry. If the tourism industry demands greater responsibility in marine management, this may have some impact on creating political will among the state decision-makers. One expert reported an unofficial statistic that up to 15% of tourists on Maui actually left because of the algae bloom. According to the same

expert, the dive industry is reported to have lost significant money due to diminished environmental quality (this report was not verified with the dive industry).

- g. Encourage fishermen to fish responsibly through numerous techniques**
- Conduct and publicize an independent review of fisheries relative to past stock conditions.
 - Highlight and publicize the apprehension and penalties on violators.
 - Provide youth with tools to encourage their parents to fish responsibly.
 - Create awareness whereby peer pressure will help to influence fishing practices.
 - Launch an emotionally appealing public campaign with a well-known and respected Hawaiian figure and with fishermen from many walks of life.
 - Educate judges and prosecutors on the seriousness of marine violations and the existing public demand for adequate punishment.
- h. Publicize assessments of the condition and marine resources in the MHI.** Evoke pride in what Hawai‘i has and concern in how resources are declining.
- i. Utilize existing MMAs and other entry points to the marine environment, such as boat ramps, as effective platforms for marine education through volunteer programs.** Experts have recommended that getting messages through key entry points will enable access to the largest number of people who utilize the marine environment. Boat ramps and county parks were emphasized as key entry points. Likewise, one expert suggested that school groups or others could be stationed at MPAs, such as Pupukeya, on weekends and provide outreach and awareness materials. While it would need to be studied and carefully designed, there is a possibility that these groups could provide surveillance to report on resource violators. The new take size and bag limits may provide an excellent test case for developing a program to expand awareness and better enforce compliance through use of citizen volunteer groups stationed at key MLCD’s and other entry points to the sea.
- j. Support NGOs to work more effectively with the DAR to advocate for successes and progress that is being made:** There is a need to publicize what is working both in Hawai‘i and the rest of the Pacific in terms of coastal and marine management. NGOs can play a key

role in promoting this type of information and to set a foundation for replication of successful approaches.

- k. Develop a Series of Public Meetings to Promote Public Support:** Once some degree of awareness has been raised, a series of public meetings should be held across the state linked to specific environmental initiatives. These meetings could be a tool to galvanize public support. This recommendation was made based on a belief that local communities are the moving force behind conservation initiatives. Local people also need a way to influence decision-makers in their areas. Public meetings could provide communities with an opportunity to speak to legislators and other decision makers about their concerns. For example, public reaction to the Maui algae bloom resulted in improved sewage treatment on Maui.
- l. Hold more discussions about these issues, keeping in mind the recommendations made by various experts that are summarized above.** A small group of key marine conservation organizations could consider discussing a communication strategy, and do so with the advice of a trained public relations expert.
- m. Work strategically with key marine conservation agencies and organizations to build a bridge between different stakeholder groups, including academia, the community, the government, and other interested parties.** A strategy to create more open communication and collaboration should be developed. Again, although the Secretariat for Conservation Biology has initiated this type of activity, experts feel there is more to be done to build these bridges.

This study confirms that the conservation community of Hawai'i is very interested in further developing effective awareness and education strategies. The overall recommendation is:

Develop a targeted working group of relevant actors to develop a comprehensive communications strategy with the assistance of public relations experts who understand the Hawaiian context. Such a strategy should take into consideration all the recommendations summarized above (Note: In late 2001, DAR announced their plans to fund the development of the coral reef component of this strategy. DAR hopes various partner groups will work with them to implement various parts of the strategy).

Initially it's important to keep the group small enough to be workable and expand the group later if needed. One important way to develop such a group and also be careful not to take too much of anyone's time is to form a small committee with a group of advisors that can be brought in on specific issues.

Encourage Comprehensive Marine Ecosystem Planning and Implementation

As noted previously, experts expressed that a major obstacle to the long-term conservation of Hawai‘i’s marine biodiversity is the lack of a comprehensive ecosystem perspective. Experts interviewed have reported that species and site-based management approaches are important, but unlikely to be effective in the long-term. An ecosystem approach takes into consideration the needs of the overall ecosystem including persistence of large enough areas of natural habitats to support viable populations of species, multi-species interactions, outstanding biological phenomenon such as altitudinal movements and migration, and other biological features that are critical to maintaining an intact ecologically viable ecosystem. Conservation actions under this type of management typically include development of a mosaic of interacting protected areas that are large enough to ensure conservation of key features of the overall system (see Box 3 Ecoregion Conservation Approach).

Current Situation

In Hawai‘i, traditional community management techniques followed an ecosystem-oriented approach. They responded to the cycles and fluxes of larger areas of sea and coast and numerous species populations, rather than tracking the population fluxes of any one species. The ahupua‘a approach is a well-known example of how Hawaiian people managed on a more comprehensive ecosystem basis. However, modern management techniques in Hawai‘i, have focused more on individual species management and there are few if any areas across the state that are currently effectively managed with an integrated ecosystem approach.

There have been several attempts to move toward integrated ecosystem management, and state agencies, such as the Division of Aquatic Resources, want to pursue this approach. In interviews for this study, DAR staff identified Marine Protected Areas (MPAs) as one proven way to effectively move toward improved ecosystem management. Complete adoption of this style of management has been constrained by limitations in funding, human resources, public sentiment, and political constraints. These attempts have also been constrained by the perception that ecosystem management is only for the benefit of the biological system, and not for the benefit of people. As a result, experts suggested that any move to ecosystem management must consider biological priorities, human needs, and be accompanied by targeted outreach and education programs. (see Section 1 in this chapter).

One of the primary recommendations of the 1991 Ocean Resources Management Plan (ORMP) was to “Implement a Regional Management Approach” that embodies the concept of integrated ocean and coastal resources management. This recommendation was based on the finding that Hawai‘i’s ocean and coastal management had been “reactive and issue-driven rather than anticipatory” and that management responses had been isolated and relatively ad hoc. While the ORMP laid out a comprehensive and progressive vision for integrated ecosystem-based management, most experts interviewed

felt that the steps to implement this had not been fully put in place, and as a result Hawai'i still does not manage marine resources in an integrated way.

Emerging efforts to manage marine ecosystems in a comprehensive way include attempts to manage larger areas of the nearshore marine environment, and attempts to link land and watershed management to marine management. For example, the Mo'omomi program and the Kona Coast Fisheries Replenishment Areas attempt to manage relatively large marine areas and include consideration of biological needs as a primary management element. However these examples do not include full no-take and comprehensive ecosystem management, as they have not been delineated with all biological features in mind. Experts in the state expressed their feeling that progress is being made in a slow but steady fashion towards no take zones and integrated management on West Hawai'i. It is critical to understand that this process is complex and takes time.

The resurgence of the ahupua'a system has played an important role in promoting ecosystem and landscape/seascape approaches. The government and numerous community groups and NGOs are supporting ahupua'a approaches to watershed management and want to link these efforts to the marine realm, although currently no efforts to do this are fully developed.

Identification of Important Areas for Conservation and Ecosystem Management

According to experts, there have been a number of exercises to identify priority areas for conservation. These include a multi-stakeholder process carried out prior to the initiation of the Hawai'i Coral Reef Initiative (HCRI). Several experts stressed that this consensus-building process was particularly useful at generating an ongoing discussion of priorities. However, this discussion and consultation process was carried out without any long-term funding or staffing and, as a result, tended to break down once HCRI was in full implementation. Experts recommended that efforts to continue this process must be adequately funded to ensure follow-up.

Likewise, NOAA is undertaking a mapping and habitat characterization assessment of all reefs to a depth of 60 feet in the MHI. These GIS driven map products, once completed in about 2004, will replace the Hawai'i Atlas Maps that were originally developed in the 1970s. In addition, there are ongoing efforts by NOAA to map the bathymetry and the coastal and nearshore habitats of the MHI.

The Ocean Summit

Currently, the Coastal Zone Management (CZM) Program of the Department of Business and Economic Development and Tourism (DBEDT) is planning to revise the Ocean Resources Management Plan to "provide a more strategic approach to ocean resource management that coordinates the management of ocean resources by government, private industry, the scientific community, and the public," (Ocean Summit Investigative Subcommittee (OSIS), 2001). A key element of this revision process will be the Ocean Summit, as well as pre-summit and post-summit workshops, that will bring together various ocean-related sectors of government, private industry, the scientific community,

and the public. The Ocean Summit and related workshops will generate amended goals, objectives, priorities, and guidelines to ensure successful implementation of the revised ORMP (OSIS, 2001).

The Ocean Summit intends to:

1. Facilitate integrated ocean and coastal management, including watershed and ahupua'a management
2. Incorporate public input through citizen participation in pre-summit workshops and post-summit focus groups
3. Incorporate elements of pre-existing projects and programs (local and abroad) that have been successful; and
4. Develop strong partnerships in order to successfully complete and implement the updated ORMP. Mechanisms to ensure implementation should be in place before the revision of the ORMP begins. A need to ensure that processes go beyond planning and adequately pursue implementation has been stressed by experts.

In particular, element number one will support the further development of an integrated ecosystem management approach. Number four is important, as the CZM program has no legal mandate to implement resource management. Implementation will depend on partnerships with other agencies and demand from public and private sectors that marine resources be managed appropriately.

Conceptual Recommendations

- a. **Develop a more comprehensive ecosystem-based marine management approach that balances the objectives of various user groups.** Many experts felt maintenance of ecological systems and biological resources should have an equal footing with demands for economic and social uses of marine resources. Currently, social and economic interests outweigh biological interests in resource management decisions. However, the social uses and economic value of marine resources depends on the biological health of those resources. Demonstrating this and reconciling biological needs and human interests is the key to effective long-term ecosystem management.
- b. **Give various interest groups an opportunity to articulate their objectives and share their ideal vision of nearshore marine resources.** By providing different groups an opportunity to articulate their objectives, various interests can be better reconciled, by demonstrating that the needs and interests of all groups are being considered. According to experts with a socioeconomic perspective, attempts to put science and biology before social issues have not, and will not, work. According to experts with a scientific background, identifying important areas for marine conservation based on socioeconomic and other non-biological criteria will dilute biological priorities and set the bar for conservation management artificially low. As a result, one expert recommended that both sets of interest groups be allowed to voice their objectives in a separate but linked process.

- c. **Work with Hawaiian and fishing groups to encourage their support for improved ecosystem management, and provide support for these organizations to enhance ecosystem management.** Many experts said that efforts by conservation organizations or by non-Hawaiians and non-fishermen to promote ecosystem management are likely to be rejected by these groups. As a result, there is a need to support both fishers and Hawaiians who support these efforts.
- d. **Efforts to promote greater ecosystem management must be based on science and accurate information.** Currently several groups are arguing against improved marine resource management, claiming a lack of data to justify a change in policy. As a result, any effort to improve ecosystem management must be supported by accurate information, including information generated by government agencies. This may require the hiring of researchers and technicians to gather and synthesize this information.
- e. **Demonstrate that ecosystem management benefits all stakeholder groups.** A productive ecosystem is the foundation upon which all human uses of natural resources depend. Therefore, it is critical to demonstrate to various stakeholder groups, including fishers that ecosystem management is designed not just to conserve important biological areas, but also to ensure their long-term access to important resources.

The following set of recommendations, based on expert opinion, suggests ways to begin moving toward more integrated ecosystem management.

Specific Recommendations

- a. **Create a task force or working group of key individuals and organizations (with professional facilitation) to focus on biodiversity conservation and ecosystem management.** Experts suggested that there have been many useful group processes on ocean resources management, but some have been constrained by trying to involve too many stakeholder groups. Therefore, experts suggested that smaller task groups be formed on specific issues, such as expanding ecosystem management.
- b. **Continue and/or update the process of identifying important areas for biodiversity conservation and ecosystem management.** Several experts noted a need to build on past efforts when identifying important areas for conservation and develop a science-based ecosystem assessment of priority areas. Some indicated that earlier exercises while very useful, did not include enough input from marine scientists who understand the role particular areas may play in the biodiversity and ecosystem processes of the MHI. Others have suggested that the earlier processes need updating as new threats, such as alien species and major sedimentation, have emerged. Other experts have said that people may be tired of group processes because many of the previous attempts seemed to have little

effect. Agreeing with this, other experts have said the key will be to adequately resource the next steps in this process. Earlier attempts were mostly done on a volunteer basis and, while outstanding, were not able to sustain the level of activity. Experts recommended that this identification/prioritization process should be in parallel process to the ORMP revision. It is important to note that some prioritization is being undertaken as part of a marine GAP analysis that is being launched by DAR.

- c. **Develop a strategic action plan for achieving comprehensive ecosystem management.** It is not possible to adequately pursue effective ecosystem management until there is a clear articulation of priorities, goals, objectives, milestones, and indicators of success in this arena. As a result, several experts recommended that a strategy be developed for more comprehensive ecosystem management. Some referred to it as a plan, while others suggested it is best called an Action Strategy. Experts suggested that this process should be pursued in parallel to the revision of the ORMP. While the revision of the ORMP is a good vehicle for more comprehensive ocean management, it involves a large number of sectors, such as harbors and ocean safety that may not need to be directly involved in the ecosystem management decisions. Therefore experts recommended that a parallel process to identify objectives and criteria, as well as important biological areas, should be pursued.
- d. **Conduct a valuation of the economic and cultural importance of Hawai‘i’s marine natural resources.** More than any other state in the U.S., Hawai‘i depends on its ocean resources for its economic stability. Tourism is Hawai‘i’s largest industry and a very large percentage of these tourists engage in marine-related activities. Many of these activities, such as sport fishing, snorkeling, diving, surfing, beach going, depend directly on healthy coastal and nearshore marine ecosystems. By clearly articulating the economic value of the intact marine environment, the marine resource conservation community will be better armed with convincing arguments for ecosystem management. It should be noted that efforts to economically value coral reefs will be funded by HCRI this year. The principal investigator (Herman Cesar) should be contacted to determine the scope of the study before pursuing additional valuation studies.
- e. **Support the revision of the ORMP.** Link this process to adequate public outreach and awareness building. Create a demand for effective marine resources management and adoption and the full implementation of the ORMP.
- f. **Support community and other attendance at Ocean Summit.** This is a fee-based summit. Fees often dissuade participants who would contribute to and benefit from such an event. A support program for attendance should be developed and highly publicized. It should include grants for travel and accommodations from neighbor islands, and other pacific countries.

- g. **Support efforts on habitat mapping of coastal and nearshore areas around the state.** Work with the Marine Ecosystem GIS Working Group (MEGIS), NOAA, and NOS to do so.
- h. **Through the data synthesis and prioritization process, identify additional needs for biological and socioeconomic research.**
- i. **Assess the current biological, socioeconomic, and political situation of areas that have been identified as high priorities for conservation.**

Create New Marine Protected (Managed) Areas

Overwhelmingly experts interviewed proposed the need for MPAs (also referred to as Marine Managed Areas – MMAs). Many experts cited data from around the world that demonstrates the benefits of “no take” reserves through increases in fish biomass and fish catch, to improvements in live coral cover and biodiversity. One expert stated that the lack of full “no take” zones in Hawai‘i is a major obstacle to long-term, effective management. Still another expert said that we would best serve ourselves, and the next seven generations, if we set aside as many “no take” zones as possible. And yet another expert cited data that indicates partially protected areas in Hawai‘i might actually be in no better shape than completely unprotected areas, because the current protected areas promote access. Other people while supportive of these reserves suggested that the name itself immediately turns people off and therefore must be amended.

Specific Recommendations on MPAs

- a. **Reorganize Marine Protected Areas into uniform divisions so that MLCDs do not run the entire gamut of uses and the public understands the purpose of each MPA.** Currently the MLCDD covers the majority of MPA uses and regulations vary between each MLCDD. As a result, the public may be confused about the purpose of each MLCDD. Experts recommended coming up with a number of MPA designations that more adequately reflect their intended use. Experts felt that current MLCDDs are primarily designed for recreation, not for conservation. According to DAR officials, they have begun this process and will be working throughout the next few years to redo this management framework.
- b. **Increase the number of no-take MPAs to provide for more adequate ecosystem conservation.** As previously mentioned, experts have emphasized the importance of no-take MPAs in the conservation of Hawai‘i’s marine resources. Currently, there are very few no-take MPAs, and as a result almost no areas where natural ecological processes are allowed to occur undisturbed.
- c. **Develop a common language for MPAs in the state that is less threatening to various user groups.** Various terms have been suggested, including Marine Managed Areas, Fishery Replenishment Zones, and others. The key is to use a terminology that does not immediately set interests groups against the initiative.

For the sake of discussion we use the term Marine Managed Area (MMA). This term is now being used in some international discussions on the topic, to indicate that management of these areas may include use, not simply strict protection. Developing appropriate language for designation of MPAs will be part of the DAR process of redoing the MPA management framework.

- d. **Partner with Hawaiian groups and fishing groups to promote the expansion of the State's current system of MMAs.** Several experts said that these groups rather than mainland-based NGOs or the state should be at the forefront of efforts to improve ecosystem management and develop a larger MMA system. However, these groups will need additional support to adequately address these areas.
- e. **Initiate a collaborative process to identify and designate MMAs that serve an ecosystem management role.** Tie this specifically to efforts recommended above to identify which areas are critical to conserving the marine resources of the MHI.
- f. **Support the creation of a Marine Managed Area Unit within the DAR and support the planned DAR process to improve MMA management in the state.**
- g. **Undertake a Marine Managed Area Gap Analysis to investigate how adequate the current marine management regime is in meeting the needs in ecosystem management.** Please note that the DAR is initiating this program with funding and support from NOAA's NMFS. Year one funding will hire a gap analysis coordinator to design the approaches and to do an inventory of current MPAs.
- h. **Investigate the legal and financial possibility of creating a Learning Reserve or a network of learning reserves across the MHI.** One expert involved in marine education suggested setting aside areas as learning reserves for the education of children and others. This would be an excellent way to simultaneously achieve the comprehensive conservation of an area, and the education of the local community.
- i. **Investigate the feasibility of creating more community-based MMAs, such as Mo'omomi and Kaho'olawe.** Given the success to date in community-based/multi-stakeholder management at Mo'omomi and Kaho'olawe, it would be very useful to investigate the feasibility of expanding techniques from these models to other places throughout the state. If it proves to be an applicable model for other places, it would be important to adequately support efforts to replicate parts of this model in other areas. DAR officials have pointed out that management that is exclusively community-based is not possible given the state's regulatory system; however, joint efforts between multiple stakeholders including agencies and communities is possible.

- j. Adequately study the economic and biological value of MMAs.** HCRI will sponsor efforts this year to better understand the economic value of coral reefs in the state. Experts suggested that there is also a need to better understand the economic and biological value of MMAs. Other experts have emphasized the need to focus on using results from these and previous studies to secure more MMAs in the state.
- k. Link all efforts to enhance MMAs to strategic public relations and awareness raising efforts.** This includes raising awareness of the value of MMAs to key sectors of society including the government, the fishing community, the tourism sector, and the public at large.
- l. Study the role of large artificial reefs in providing ecosystem benefits, such as protection of populations of multi-species and their interactions.** One expert suggested that large artificial reefs might create natural refuges for large fish, because fishermen can't get to the fish in the interior of the artificial reefs. The expert also suggested that reseeded coral could create a thriving ecosystem that would be acceptable to fishermen, because they could still fish on them. Several other experts; however, emphasized that there is an ongoing debate about the benefits of artificial reefs. Some experts suggest that artificial reefs act as fish aggregating devices that draw fish from other areas and can therefore subject fisheries to greater impacts as fisherman target these reefs. The take home message from experts, is that artificial reefs have a potential role in reef management but this role must be carefully discussed, designed, and studied before they are applied as a management tool.

Box 3 The Ecoregion/Ecosystem Conservation Approach

In recent years, a number of major conservation organizations including the World Wildlife Fund, The Nature Conservancy, and the World Conservation Union have increasingly recommended scaling up conservation efforts to protect larger integrated ecosystems. Historically conservation has focused on specific sites for protection and these are rarely larger than individual national parks or MPAs. Conservationists feel these approaches are not enough however, to protect a representative complement of the world's outstanding biodiversity. We must collectively move behind these site-based approaches and protect ever-larger areas in a biologically logical way that ensures that important species, habitats, ecosystem processes, and other features are not lost. These larger areas are referred to as ecoregions and are delineated by biologically distinct and interdependent habitats and species assemblages. Through rigorous scientific analysis, Conservation Biologists have identified a large number (hundreds) of ecoregions across the world. Examples include the Galapagos Islands, the Chihuahuan Desert in Mexico and the U.S., the Bering Sea, between Russia and Alaska, and many others. Due to its isolation, Hawai'i's marine realm has been identified as a distinct ecoregion and conservation priority.

Now that a large number of the world's high conservation priority ecoregions have been identified, conservation scientists felt we must establish a methodology to conserve these large areas. Recognizing we cannot conserve everything in such vast areas (for example, the Chihuahuan Desert includes several large towns and cities as does Hawai'i's marine ecoregion), a methodology was developed to identify which areas within an ecoregion must be protected to maintain the biological character of the system overall. The goal of this Ecoregion Conservation approach is to protect a biologically logical mosaic of important places that will include a representative set of the species, habitats, unique biological phenomenon, ecosystems processes of an ecoregion. By establishing such a mosaic of protection we can be sure that no key element of the system overall is lost and as a result fifty, one hundred, or even one thousand years from now ecoregions that are conserved through this approach should continue to be ecologically viable and maintain the biodiversity that made them so distinct to begin with. Putting this theory into practice is extremely challenging given competing human interests; however conservationists feel it will be necessary or we will continue to lose our outstanding natural heritage.

The process to conserve an ecoregion includes:

1. **Prioritization of Important Conservation Areas through an Ecosystem Approach:** An ecosystem approach takes into consideration the needs of the ecoregion/ecosystem (its processes, habitats, and species) overall.

This prioritization is guided by the basic goals of conservation biology. These include:

- Conserving areas that represent the full range of habitats and ecosystems
 - Maintaining viable populations of key species
 - Protection areas large enough to ensure resilience to stochastic events, such as cyclones, bleaching events, earthquakes etc.
2. **Analysis of Threats, Socioeconomic and Political Feasibility, and Obstacles to and Opportunities for Conservation:** Conservation dollars are unfortunately limited. As a result, we must utilize them where we feel they will be most effective. To do this, conservationists want to have a good understanding of the degree of threat to any one priority area and the feasibility of making conservation work. For that reason, we must carefully analyze the socioeconomic and political situation across the landscape of priority conservation areas and develop our strategies keeping in mind any obstacles to and opportunities for effective conservation.
 3. **Development and Implementation of a Collective Conservation and Management Strategy:** Once the priority conservation areas of an ecoregion have been identified, and the socioeconomic aspects have been assessed, a collective conservation and management strategy can be developed and implemented. This strategy should set the road map for the collective action by a large suite of actors to effectively conserve high priority areas over time.

Hawai'i has never gone through such a process for the marine realm and many experts have recommended that some contextually appropriate variation on this approach be pursued.

Improve Communications and Collaboration among Stakeholder Groups

An obstacle mentioned by several experts is the limited communication and coordination both within and between, the various agencies and organizations involved in marine management. Many initiatives have required a high degree of coordination, such as the development of the ORMP and the identification of important areas for conservation. While experts cited satisfaction with many of these processes, they also cited a lack of consistent communication and collaboration as a concern. Given the limited amount of funds available in the state for marine conservation, some experts felt more collaboration could help to increase the efficiency and efficacy of marine management actions.

Current Situation

Recognizing the general interest among the marine management community for increased communication and collaboration, the Secretariat for Conservation Biology at the University of Hawai'i successfully secured private foundation funding to help enhance coordination and communication on marine management activities. The Secretariat has formed an interim steering committee and is currently developing a strategy for increased information exchange and collaboration between agencies and organizations that have an interest in Hawai'i's marine resources.

Steps in this process will include: An Inventory of All Current Activities; Design for a Communications Network; Develop a Strategic Plan for a Communications/Collaboration Network (focused on managing information); Develop Proposals to Implement the Plan; Outline Priority Issues for Research and Action in Marine Management.

Recommendations

- a. Capture lessons learned from previous collaborative efforts for marine and coastal management in Hawai'i.** To be successful, many of this study's recommendations require collaborative efforts between the major stakeholder groups in marine conservation. As a result, we recommend a short review of previous collaborative efforts in marine conservation in Hawai'i. A few simple lessons learned from earlier attempts to collaborate, suggest that collaboration appears to work best if:

- Participants see a clear benefit to the collaboration, and can do their job better as a result of the collaboration.
- Participants recognize a clear benefit to conservation. While an improved ability to do one's job is critical, to remain motivated participants must feel the collaboration will create results that exceed the outcomes the individual agencies would achieve independently.
- Participants appear to respond best to collaborative efforts if they are specific, and roles and responsibilities are somewhat predictable.

In areas where the need for collaboration is open-ended, collaborative activities should not be fully dependent on securing outside resources. These resources may be a long time in coming or may never become available. If the collaborators can find some means by which they can work together using existing resources, this is generally more effective.

- b. Support and participate in efforts by the Secretariat for Conservation Biology to improve communication and collaboration.** The group sponsored by the Secretariat for Conservation Biology has made some progress in initiating a communication network. While the broad spectrum of stakeholders in marine resources is not yet represented in the process, the initiative intends to do all that it can to be inclusive.

Within this context, the following additional initiatives to increase collaboration were recommended by experts.

- A daily email listserver (modeled after the coral list serve) that will help to increase communication and exchange of ideas on marine issues in Hawai‘i.
- A quarterly newsletter or supplement on the state of Hawai‘i’s marine resources and current efforts to effectively manage these resources.
- Periodic topical meetings on particular conservation and management strategies including participation of other Pacific Islanders. At least two experts interviewed suggested that the people of Hawai‘i would be well served by increasingly looking to the rest of the Pacific to learn and share about resource management. The biannual Aquatics Conference has highlighting the status of Hawai‘i’s marine resources, and also exposes the Hawai‘i community to experiences in other countries.

Build Capacity for Effective Long-Term Resource Management

Capacity building is a broad and crosscutting topic that spans all aspects of natural resources management. For the purposes of this study we defined capacity building as any effort to create a set of skills or abilities that enables an individual, organization, or stakeholder group to be more effective at natural resources management. Under this broad definition, capacity building activities can range from the short term, such as supporting attendance at a workshop, to the long-term, such as supporting students pursuing graduate training in natural resource management.

With this as background, the study asked a broad range of stakeholders what they feel should be pursued to build capacity for more effective management of Hawai‘i’s nearshore marine and coastal resources. Some recommendations for skill building are discussed in previous chapters. However, recommendations specific to building institutional capacity across a range of conservation activity areas are discussed below.

Current Situation

According to experts, the current situation in the state is one of extremely limited capacity to adequately address the needs of marine conservation and management.

Specific Capacity Limitations at the State Government Level

- a. DAR has an annual budget of \$5 million, and is not able to fund all of the positions it needs to manage marine resources adequately. According to a senior DAR official, DAR would like to create the following positions: Community Outreach Coordinator, Marine Protected Areas Coordinator, Endangered Species Specialist, Alien Species Coordinator, and Human Dimensions Coordinator. There is also a need for greater GIS and data basing capacity, an increased number of biologists including experts in alga, fish, and invertebrates, and more activity coordinators on each island.
- b. DAR does not have a strategic plan or biologically-based objectives and targets. DAR did develop a vision of what it would like to pursue, but discovered this would require twice their current budget.
- c. When strategic plans have been developed, numerous sets of constraints and obstacles, including lack of staff and financial resources, generally result in the plans not being fully implemented.
- d. The existing Ocean Resource Management Plan (ORMP) does not include targets or indicators that are biological in nature, but primarily focuses on process targets and activities. This plan also has no indicators of success. As a result, there is no way to determine if the plan is achieving its goals. Finally, the plan does not carry the force of law and, therefore, has never been implemented. The plan is also so comprehensive in nature that it does not provide sufficient detail on biological and ecosystem concerns.
- e. There is no effective mechanism for communication or coordination between government agencies with overlapping jurisdictions.
- f. A combination of factors including financial limitations and capacity issues make it difficult to find and retain highly trained staff. This limits the agencies' abilities to be as effective as possible.
- g. Opportunities for staff training and professional enhancement are limited by financial resources and, in some cases, by attitudes.

Capacity Limitations Emphasized at the Non-Government Level

- a. NGOs are constrained by limited staff and financial resources. One organization interviewed, felt their limited ability to raise funds was directly related to the

limitations of their staff and board. They felt they needed to hire new staff to guide the organization strategically, while also helping them to raise funds.

- b. NGO boards are not well equipped and often do not fully understand their roles.
- c. Burnout is highly likely for the staff of many small NGOs. In these organizations, staff serves a wide range of functions from programmatic, to community outreach, to administration, accounting, and fundraising. Many small NGOs have only one or two full-time staff, and it is extraordinarily difficult for any one person to maintain work in all these areas.
- d. Time constraints make it extremely difficult to train people to work more effectively. Also, annual funding cycles often mean that staff can only be brought on for a year, making it difficult to invest in training.
- e. Many small NGOs are formed by concerned citizens around specific issues. Some may go dormant or disappear if the issue is addressed or if the lead individuals burn out or refocus on other issues in their lives. However, in many cases, particularly in legal battles, the issues may go on for years and years. Many NGO staff work other jobs, and find it difficult to continue addressing their original objectives over many years.

NGOs identified through this study that are working on marine conservation issues in the MHI include:

- **KAHEA** - KAHEA is a new NGO that has focused most of its marine attention on the Northwestern Hawaiian Islands, but is pursuing some projects in the MHI and has plans to further develop its portfolio in the MHI.
- **Western Pacific Fisheries Coalition** (Organized by the Hawai'i Audubon Society) - The Coalition raises awareness and advocates for fisheries issues, such as shark fining. Upcoming efforts include advocacy for fishery management in the nearshore environment in the MHI. The Coalition also organizes a biannual Aquatics Conference (held in November of this year).
- **National Audubon Society** - National Audubon has a representative from the Living Oceans Program in the state. To date their program has focused primarily on pelagic fisheries and seabird by-catch issues.
- **Sierra Club** – Sierra Club supports marine conservation through one coral reef volunteer, who also represents Reef Check in the state. The Sierra Club has a grassroots volunteer network that can be organized both for advocacy and volunteer environmental activities.
- **Earthjustice Legal Defense Fund** - ELDF focuses its efforts on legal aspects of environmental conservation. They litigate against entities that do not comply sufficiently with environmental regulations. They provide an excellent vehicle to pursue legal sanctions against environmental abuses.

- **The Nature Conservancy** –To date, TNC has focused primarily on terrestrial conservation. In 2001, TNC is working to develop a Hawai‘i Marine Conservation Program.
- **The International Marinelife Alliance** - IMA has built its program and strong reputation in Southeast Asia and the Pacific addressing destructive fishing practices and the live fish trade. IMA has recently opened an office in Hawai‘i and may work on Hawai‘i issues.
- **Environmental Defense Fund** - Environmental Defense Fund (EDF) has one staff devoting some portion of her time to advocacy on Hawai‘i environmental issues.
- **The Oceanic Institute** - The Oceanic Institute (OI) has one researcher that devotes a large amount of his time to conservation and conservation-related research in the MHI. The Oceanic Institute is a non-traditional NGO that focuses on aquaculture research.
- **The Social Science Research Institute of the University of Hawai‘i** - The SSRI has staff that oversees the HCRI program and can provide consulting services to support marine conservation in the MHI. Please note the SSRI is a program of the University of Hawai‘i and therefore has a government affiliation.
- **The Heritage Program** - The Heritage Program has not historically devoted much time to marine and coastal issues, but has both data and expertise to support efforts in this area on a contract basis. With support from DAR, the Heritage Program has recently hired a staff member to coordinate a Marine GAP Analysis to compliment the ongoing terrestrial GAP analysis.
- **The Waikiki Aquarium** - The Waikiki Aquarium has both an active research program that focuses considerable attention on conservation related research in the MHI, and a marine education program that reaches a high percentage of school children on the island of O‘ahu.
- **The Polynesian Voyaging Society** (Ocean Learning Center) - PVS is currently establishing an Ocean Learning Center that will develop a comprehensive marine education curriculum.
- **Hawai‘i Wildlife Fund:** supports various marine life research projects, coordinates a volunteer turtle monitoring program and trains marine naturalists.
- **Hui Malama O Mo‘omomi:** The Hui has focused its attention on the community-based management of the marine resources of Mo‘omomi, a coastal area on West Molokai (see Box 4).
- **The Ocean Conservancy:** The Ocean Conservancy (formally the Center for Marine Conservation) has launched a campaign known as the Ocean Wilderness Challenge and seeks to protect 5% of U.S. oceans as wilderness. Protection of the Northwestern Hawaiian Islands is one target of this campaign.
- **The Bishop Museum:** is involved in several aspects of marine conservation in the state, including surveys, documentation, collection, and display of marine biodiversity; research on alien species; research on coral disease; research on marine ecosystems; and many other topics. Also, the Bishop Museum is a consistent supporter of symposia and working meetings on marine conservation issues in the state.

- **The West Hawai‘i Fisheries Council:** This council is a community-based group that was set up to address concerns regarding aquarium fishing on the West Hawai‘i Coast. In 1999, this council recommended nine Fishery Replenishment Areas along this coastline that prohibit aquarium fish collecting in 35% of the coast. This fishery management plan has been approved by Governor Cayetano, and the FRAs officially became closed to aquarium collecting on January 1, 2000.
- **Reef Check:** Reef Check organizes a volunteer citizen reef-monitoring program. The reef check methodology is in use around the world and more twenty-five sites are regularly monitored in Hawai‘i.

We apologize if any descriptions are inaccurate or if we have missed any important groups and will gladly update this list based on your comments.

Recommended Activities to Build Capacity for Long-Term Conservation Impact

Focal Areas for Conservation Capacity Building

Experts have cited a wide range of areas where skills and competencies need to be built to be more effective at conservation management. Their recommendations include:

- Hold an NGO brainstorming session to discuss the institutional capacity needs of local organizations.** Many local organizations suffer from similar constraints, such as challenges in strategic planning, fundraising, administration, board relations and responsibility, and many others. This input can then be used to develop mechanisms to support NGO capacity strengthening in the state. A recent conservation leadership workshop helped to serve this role for a number of NGOs in the state.
- Develop mechanisms to support capacity building for organizational development.** To address current capacity limitations in NGOs and grassroots groups, it was recommended that some sort of facility be established to provide institutional development support and skill strengthening for NGOs. This program would assist local NGOs and grassroots groups to develop particular skills, such as fundraising, board development, and accounting.
- Support DAR to increase their ability to more effectively manage biodiversity and natural resources.** According to the DAR, a number of programmatic needs are not being served due to staff and financial constraints. DAR also does not have a strategic plan or clear biological objectives and indicators for their programs. Given DAR’s critical position and mandate, this agency must have sufficient capacity to do its job properly if we want the condition of marine resources to improve. Experts suggested supporting DAR through a multi-tiered effort that includes strategic planning and goal setting, support to key positions, and creating public demand for increased funding for marine and aquatics management. Others have suggested that the DAR lacks internal support for enhanced strategic planning.

Because the State is not able to completely perform the tasks of its mandate, the private sector can help to fund key positions. However, this should be an interim arrangement and efforts to increase DAR funding should come directly from the public and industry, as awareness of needs in marine management grows.

DAR specifically highlighted the following positions that can be funded by the private sector. Each position should have an accompanying program with staff and resources:

- Threatened and Endangered Species Coordinator
- Community Affairs Coordinator
- Alien and Invasive Species Coordinator
- Marine Managed Area Coordinator
- Human Dimensions Coordinator

Many other states have programs that focus on the human dimensions of resource management. However, DAR has no staff to focus on this area. Conflicts between DAR and the public have been common over the years and could have been more effectively dealt with, or perhaps prevented, had DAR had staff to support information, education, and community affairs. Experts noted however, that improving DAR's public relations should not become a substitute for improving the efficacy of DAR's management, and other aspects critical to its operation and the effective management of Hawai'i's marine resources.

- d. Strengthen enforcement capacity.** According to many experts interviewed, the State's current enforcement capacity is extremely limited. There is a need for increased funding for aquatic enforcement, which requires in part, public demand for effective enforcement. Some experts indicated that current natural resource enforcement is not focused on aquatic issues. They recommended the creation of an enforcement group dedicated exclusively to aquatic issues. Likewise, it was suggested that penalties need to be stronger, and that fines should not go to the general treasury, but should go to enforcement and management. Training public groups to assist with surveillance may also be an effective tool.
- e. Build community capacity to participate effectively in resource management.** According to experts there are numerous communities across the state that want to protect marine resources in their local areas, however they are constrained by many factors, including limited resources, limited knowledge of how to organize themselves, and limited time to work on issues. Experts recommended providing these groups with institutional, financial and programmatic expertise. Some experts suggested funding a single group that could work with and fund local groups, while others recommended funding each group independently. Another recommendation was to develop community or regional task forces to undertake monitoring, surveillance, public education and environmental advocacy. While supporting improved management, these groups could also bring an intimate knowledge of local areas to the professional conservationists.

- f. **Educate judges and prosecutors as to the importance of marine management and the need for stricter penalties.** Many experts cited limited penalties for environmental violations as a major constraint to effective deterrence. Other experts cited the large number of environmental violations that go on in the state regularly, but that are never reported, much less prosecuted. Those that are prosecuted often do not receive harsh enough penalties to deter further violations. As a result, there is a serious need to educate judges about the importance of environmental management, and the need to levy stiff penalties.
- g. **Support student training and internship programs.** Students are not only important resource users, but can also be excellent stewards. Currently, the marine conservation community has very few human resources. Building a cadre of well-trained students who are motivated to work on marine resource conservation is an excellent means to create more capacity in the state. Of course such an initiative must also be accompanied by growth in the NGO and public sectors, in order to eventually provide meaningful employment for these students. Supporting an internship program at the high school, college, and graduate levels is an excellent way to create support for immediate efforts, and to build long-term capacity for the conservation movement in the state.
- h. **Develop a marine conservation scholars/fellows program for Hawaiians.** Experts also noted that a lack of people of Hawaiian ancestry working in marine management and conservation. Several experts suggested establishing some sort of program to enable Hawaiians to bring their skills to bear on marine resource management, and to learn more about marine conservation.

Address Alien and Invasive Species

As discussed in Chapter 2, invasive and alien species are a recently identified but significant threat to Hawai‘i’s nearshore marine ecosystems. In some areas, alien algae is so widespread that ecosystems have experienced complete phase shifts from coral dominated systems to systems dominated by one or a few species of algae. In other areas, exotic fish species may be out-competing native species, potentially leading to the extirpation of native species. Experts emphasized the need to better understand and address alien species. Most experts focused their attention on alien algae during interviews, however, there is a need to better understand and address all alien aquatic life.

Current Situation

There have been a number of studies on alien species in the MHI. A partnership program between the University of Hawai‘i, the Waikiki Aquarium, and the Hawai‘i Institute of Marine Biology (HIMB) has worked to identify the distribution of alien algae in the MHI. The partnership is initiating studies to experiment with eradication methods for 5 species of algae. Efforts by the Bishop Museum have focused on a better understanding of alien sponges, invertebrates, and shipping as an entry point for alien species. Other efforts not identified by this study may also be ongoing or planned.

While these research efforts have made progress in understanding alien and invasive species, experts stressed that there is a dearth of information on alien aquatic species. This includes which species have been introduced, the causes of alien and native species outbreaks, the current distribution of these species, the ecology of alien and invasive species, and the relationship between alien, invasive, and native species. Currently, the majority of funds for alien species work support identification and research, not management. There is also insufficient funding for the monitoring of new introductions.

Currently, the primary activity on alien species is carried out by a handful of researchers at UH, HIMB, the Waikiki Aquarium, and the Bishop Museum that, in collaboration with DAR, are trying to research and develop management techniques for these species.

Likewise, there is a partnership between the USFWS, DAR, and others, such as the University of Hawai'i, the Bishop Museum, and the Waikiki Aquarium, to develop management strategies for alien algae.

According to some experts there was an earlier process to address alien species through the Alien Species Task Force, which involved a representative set of stakeholders. However, this task force was focused primarily on terrestrial species, not aquatic species.

Some experts feel that the recognition of the problem and the increased action and resources may enable the conservation community to adequately manage for alien and invasive species expansion (at least in the case of algae). Fortunately, many algae species remain isolated in Kane'ohe Bay or in West Maui, and have thus far not spread to other islands. If mechanisms for eradication can be developed quickly enough, this may enable managers to eliminate or control the alien alga in Kane'ohe Bay, preventing further expansion of their populations.

There is less activity focused on alien invertebrates and vertebrate species, including mollusks and fish species. These species have not yet caused large visible impacts, such as the algae blooms of West Maui, and therefore may garner less attention. However, the resource management community of the state is well aware of the potentially devastating impact these species could have and would devote attention to these issues if resources were available.

Recommendations

- a. **Support and expand studies on eradication methods.** Studies on eradication will be funded by the HCRI this year. However, elements of these studies are insufficiently funded.
- b. **Raise the profile of alien species issues with state and federal decision makers:** There is a lack of understanding of the potentially devastating economic and biological impacts of these species. Awareness must be raised to ensure more attention and funding from decision-making bodies.

- c. **Once effective eradication methods are understood, support implementation of these approaches.** Again, this must be carefully controlled as algae can reproduce by fragmentation and therefore control and caution are immensely important in any eradication effort.
- d. **Support studies on the relationship between alien algae spread and land features, such as geography, development, nutrient sources, and other land-based features.** At this point, experts believe land-based sources of nutrient are a major contributing factor in the expansion of alien algae. However, it is important to do studies that can determine the relationship between land-based features and algae outbreaks in the state.
- e. **Support studies on the relationship between herbivory and algae spread.** Another cause of the spread of both alien and native invasive algae is a reduction in herbivorous fish populations as a result of fishing pressure. To better understand how to manage alien algae, it is important to understand the role of herbivory in the control or release of certain species.
- f. **Develop a comprehensive multi-stakeholder strategy to address alien and invasive species.** There has not been an effort to bring together all relevant stakeholders to develop a strategy to address these issues over the long-term. Given the complex nature of alien and invasive issues, and the multiple agencies involved in prevention and management, many experts suggested the development of a collaborative public-private partnership. Several experts emphasized the importance of the marine alien species plan currently being prepared by the State. This will focus State efforts on marine alien species, and open up the possibility of federal funding for marine alien species issues.
- g. **Create a stronger linkage between the agencies involved in the introduction and spread of alien species.** The Department of Agriculture regulates legal introductions, while the Division of Aquatic Resources is tasked with managing against invasive species (alien or native), and the Department of Health is responsible for the management of water quality (which is believed to be in part responsible for outbreaks of alien species, particularly algae). Improved communication should be part of the effort to develop a comprehensive multi-stakeholder strategy for more effective alien and invasive species management.
- h. **Conduct additional surveys and follow-up surveys to understand the distribution of alien species, particularly in high priority environments such as intact reefs.** Several surveys have been undertaken at different sites around the MHI. However, many areas remain under-surveyed, while still other important marine sites need to be resurveyed. For example, Kaho‘olawe was surveyed in 1988, nearly 4 years ago. Given that early detection is a key to protection, important areas such as Kaho‘olawe, Lana‘i, Molokai, and others

with intact natural communities should be resurveyed regularly to ensure no new introductions and no invasions by existing or native species.

- i. **Organize communities in key areas around the state to take on monitoring for new introductions.** Given the difficulty and expense of mounting full-time monitoring in all parts of the MHI, local communities can act as an important early warning system. Through existing mechanisms, like Reef Check and other community organizing groups, local communities can be organized to monitor for alien species and native species invasions in several areas around the MHI.
- j. **Maintain natural populations of grazing fish to combat algae outbreaks.** Several experts stated that depletion of herbivorous fish is one of the main contributing factors to outbreaks of alien or native algae. As a result, maintaining natural populations of these grazers will be a key to effective management and control of alien algae. This will be particularly important in areas that have other contributing factors such as high nutrient loads, and in important habitat areas where alien algae would be devastating. Molokai, Kaho‘olawe, Lana‘i, Ni‘ihau, and Kaua‘i are all important places to ensure that herbivorous fish populations remain healthy, as these places still maintain healthy reef systems that would be deeply impacted by alien algae outbreaks.
- k. **Support scholarships and post-graduate training for algal ecologists, phycologists and taxonomists who can work on alien species issues.** There are very few adequately trained phycologists or taxonomists in the state. Therefore, a program to train individuals in these fields is an important step in early identification of alien species.
- l. **Undertake thorough surveys of marine ecosystems to understand the distribution of both native and alien species.** Experts suggested devoting more time and funding to surveys and collections of marine species (both native and alien) to help further understand the full suite and the distribution of species present in the state. Experts believe that nowhere near the full complement of Hawai‘i’s marine biodiversity has been surveyed or collected. These efforts will help to establish a baseline understanding of the biodiversity of the state from which to monitor change over time.
- m. **Develop capacity to limit introductions by hull fouling and ballast water.** Currently, there is little regulation controlling the introduction of alien species through hull fouling or ballast water. Likewise, there is little capacity to adequately inspect and enforce existing regulations. As a result, vessels carrying alien species regularly dock and exchange ballast in Hawai‘i’s nearshore waters. A strategy to address these threats should be developed, and communication between various regulatory agencies should be strengthened.

Expand Community-Based Marine Management Including the Documentation and Application of Indigenous Knowledge

Several experts suggested that local communities are a overlooked resource in terms of coastal and nearshore management. There are currently, only a few examples of community-based natural resource management in the state. The Mo‘omomi case was cited by several people as an important example, while Limahuli on Kaua‘i is another example that experts say offers promise. Likewise, many experts expressed that the critical knowledge of fishermen and others is being lost as people are growing older. As a result, many people interviewed recommended that there must be efforts made to document this knowledge and pass it on to younger generations. Many experts cited examples of community-based management that depend in part on traditional knowledge to promote marine resource management.

Current Situation

Western/modern resource management regimes view resources very differently than traditional systems. Under western/modern systems species-specific resource management is the norm, focusing on how many fish or how much of a particular resource can be extracted. Traditional resources management regimes in Hawai‘i tended to focus more on identifying times and places that fishing could [and could not] occur so fishing would not disrupt biological processes and habitats. Likewise, traditional management includes human beings as an integral part of the ecosystem and its functioning, where as western/modern management tends to separate humans from the environment under management.

Traditional systems of management are more in tune with the natural rhythms of the coral reef ecosystem than modern approaches, and should be revived wherever possible. This is the result of the intimacy that local communities have had with the marine realm. Modern techniques have focused more on generalizations and single species management, and do not as accurately reflect or protect the natural rhythms of a marine area. Hawai‘i is constrained by the difficulty of effectively reconciling modern management and economics with traditional management approaches. However, there is evidence that traditional systems can be combined with Western strategies such as “no take,” or temporal closures as a way of integrating traditional and modern knowledge.

The Mo‘omomi Demonstration Project has successfully applied traditional knowledge to effective management of an ecosystem and its resources on Molokai (see Box 4). Much can be learned from this project in an attempt to conserve Hawai‘i’s natural resources. Given the political and financial constraints associated with starting new MPAs, it may be useful to consider the community model as a starting point for marine ecosystem protection. Mo‘omomi is a rare case where several important factors led to its success. However, experts suggest that Hawai‘i’s natural resources managers must take it upon themselves to investigate other communities where elements of this model may be applicable. According to the State, there is some disagreement about whether a community from a particular area has jurisdiction of the marine resources adjacent to that area. As a result, the State has indicated that community-based management may not be

a universally applicable approach to marine conservation such as the Mo'omomi case, but these seem to be effective. As a result, experts recommended investigating the positive and negative elements of these examples and investigating the feasibility of replicating these examples or elements thereof in new areas.

There are several publications that have recorded traditional Hawaiian knowledge on marine resources management. However, there remains a vast body of knowledge in the minds of older Hawaiians that will soon be lost if not recorded. The recording of traditional knowledge is important both for historical purposes and to inspire Hawaiians of all ages to take a more active interest and role in resources management. Application of traditional resource management in combination with western/modern techniques is a promising way to enhance resources stewardship.

Recommendations

- a. **Assess the positive and negative aspects of community-based marine management, and the feasibility of expanding these approaches to other sites.** Most experts interviewed felt the Mo'omomi case and other similar efforts are very positive and effective for marine conservation. Others, particularly officials with the State, were not yet convinced of the applicability and legality of this approach. As a result, it is recommended that this approach be thoroughly assessed through a collaborative effort that involves the State and NGOs, both from a legal and efficacy standpoint. The feasibility of expanding this approach to new areas will depend largely on the participation of the State, NGOs, and community members.
- b. **Create a cadre of technically experienced community outreach workers to help new communities initiate and maintain conservation efforts.** Experts recommend creating a cadre of technically experienced community outreach workers to facilitate community-based conservation. Few experts are trained to initiate and facilitate community-based conservation efforts and there is relatively little capacity in this area in the state. As a result, outside training by specialists may be necessary to help this cadre of people build the necessary skills in community entry, community-based conservation, monitoring and evaluation, and other aspects needed to replicate these models in new areas.
- c. **Learn lessons and apply them from community-based conservation efforts in other parts of the Pacific where more traditional management may be more applicable.** There is more experience with and capacity for community-based conservation in the Pacific, than there is in Hawai'i. While the political and economic context of Hawai'i is very different from the rest of the Pacific, there are many lessons that can be learned and applied from other Pacific Islands.
- d. **Initiate an effort to document traditional knowledge of fishing and other marine resource management techniques.** Suggestions included making video interviews of fishers, writing journals, and producing television documentaries.

Likewise, one expert recommended the creation of a learning reserve where young people would learn traditional marine lore, fishing techniques, and other important elements of traditional knowledge. This would provide an excellent venue for the collection and documentation of indigenous knowledge as well as the sharing of it with younger generations. The documentation of this information could help to inform outreach, education, and public awareness.

Effectively Manage Nearshore Commercial and Recreational Fishing

Overfishing and the use of gear types that are destructive or facilitate overfishing (such as gill nets and spear fishing on SCUBA) were cited by many experts as major problems. Strategies to address fishing as a threat to marine species and ecosystems must be carefully developed as there are strong interest groups who support unregulated fishing in the state. It is important that fishing interests be brought into the circle of organizations and individuals who support more effective fisheries management.

Current Status

Most fishermen now recognize that there are problems and that the fishing is no longer as good as it used to be. Much more effort is now required to catch the same or smaller amount of fish.

According to experts who spend a significant amount of time fishing, and previously or currently fish commercially, there is a bell curve of opinions. A relatively small number of fishermen on one end of the curve say that there are no problems with fisheries stocks, and that there are still plenty of fish. Others at the far end of the spectrum will say that the fish populations are heavily depleted, and we must take action right away to prevent further degradation. The majority however feels that there has been a decline in fish populations. Many say that although it's not as easy to get fish as it used to be, they can still get all the fish they need by going to different areas. These fishermen are likely to believe that some management should occur, but do not feel that we are in a crisis mode.

Current efforts to more effectively manage fishing include the DAR's recently released revisions to the state's fisheries regulations. These updated regulations more adequately address the biological needs of the species that are under regulation. For example, under the new regulations, moi (pacific threadfin) could only be caught and kept once it's 11 inches. Previously, moi could be caught at 7 inches. However, the fish does not change sex until it is 11 inches. The new regulation takes the biology of the fish into account and is therefore much more appropriate. The key will be successfully keeping this and other regulations and communicating these new regulations and the reasons for their enactment to as many people as possible so people are aware of the change and can comply. Surveys of recreational catch in the past have shown that a significant portion of fish being caught are far below the minimum size regulation, which in turn is far below the minimum size for reproduction (Birkeland and Friedlander, 2001). As a result, finding a way to get fishers to comply with the new more biologically appropriate minimum size limits will be critical to the long-term persistence of target species.

A Gill Net Task Force has also recently developed updated guidelines for the use of gill nets. These include restrictions of the length of the net, the time the net can be down and how often it must be checked. Some experts interviewed were happy with these new regulations and feel the key to making them effective is educating people about them and enforcing them. Other experts are not satisfied with these new regulations and feel more stringent measures on gill nets are necessary.

As has been mentioned in the study, currently there are no recreational fishing licenses in the state. As a result, there is no way for DAR to know exactly how many people fish recreationally or how many and what kind of fish recreational fishers catch. As a result, it is impossible for DAR to adequately manage recreational fishing. With the support of NOAA, the DAR is currently launching an effort to survey recreational fishers about their effort and catch.

Conceptual Recommendations:

- a. **Manage fishing based on the biological needs of the resource including multi-species interactions and Ecosystem Dynamics:** While there are increasing signs that DAR is working to manage fisheries based on biological needs, there is a long way to go to ensure that the biology of target species, their habitats, and the ecosystem overall is adequately considered in fisheries management decisions. We need not reiterate the points made earlier in the ecosystem management section of the study, but it is important to note that a large number of the experts interviewed stressed these points.
- b. **Work with fishers to help them meet their needs while demonstrating that fisheries conservation is in their best interest:** A large number of people in the state fish regularly and many include wild caught fish in some portion of their diet. While many fishers suggest that there is not a problem with fish populations, a greater number of fishers recognize the decline in fishery resources and would like to do something about it. Understanding the needs and desire of these individuals as well as the broad spectrum of fishers will be critical to conserving the resource. It is critical to help fishers come to the conclusion that their fishing future is dependent on conservation and resource management measures today.

Specific Recommendations:

- a. **Launch an effort to adequately address destructive fishing gear types.** The most common recommendation is to aim for the complete ban of gill nets and greater restrictions on spear fishing with SCUBA. Such an effort would have to be elegantly orchestrated to be effective, but it is important to note that similar efforts have been successful in other U.S. Pacific Islands such as American Samoa (Birkeland and Friedlander, 2001). It was suggested that no one group should take this on without careful and consistent consultation with other organizations. A collaborative strategy is more likely to succeed than an effort by any one group.

- b. **Create a recreational fishing license.** Most recreational fishing happens close to shore and much of it in or near coral reef environments. The creation of such a license is a critical step to improving fisheries management and must be accompanied by the establishment of sufficient capacity to manage distribution and sales of the license and the collection and analysis of data resulting from the license. Periodic surveys about catch amount and species should be pursued as well to help managers better understand the situation with recreational fishing.
- c. **Accompany changes in fisheries regulations with awareness building and educational messages so people are aware of both the changes and the reasons underlying it.** Experts who fish regularly said that many responsible and respectful fishermen will follow regulations if they are aware of them. They recommended that an outreach and awareness campaign accompany any changes in fisheries regulations. This campaign should focus on places where fishers congregate such as gear shops, harbors, and fishermen's clubs. Fishers and respected Hawaiian figures would be the best spokespeople.
- d. **Greatly enhance DOCARE's capacity to effectively enforce fisheries regulations.** Updates to fisheries regulations will not be fully effective unless DOCARE has sufficient capacity to enforce them. As discussed in other sections, DOCARE's capacity to enforce existing and new regulations must be increased.
- e. **Develop Citizen Action Groups to help support DAR and DOCARE by undertaking surveillance and education about new fisheries regulations as they come out.** In previous recommendations, we highlighted the suggestion that Citizen Action Groups be formed to monitor marine ecosystems, assist with community education, help with lobbying and advocacy, and be involved in other conservation activities as appropriate. Helping to support DAR and DOCARE by raising awareness of new regulations and reporting on violators is a good use of volunteer citizen time. A local NGO should be supported to help organize, train, and deploy Citizen Action Groups in cooperation with DAR and DOCARE.
- f. **Develop more "no take" and managed areas.** Overwhelmingly, experts expressed the need to create more "no take" areas in the MHI. Many stated that no degree of fishery regulation would fully protect the marine resources of the MHI, unless accompanied by easily discernable and enforceable "no take" areas. Given various interest groups, it will be difficult to create new no take zones in the state; however, if these efforts are pursued as part of a comprehensive strategy that includes awareness, education, biological prioritization, community-based management and other activities, there is some hope for the creation of new managed areas with "no take" zones as a part of their designation.
- g. **Develop an immediate strategy to ensure conservation of top priority sites for nearshore fisheries.** There are many areas in the state that are important to the maintenance of healthy fish stocks. As part of the biological prioritization under

the ecoregion/ecosystem management approach, high-priority areas should be identified and protected. Given the complexity of protection sites in the state, strategies for the conservation of these known high priority areas should be developed and implemented with participation of appropriate stakeholders.

Address Coastal and Upland Development and Land-Based Effects on Water Quality in the Nearshore Environment

A common threat mentioned by experts is the impact of land-based activities on the nearshore environment. According to Hawai'i's *State of the Reefs*, (Clark and Gulko, 1999), no place in Hawai'i is more than 29 miles from the coast. As a result, nearly all land-based activities eventually impact the sea. Urban and residential development is typically within a few miles from the sea, while seawall construction, channelization, harbor development, agriculture, sewage disposal, chemical spills, road runoff, and many other land-based activities have major impacts on nearshore environments.

While coastal development and resulting water quality impacts stressed by numerous experts as major threats, this is perhaps the most difficult threat to address. While point source pollution is relatively well regulated by the EPA, non-point pollution resulting primarily from coastal development, agriculture, and industry remains an extremely difficult problem to address.

Ongoing programs that are addressing water quality issues include watershed partnerships that have brought together landowners to cooperatively improve watershed management. A goal of many of these efforts is to reduce sedimentation, and the runoff of agricultural products. These efforts include reforestation, fencing programs to reduce wildlife grazing, and reducing the use of these pesticides and fertilizers. Other citizen partnerships have been organized to clean and landscape streams and stream banks to reduce debris and sediment outflows. DLNR has formed a Coastal Lands Program to conserve the state's beaches, while the advisory support on coastal zone management is provided by the State Coastal Zone Program, and the Fish and Wildlife Service Coastal Program helps support efforts around the state to manage coastal development, reduce sediment, reduce coastal grazing, and other measures to protect the coastal zone. In addition, the U.S. DOA has farm programs that work to reduce sedimentation while the Hawai'i DOH has a program to reduce non-point source pollution. In addition, DOH, the EPA, and NOAA have produced an excellent reference document, "The West Maui Watershed Manual" to help watershed residents better protect their water quality.

While all of these efforts represent an excellent suite of activities, none is of sufficient scale to adequately address the coastal development and water quality issues facing the state. A number of additional activities are needed to help adequately address these concerns. Perhaps more than any other issue, addressing coastal development and water quality concerns require collaboration and partnerships.

Recommendations:

Conceptual Recommendations:

- a. **Empower citizens to protect watersheds and reduce their impact on nearshore waters.** One of the best ways to empower people who live in watersheds is to educate them about how to help protect water quality. The West Maui Watershed Owners Manual is an excellent example of how agencies can work together to provide specific advice to individuals and companies. More education and outreach materials are needed to demonstrate the importance of watershed protection and to show people what steps they can take to do their part. Simple but important steps include reducing the use of household and agricultural chemicals, leaving riparian zones vegetated, participating in re-vegetation efforts, and replacing septic tanks with municipal sewage treatment.

Specific Recommendations:

- a. **Undertake a coastal sensitivity analysis.** Across the state are sites that are coastal conservation priorities because of the uniqueness of their habitats, or because they are vulnerable to impacts such as development and oil spills. To understand how best to protect a representative network of important conservation sites across the state, a coastal sensitivity analysis should be completed as part of the Ecoregion/Ecosystem Planning Process.
- b. **Conduct an analysis to overlay priority marine areas with key watersheds.** There are a number of watershed partnerships and ahupua`a initiatives either emerging or on-going in the state. This study did not uncover any efforts to identify priority marine sites and overlay those with priority watersheds. However it should be noted that when priority watersheds and priority marine areas are connected, this elevates their conservation importance even more.
- c. **Work with State and County authorities to limit development in sensitive coastal areas.** Once sensitive coastal areas have been identified, it is important that state and county entities are aware of these areas, and commit to regulating development in these areas. Current development practices have had a huge impact on sensitive coastal areas. NGOs should support education, outreach, and public advocacy efforts to encourage state and local governments to include biodiversity considerations in state zoning, county land use planning and to limit development in sensitive coastal areas. Likewise, commercial developers and the consumers of commercial development should be educated about sensitive coastal areas and encouraged to support appropriate development regulations.
- d. **Develop education and incentive programs to promote responsible watershed and coastal management practices.** Experts on water quality strongly suggested the development of incentive programs particularly for farms and ranches, which are a major source of fertilizers and pesticides. These incentives could include

payments, tax breaks, technical assistance, and other support programs for land owners willing to put in place watershed management practices such as reducing the use of pesticides and fertilizers, replanting denuded lands, fencing out ungulates and grazers that promote erosion, and maintaining riparian buffer zones along water courses. Other types of incentive programs such as tax breaks can be offered to developers who follow environmentally sensitive design approaches in coastal development. Providing guidance and technical assistance on these design techniques is an important part of any incentive program.

- e. **Enhance efforts to manage urban storm water.** Urban storm water is a significant source of non-point source pollution and excessive fresh water flows. Mitigation measures include building water retention ponds in developed areas to reduce the negative affects of hardened surfaces on water flow, labeling drains to warn against dumping, reducing the amounts of household, lawn, and agricultural chemicals used, and constructing streets and parking lots to shunt water to vegetated areas rather than into storm drains. In general, awareness and a willingness to follow some simple practices such as these will greatly reduce marine impacts from storm water. Educational efforts on storm water issues should also accompany educational efforts on watersheds in general.

Additional Recommendations: Develop Sustainable Financing Mechanisms

While the point of this study was to synthesize the opinions and recommendations of experts in the field of marine management, the consultant would like to make one recommendation that was not made by any of the experts interviewed on the topic of conservation finance.

Effective marine conservation in Hawai'i will require a massive scaling up of conservation activity. The current budgets and staffs devoted to marine management are not sufficient to address the large-scale system problems facing nearshore environments in the MHI. A large amount of additional funding will need to be raised to adequately address this problem. Given the current economic situation, we cannot expect this funding to come from any one sector, but must work with a number of sectors including government, foundations, and the private sector. While we make a few recommendations regarding the generation of conservation finance from foundations and government, we focus our recommendations on a sector that is underrepresented in funding marine conservation in the state. This is the private sector. Considering that over six million visitors per year come to the state and that the majority of them engage in some ocean-related activity, it is in the private (particularly the tourism industry) sector's best interest to help ensure that the marine environment remains attractive to tourists.

Experience from conservation finance projects around the world has indicated that various private sector interests can be motivated to support conservation if they can be shown how it will benefit them directly. Industries such as the dive and cruise industries are particularly dependent on an attractive marine environment. As a result, it may be

possible to interest these entities in funding marine conservation. Many companies are already actively involved in marine conservation both directly and through providing funding support. However, several experts have cited a general reluctance on the part of these industries because they feel they are already taxed enough and they also may not see the direct benefit. Several recommendations may help these industries to more directly see the benefit of providing significant support for conservation.

- a. **Develop a comprehensive marine conservation finance strategy focused on the private sector and other donors such as foundations and government.** Currently, most conservation financing in the state is generated by individual organizations for specific operations, programs, or projects. However, in the long-term, it can be very effective to develop a collaborative funding strategy. In essence, existing organizations need to identify what must be done to conserve Hawai‘i’s outstanding marine resources, and calculate how much it would cost to do so. A fundraising strategy that focuses on achieving the goals necessary for broad marine conservation may be more compelling to large-scale donors than individual projects. Likewise, a strategy that involves a number of donors to build a sustainable financing mechanism may offer some promise in the long-term. The following recommendations comprise elements of a comprehensive strategy.
- b. **Establish a Hawai‘i Natural Heritage Trust Fund.** Currently, conservation donors fund projects on an annual or multi-year time frame, generally never exceeding three to five years. Three-year projects are typical, and it is also common that funders will provide for two, three-year phases. There is a major problem with this type of funding in that, it generally takes between three to six years to achieve conservation success and by the time success has been achieved funding is exhausted. This funding approach does not recognize that some highly important conservation actions have a recurring cost that will never go away. For example, whether or not you build excellent partnerships for conservation action, there will always be a cost for boat fuel, paying staff salaries, and other essential activities. It is rare for a particular conservation area to generate sufficient funding to pay for its recurring management. As a result, conservation trust funds that provide sustained funding are an important mechanism to help ensure that conservation costs can be met on an annual basis. One recommended approach is to create a trust fund with a marine and coastal focus and to work with related partners and industries to build such a trust.
- c. **Generate public support and lobby for increased government appropriations.** Any comprehensive fundraising strategy will require a number of donors but should not be a substitute for increasing government funding. Currently in Hawai‘i, Government funding is extremely low for marine management. Experts recommended a targeted lobby effort be launched to focus on all levels of government and should be accompanied by an awareness and outreach campaign making use of multiple media outlets.

- d. **Launch awareness campaign to demonstrate that pro-environment is pro-tourism.** Experts currently feel that the tourism industry is opposed to environmental conservation because they feel it will negatively affect their business. It is true that in some areas of the state opposition to coastal development has and may continue to impact the tourism industry. However, tourism and environmental conservation can go hand in hand to protect the local environment, and produce a profit. Experts felt that pilot projects are needed to demonstrate to tour operators that environmental conservation supports tourism. In addition, an economic analysis of the value of intact marine environments could help to prove this, and enhance support from the tourism sector.
- e. **Work with industries to understand their needs and provide conservation products that help to meet those needs.** One recurring problem between conservation and tourism operators is that conservationists rarely understand the needs and interests of these operators. Likewise, different operators have different needs depending on the scale of their business. It is extremely helpful if conservationists can try to better understand the needs of the industry in developing strategies to work with them.
- f. **If willing industries can be identified, enter into partnership agreements to generate conservation finance.** One of the best ways to demonstrate the efficacy of conservation finance partnerships is to enter into trial partnerships. Typically, these partnerships focus on generating funding through conservation fees on tourism. Trial partnerships with “early adopters” can help to test the waters of working with industry, and help them understand how larger partnerships or mandatory fees may eventually work. It will also demonstrate to other industry members that conservation finance can be pursued without diminishing profits or the number of guest arrivals.
- g. **Work with industry to develop a conservation fee structure.** One way to build the tourism industry's confidence is to conduct “willingness to pay surveys,” in which tourists are asked how much they would be willing to pay for particular conservation benefits. For example, cruise industry participants could be asked what amount they would be willing to pay to help ensure that the coastal and marine environment of the Hawaiian Islands is conserved and protected. Typically, tourists are more than willing to pay what in essence is a tiny fraction of their whole vacation package to help protect the beauty of the place that they are visiting. Tourism operators are often afraid that an extra fee will make tourists go to another destination, or chose another operator. Experience in conservation finance indicates that this is typically not the case. Tourists are unlikely to shift their vacation destination because of a small conservation fee. Mandatory industry-wide fees can help to limit issues of competition between operators. Some experts recommended that such fees should go to a dedicated fund from which grants can be issued through a formal review process. One expert suggested that a percentage of this money should go to resource management agencies.

Box 4 Mo'omomi: Community-Based Marine Conservation on Molokai

The Mo'omomi Demonstration Project on Molokai is perhaps Hawai'i's best example of the integration of traditional resource management and Western/modern resource conservation. The project was designed to demonstrate that more responsible fishing could be achieved through revitalization of community-based management. While there are several documents that provide excellent summaries of the history, objectives, and lessons of the project, here we summarize a few key points that should be considered in the continuing effort to conserve Hawai'i's natural resources. The majority of the following information came from a report prepared by Hui Malama O Mo'omomi in 2001. It should be noted that while the majority of experts interviewed cited Mo'omomi as a positive example of progressive marine conservation, there is a diversity of opinions on how applicable and appropriate this model is. Some State officials indicated that a local community may not have a defacto right to manage marine resources adjacent to their land area, as marine resources are a common property in the state. Also, other experts pointed out that the area is extremely remote with little user overlap and relative low biodiversity. As a result, many experts felt that the applicability of this approach must be assessed on a case-by-case basis.

A progressive law, passed in 1994, created an opportunity for communities to undertake local management of marine resources. Hui Malama O Mo'omomi also formed in 1994, to revitalize subsistence fishing and traditional values in the Mo'omomi area.

A key feature of the Mo'omomi community is its relative dependence on fish protein and other marine products for subsistence. While many people fish for local consumption, few communities depend on local fish for subsistence. However, at Mo'omomi, farming and fishing provide approximately one third of the food for a community of approximately 1,000 people. Other places that may have similar characteristics to Mo'omomi include Limahuli, Miloli'i, and Ni'ihau.

The objectives of the project were:

- To establish a marine resources monitoring program that integrates traditional observational methods and understanding with science-based technical data,
- To foster consensus about how fishing should be conducted in order to restore community values and stewardship, and to demonstrate the communities commitment and ability for self-management, and
- To revitalize a locally sanctioned code of fishing conduct and to make a cooperative agreement for community-based management of shoreline and nearshore fisheries in and around Mo'omomi Bay.

Throughout Hawai'i, before colonization, the traditional kapu system helped ensure that marine resources were well managed. Traditional systems operated in tandem with the ecological processes of nearshore areas, creating closures of areas during important life cycle events, such as spawning. The kapu system is no longer practiced, however, a code of conduct developed by a community on Molokai is based on many of the kapu system's principles. The code of conduct is enforced through respect, peer pressure, education and continual community feed backing, and has proven to be a successful management tool at Mo'omomi. The project has been successful at enhancing responsible fishery management through community-based methods. Western/modern conservation approaches have primarily been used to help monitor resources.

Fish populations appear to be in better condition at Mo'omomi than many places on O'ahu and other islands. For example, fish biomass is up to 50% greater at Mo'omomi than at any other site sampled in the MHI by DAR, while diversity is between 30% and 50% greater. Likewise, highly sought after moi (pacific threadfin) were shown to be much larger at Mo'omomi than other sample sites (10.64 inches at Mo'omomi versus 9.42 inches on O'ahu). While this higher biomass and diversity cannot be fully attributed to the two-year tenure of the demonstration project, the project has shown the ability to address unsustainable fishing through peer pressure. In one case, local fishermen who broke the code of conduct were reported and admitted their guilt. One of the illicit fishers actually ended up joining the board of the Hui.

Primary lessons learned from the project are:

- Community building and proper cultural protocol are essential to understand and revitalize marine conservation traditions.
- Young practitioners who are committed to the community's basic values and to Hawai'i an culture must be recruited.

While Mo'omomi has been successful to date, it is important to note that in other areas across the state, community-based management has been tried and has not succeeded. For example, in Kane'ohe Bay a large attempt at improving resource management through community-based approaches failed to produce positive results. This may have stemmed from the complexity of the situation in Kane'ohe as well as the relative lack of any well-defined community. Kane'ohe lacks the special conditions of community cohesiveness as well as pride and interest in traditional management that are present in Mo'omomi. While there is no doubt that Mo'omomi is a unique case, experts believe that there are other communities where elements of traditional management can be effective. Given the difficulties of creating new MPAs and the current limitations of western/modern management techniques to conserve fish stocks, community-based management may be one important means of effective management of nearshore ecosystems in Hawai'i.

Information for this case study came from Pacific American Foundation, and Hui Malama O Mo'omomi, 2001.

Chapter 4: Successes and Opportunities in Nearshore Marine Management

Although there are clearly many threats and obstacles to the conservation of marine biodiversity in Hawai‘i, it is important to highlight the progress, successes, and opportunities in marine conservation in the state. Currently, there is a great deal of activity either ongoing or developing in marine conservation in the state. Several projects have already achieved success in marine management, and others have set a solid foundation from which marine management can be enhanced over time. Likewise, through new funding, several of the recommendations of this study will be addressed in coming months and years. For example, DAR is planning the development of a coral reef-related communications strategy involving professional public relations specialists and is also launching an initiative to improve the reach of marine managed areas in the state. Additionally, as was mentioned in the beginning of the study, the majority of threats and obstacles to marine conservation are being worked on to some extent. As a result, one key to successful conservation management appears to be the strengthening and deepening of ongoing marine management projects and programs in parallel with new conservation initiatives.

Several experts, as well as this consultant, perceive a palpable energy and enthusiasm that is building for more effective marine management. Several experts noted a definite increase in interest and energy for marine management in recent years and months.

Many people interviewed indicated that the conservation community is at a pivotal time, and is ready to make an outstanding and significant difference in marine management. Much of this has already started. For example:

- increasing numbers of people and NGOs are starting to work on marine issues;
- well-established NGOs are creating new programs such as the Western Pacific Fisheries Coalition;
- the State is developing new ways to manage marine areas such as the Kona Coast Fisheries Replenishment Zones, and new funding is being provided to work on marine managed areas;
- for the first time we have monitoring programs that are revealing the condition of the MHI’s marine resources, and
- energy and enthusiasm are building in a variety of sectors to improve management of marine resources.

Perhaps the best analogy is that Hawai‘i is experiencing a ground swell of interest and enthusiasm for marine management, and there seems to be a great opportunity to work collectively to make a difference.

The following examples of successful or promising initiatives offer great hope that we can collectively overcome threats and obstacles and effectively manage Hawai‘i’s natural resources. One of the keys to overcoming these obstacles appears to be magnifying existing efforts to a scale that more adequately addresses the threats and obstacles to

effective management. The following list is not comprehensive and provides just a short summary of some of the activities that are going on in the state:

1. **Mo'omomi Demonstration Project on Molokai.** See Box 4: Mo'omomi, p. 68.
2. **Limahuli Watershed Initiative.** This initiative on the North shore of Kaua'i is working to extend a terrestrial watershed conservation initiative to the nearshore marine environment. The initiative has benefited from outreach and support by the Hui Malama O Mo'omomi. This effort has considerable potential to succeed given the intactness of the watershed and nearshore marine environment, the backing of a well-established NGO (the National Tropical Botanical Gardens), the support of the local community, and the interest of funders. Both this initiative and Mo'omomi should be watched and assessed carefully to determine their broader applicability.
3. **Hawai'i Coral Reef Initiative (HCRI).** This initiative has funded several important efforts such as coral reef assessment and monitoring, multi-stakeholder decision-making processes for conservation of Kane'ohē Bay, research on alien algae distribution, and will be funding assessments of the economic value of coral reefs, continued monitoring, and experiments on how to best remove alien algae.
4. **Coral Reef Assessment and Monitoring Program (CRAMP).** Funded in large part by HCRI, CRAMP is the most extensive effort to date to assess and monitor the condition of Hawai'i's coral reefs. This program has developed a monitoring protocol that enables the collection of detailed information about the condition of coral reef ecosystems in the MHI.
5. **Cooperative Research on Alien Algae.** A partnership between the University of Hawai'i, the Waikiki Aquarium, and the Hawai'i Institute of Marine Biology has been pursuing studies on the distribution and spread of alien algae and with support of HCRI will work this year to better understand how to eradicate alien algae species. The program has set up an excellent website that is the most comprehensive and up to date source of information on alien algae in the state.
6. **Initiative to Understand and Manage for Alien Species.** In tandem with the partnership program discussed above, the U.S. Fish and Wildlife Service, the Bishop Museum, and other agencies are supporting a series of public workshops on marine alien species. The first workshop held in May of 2001 focused on educating resource managers and the public on the issue of alien marine species, particularly algae. A second meeting was held in October 2001 and focused on developing management strategies to more effectively address the introduction and spread invasive algae.
7. **Western Pacific Fisheries Management Coalition:** This program of the Hawai'i Audubon Society is focused on fisheries management and marine advocacy, outreach and education. This program played a significant role in the effort to ban shark finning and plans to work on other fisheries issues in the future.
8. **Northwestern Hawaiian Islands Rapid Ecological Assessment:** This represents the first comprehensive effort to survey and document the resources and biodiversity of the Northwestern Hawaiian Islands. It involved several federal and state government agencies including the National Marine Fisheries Service, the Fish and Wildlife Service, the Northwest Hawaiian Islands Reserve Commission, and the Division of Aquatic Resources.

Box 5. The Kona Coast Fishery Replenishment Areas: A Conservation Success Story

In 1999, a landmark law and associated rules were created, placing almost one third of the West Hawai'i coastline under fisheries management to conserve species collected by the aquarium industry. This Fisheries Management Area and the subsequent Fisheries Replenishment Zones became the single largest managed coastline in the MHI and have created a precedent for improved fisheries management throughout the state.

This law was the result of 20+ years of conflict between aquarium fish collectors and dive operators in West Hawai'i. Dive operators and biologists argued that collection was rapidly depleting species of coral reef fish, while collectors claimed that they were unfairly singled out as the cause of depletion. After years of complaints, the 1996 Legislature directed the DAR to create a West Hawai'i's Reef Fish Working Group to develop recommendations on managing the fishery. Several meetings were held between May 1996 and September 1997 and numerous recommendations were offered; however, none were adopted due to opposition by the fishing industry.

In 1998, community groups such as the LOSTFISH Coalition and the Hawai'i Conservation Association began a campaign to limit aquarium collection and improve management of the industry. Statistics showing declines in the top ten aquarium species provided powerful arguments for improved management. Between the late '70s and 1998 in selected areas of West Hawai'i, populations of these ten most populous species had dropped 54 % at Ke'ei and 59 % at Honaunau. Other data indicated that Yellow Tang, Potter's Angels, Long Nose Butterflies, Moorish Idols, and Achilles Tangs had decreased by 45 to 63% over only a two -year period (*Environment Hawai'i*, 1999).

In 1999, after considerable outreach, education, and negotiation, a law was passed establishing the West Hawai'i Regional Fishery Management Area, requiring that a minimum of 30% of the West Hawai'i coastline be set aside as fish replenishment areas (FRAs) (*Environment Hawai'i*, 1999). This law also required the establishment of a community advisory group, the West Coast Fisheries Council. This Council subsequently identified nine areas to be managed as FRAs, where aquarium fish collection would be completely prohibited. Likewise, these areas would establish separate rules for other fisheries, including the use of gill nets and other techniques thought to be destructive. The successful passage of this law and the subsequent rule making authority to delineate FRAs, represent a significant conservation success, where citizens acting together initiated and saw through the creation of new conservation areas.

According to those involved in the West Hawai'i case, a number of factors came together to enable this success. These included an educated and involved citizenry that extended well beyond the immediate stakeholder groups, solid data demonstrating declines in the fishery, excellent community organizing by the LOSTFISH Coalition, and supportive delegates in the legislature. In West Hawai'i, concern about the impact of aquarium collection had become quite widespread and as a result, citizens were attuned to the issues and willing to participate to help resolve it. Organized community-monitoring teams and monthly reef talks at public venues helped to raise the level of awareness in the community. Finally, having solid data demonstrating declines in the fishery provided nearly irrefutable evidence that collecting was impacting populations of key species.

According to experts, other communities around the state would like to establish their own Fishery Management Areas. Many lessons learned from West Hawai'i can be applied in these new efforts, but there is also a significant need to ensure these efforts have the capacity they need in community organizing, education and outreach, and information gathering and presentation as these were key elements of success in the West Hawai'i case and may lead to new successes in fisheries management across the state.

9. **Designation of the Northwestern Hawaiian Islands Reserve.** The designation of this reserve resulted from the collaborative efforts of numerous NGOs, and state and federal agencies. It is important to note that the Bush Administration is currently reviewing this designation, and several interests are challenging its designation.
10. **Marine Ecosystem Geographic Information Systems Group (MEGIS).** This group is working to more fully document and database information on the Hawaiian Islands in a spatial (GIS) format to provide managers with accurate and up to date information. This group is working with the National Ocean Service to map the bathymetry of coastal and nearshore marine habitats through remote sensing methodologies such as hyper-spectral imaging. These efforts have improved communications on marine issues in the state.
11. **New forms of marine management.** There are new forms of MPAs related to marine ornamentals collection on the Kona coast. This effort provides an excellent example of combined citizen and government action to improve management of a threatened resource (see Box 5 for a full description).
12. **New take size and bag limits currently being rolled out by DAR.** DAR has recently developed new fisheries regulations based on science and biological considerations, such as sexual maturity. These new regulations include new take sizes and bag limits. While these changes are positive, some experts have recommended that maximum size limits should be included in these changes.
13. **Efforts by the Secretariat for Conservation Biology.** The Secretariat is working with a small steering committee (that represents some of stakeholder groups) to set up a more effective means for communication and collaboration between various marine resource management agencies and organizations.
14. **A coral reef disease study supported by the USGS, the National Wildlife Health Center, and the Fish and Wildlife Coastal Program.** This study is to better understand coral reef diseases with study sites on O‘ahu, the Kona coast, Johnston Atoll, Midway, Tern Island, and American Samoa. The study will characterize coral reef diseases and make a histological atlas of diseased coral tissue.

Other important efforts that we do not have as much detail on include:

15. **Surveys of recreational fishing catch that are being initiated by DAR**
16. **The consultative process that lead to the Ocean Resource Management Plan (ORMP)**
17. **Effort to revise and update the Ocean Resources Management Plan**
18. **Bi-annual publishing of the Status of Coral Reefs in the Hawaiian Islands**
19. **A coastal sensitivity analysis of areas that are particularly vulnerable to oil spills by NOAA**
20. **An effort by DLNR to map erosion-prone beaches across the state and develop guidelines to reduce beach erosion related to development**
21. **Coastal Management efforts of the Fish and Wildlife Service with the state and private landowners, including re-vegetating areas and fencing out alien grazers.**

Experts emphasized many of these initiatives as key efforts that should be further developed and built upon to ensure long-term conservation efficacy in the state. Many experts felt that one of the best things that can be done with new funds is to help ensure that key efforts are sufficiently supported, and that people working in the marine conservation community are sufficiently paid. It is critical to note; however, that the threats and challenges to marine resources in the state still vastly outweigh the current scale of conservation and resource management activity. Unless conservation activity is magnified by several fold, we will likely witness the continued decline and degradation of marine resources in the MHI.

Box 6. Conservation Success: The Campaign Against Shark Fining

Across the state of Hawai‘i, the marine conservation community has achieved a number of significant successes. One of the most commonly mentioned by experts is the campaign that has essentially ended the practice of shark fining in the state. According to the Western Pacific Fisheries Coalition, sharks have never been a target fishery in the state but in the early 1990s, economic growth in parts of Southern China fueled an increased demand for the delicacy shark fin soup which in turn sparked a world wide increase in shark fining. This surging demand reached Hawai‘i, and sharks once caught primarily as by-catch in the long-line fishery were increasingly finned rather than released.

In 1997, a group of mainland-based foundations visited the state and discussed conservation priorities with a number of groups. Addressing the practice of shark fining emerged as a conservation priority and the next year, the foundations came together to fund the Western Pacific Fishers Coalition. This coalition, which is coordinated by the Hawai‘i Chapter of the Audubon Society, placed shark fining on its agenda and by 1998 was into a full swing campaign to ban the practice. But this wasn’t the only priority of the small coalition. They also chose to work on other issues including pushing for all regulatory authority on marine issues to be fully vested with the Division of Aquatic Resources and to empower the Division to have regulatory authority on ballast water (a major potential source of alien introductions). Taking on these issues was challenging, but as success started to emerge in the shark fining case, it became clear that the effort was worth it.

As the coalition carried out its advocacy, outreach, and lobbying efforts on the shark fining issue, a number of synergies started to come together. A state Bill to require that sharks be landed whole was introduced and was tantamount to banning the fin trade since boats could not afford to transport entire sharks given the relatively small value of each fin. The Coalition put out a full-page article in the local paper raising public attention to the issue, and in February of 1999 a conference on sharks was held. At this conference, new video footage showing the practice of fining was aired. News media picked up the grotesque film and people across the state could see with their own eyes the waste and cruelty associated with the practice of fining. This combination of advocacy and timing with the conference raised the attention of a number of lawmakers, strengthening the arguments of advocates to ban the practice.

Another factor that helped lead to the ultimate success of the campaign was support from local fishermen. Hawaiian fishermen have a long tradition of not wasting and Hawaiian culture reveres sharks. As a result, a number of outspoken local fishermen spoke strongly against the practice. Despite the strong support from the public and a major sector of the fishing community, other fishermen, government agencies, and the restaurant industry opposed the legislation. Fortunately, through negotiation, these differences were resolved. The government agencies became supportive of the legislation and the restaurant industry accepted the legislation as long as packaged shark fin would still be allowed into the state. Likewise, the lobbying of the local fishermen outweighed that of those in favor of fining.

By the 2000 legislative session, over two years after the campaign started, both a state and federal law banning the landing of any shark part and requiring the landing of the animals entire body were put into force. In essence, this regulation eliminated the practice of shark fining in Hawai‘i. Rule making for the federal law continues and strong lobbies such as the Western Pacific Fisheries Council still oppose the ban. In fact several bills have been introduced recently that would allow filleted shark to be landed thus opening a loophole for the landing of fins. Despite these attempts to weaken the current law, conservationists are hopeful that these attempts will be defeated and continue to work to protect sharks and uphold the new law that has essentially done away with the practice of fining in the state.

This case demonstrates how a number of factors can come together synergistically to support conservation success. However, it is important to remember that these things did not happen on their own. They required the diligent work and commitment of a number of conservationists who could focus on this issue over many years. Ensuring capacity for conservationists to focus on issues like this is critical to the protection of Hawai‘i’s marine biodiversity.

APPENDICES

APPENDIX I: Important Areas For Marine Biodiversity as Identified by Interviewees

Based on expert opinion, this section highlights a number of important areas for nearshore marine conservation for the MHI. The study has not undertaken any primary surveys, nor has it undertaken habitat assessments. Important areas have not been prioritized and were not assessed based on their contribution to overall ecological processes or biodiversity. It is recommended that a more detailed, ecosystem-based prioritization be undertaken to support increasing efforts to pursue ecosystem-based management in the state (see Recommendation Category 2).

The study explicitly asked experts to identify their priority area based on the following criteria:

- * Biodiversity (high species richness or endemism),
- * Natural habitats,
- * Ecosystem processes,
- * Natural resources, and
- * Unique or rare species

Common Themes:

Many common themes emerged regarding priority areas. Overwhelmingly people recommended islands other than O‘ahu and Maui as having the most intact marine ecosystems and suggested that remote areas within those islands are generally in the best condition and should be conserved. Most of the experts focused on areas that are still in relatively good condition.

Important Areas for Conservation Summarized by Island:

Ni‘ihau, Lehua Rock, and Ka‘ula

For an excellent summary of the biological features of Ni‘ihau and several other of the MHI please see the CRAMP website: <http://cramp.wcc.hawaii.edu/>.

Many experts recommended that Ni‘ihau, Lehua Rock, and Ka‘ula are major priorities for conservation. The west side of Ni‘ihau was identified as having intact reefs and relatively healthy fish populations. One expert recommended that the marine area surrounding the entire island would be a good candidate for community-based management and marine protected area status. Many experts recommended that because Ni‘ihau is privately owned, there is potential to work with the owners and the resident community to develop a marine conservation program for the island.

The coastline of Ni‘ihau is approximately 45 miles in length. Ni‘ihau experiences a great deal of wave energy from all directions, and as a result, reefs are not well developed. There are numerous pinnacles, overhangs, underwater caves and vertical walls along the northwest shoreline, and biologically rich reef communities are said to occur off the south end of the island (Naughton, J. Personal communication 2000, cited on CRAMP website, 2001). Unfortunately, there is relatively little biological information about the marine resources of Ni‘ihau.

Threats to the island include fishing by people from other islands in the MHI, which has the potential to reach unsustainable levels. Little is currently known about the fishing pressure on Ni‘ihau, but some experts suggested it might already be heavily fished. Other experts suggest that Ni‘ihau is likely to have light fishing pressure when compared to the other MHI. Rough weather is a deterrent to fishing during some parts of the year. Dive operators mostly take visitors to the Northwest tip of the island or to Lehua Rock.

This diversity of opinions suggests a resource condition and resource use survey is necessary to fully understand the situation on Ni‘ihau. In addition, while fishing pressure may in fact be low, as other areas in the MHI become more degraded, fishing pressure in Ni‘ihau may increase.

Recommendations for possible conservation actions for Ni‘ihau, Lehua Rock, and Ka‘ula include:

1. Surveys to better understand the biodiversity as well as the condition of the marine resources of Ni‘ihau, Lehua Rock, and Ka‘ula.
2. Resource use assessments to understand fishing pressure and its impacts.
3. Quantification of the reef fish stocks in lightly fished areas are needed to establish a baseline comparison to more heavily fished areas in the MHI.
4. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
5. Discussion with the owners and residents regarding possible protection or management of the nearshore marine environment.

Kaua‘i

Kaua‘i is the oldest and northernmost island in the MHI. The island is composed of a central volcanic peak, Mt. Wai‘ale‘ale, which has been documented as the wettest place on earth. Experts stressed Kaua‘i as a priority because it lacks the massive development and population pressure of O‘ahu, and the growing pressures of Maui. As a result, its marine areas are in better shape than those of O‘ahu; however, they are impacted by agricultural practices, fishing, and other threats. Kaua‘i is impacted by high winds and waves from the northwest in winter months. As a result, despite its age, coral reefs are not as well developed on Kaua‘i as on other islands, such as Molokai or Maui that are more sheltered. Kaua‘i is home to both precious corals and one of two barrier reefs in the state. Kaua‘i’s reefs were badly impacted by hurricane Iniki; however experts suggested that these reefs have show signs of natural recovery.

Experts emphasized a few areas. These include:

Mana Reef: This reef is located offshore from Ha‘ena and is one of the only barrier reefs found in the MHI.

Polihale: Experts mentioned Polihale on the western most side of Kaua‘i as a very important coastal area. Home to Polihale State Park the area is comprised of dunes and harbors native vegetation. Despite its status as a state park, experts indicate this area may not receive the full protection that it needs.

Napali Coast and Limahuli: Both the watershed area at Limahuli and the coastal and marine areas lining the Napali Coast were emphasized as important areas for conservation. Limahuli was particularly emphasized as it is an intact watershed in a relatively unpopulated area and has the potential for linking a complete ecosystem to the sea. Currently a marine conservation initiative is in the planning stages that will parallel the existing watershed conservation efforts in this area.

The reef complex off the northeast end of Kaua‘i: This reef was mentioned by several experts as relatively intact and important for marine conservation.

The beaches on Ha‘ena and the south shore of Kaua‘i, including Poipu: These beaches are an important refuge for resting monk seals and provide long, intact areas of coastline.

The Hanalei River: This river was also mentioned as an important area because it is one of only a handful of remaining natural rivers in the MHI.

Recommendations for Kaua‘i:

1. Surveys to better understand the biodiversity as well as the condition of the marine resources of Kaua‘i.
2. Resource use assessments to understand human activities and their impacts.
3. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
4. Discussion with stakeholders about possible protection or management of the nearshore marine environment.
5. Development of a multi-stakeholder strategy for the long-term conservation of Kaua‘i.
6. Support to the community-based conservation project at Limahuli and other similar efforts on the island.

O‘ahu

O‘ahu has the most degraded marine resources in the MHI. However, there are some priority areas for conservation. O‘ahu is also an excellent area in which to study the long-term impacts of human activity on marine systems.

Areas mentioned as priorities by experts include:

Kane‘ohe Bay: This bay harbors all major reef types in the MHI – patch reefs, barrier reefs, fringing reefs. While poor water quality and significant invasive algae degrade it, the area is still considered a major priority by almost all experts interviewed.

Ka‘ena Point: Many experts mentioned Ka‘ena Point as important because of its relatively intact fish populations. Due to rough weather, it is normally only possible to fish here during part of the year. As a result, fish populations in this area are still in good condition. Experts suggested that this would be a good place to create a “no take” MPA.

Hanauma Bay: This bay was cited by many experts as a success story in marine management for O‘ahu. While over a million people visit it annually, it was reported by several experts to maintain healthy fish populations and intact coral reefs, particularly away from shore. However, reefs near the beach have largely been degraded by foot traffic from snorklers. Many experts suggested that Hanauma should be more strictly regulated to prevent further degradation, but also cited the “no fishing” regulation and local government management as significant success factors. Ecosystem impacts from fish feeding have been cited as one of the main threats to restoration of a natural system in Hanauma Bay.

Kahuku: According to one expert a coastal area just outside the James Campbell National Wildlife Refuge in Kahuku is an important area for coastal dunes and native plants. The Wildlife Refuge itself is an important area for migratory waterfowl.

Offshore Islets: According to several experts, offshore islets are both important for seabirds and for their surrounding marine areas. The Fish and Wildlife Service may soon initiate an effort to eradicate rats and other pest species that threaten seabird life on these islets. Another expert suggested that marine areas surrounding these islets be put into protected status, as they harbor high biodiversity. Examples include Mokumanu, Mokulua, Manana, and others.

Wai‘anae: One expert stressed the importance of the finger coral beds near Ko Olina in Wai‘anae. According to the expert, these beds are in good shape and should be conserved as a matter of priority. Likewise, another expert stressed the importance of old growth lobe corals in this area.

Threats on O‘ahu are well known and include coastal development, water quality resulting from the high human population, overfishing, and the spread of alien species.

Recommendations:

1. Surveys to better understand the biodiversity as well as the condition of the marine resources of O‘ahu.
2. Resource use assessments to understand human activities and their impacts.

3. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
4. Enhanced research on the impacts of human activities on marine resources in O‘ahu.
5. Development of a multi-stakeholder strategy for the long-term conservation of O‘ahu.
6. Experiments on restoration around O‘ahu and the possible use of large artificial reefs as natural refugia for fish. (Note the importance of careful research on this restoration methodology).
7. Surveys of Ka‘ena and discussion with relevant stakeholders about developing this area as a possible protected area.
8. Support including education for roll out of new minimum fish sizes and other DAR regulations.
9. Education and outreach to fishers, decision makers, and the public since O‘ahu is the population center of Hawai‘i.

Molokai

Several sites on the island of Molokai were recommended as high priorities for conservation. According to experts, Molokai is one of, if not the most, intact of any of the MHI, but is suffering primarily from the impacts of significant sedimentation and now has some introduced species of algae as well. Generally speaking, the community on Molokai has an interest in conservation and there are several opportunities in this area. As a result, Molokai is one of the top priorities for working on marine conservation.

Priority areas mentioned by experts include:

South Coast: Molokai’s south coast is home to the state’s most extensive and best-developed fringing reef. Several experts highlighted this entire reef as a conservation priority. The reef areas with the highest known coral cover in Hawai‘i (Pala‘au and Kamalo, both of which are CRAMP sites) are located along this fringing reef.

Experts have cited the east end of the South Shore as a major priority for marine conservation as it harbors as much as 100% coral cover and its reefs are in relatively good condition. According to several experts this area is a prime candidate for conservation as the community in the area is interested in conserving their natural resources. Already some in the community are working to restore fishponds in this area.

According to one expert, the South Shore of Molokai is a good example of both various reef impacts and natural reef communities. The expert reported that the quarter closest to the shore is impacted by sediment, the second quarter by alien algae, and the third and fourth quarters are home to more intact reefs. The Southwest point on Molokai was also identified as a priority because it harbors relatively intact populations of reef fishes.

North Coast: Conservation priorities on the North Shore of Molokai include Kalaupapa, Halawa, which was reported by experts to be one of Hawai‘i’s last naturally functioning watershed/estuaries, and the Northwest Point of the island (‘Ilio point), which is an important area for fisheries. Mo‘omomi on the Northwest end of the island stands out as

an important conservation area for marine turtles and fish but also as a model for community-based management. (See Box 4 describing community-based management at Mo‘omomi). Also, Kawa‘aloha Bay, to the east of Mo‘omomi is reported to be another important site for green turtle nesting. Although the North Shore experiences much more wave energy and has several areas of high cliffs, its marine resources are still of importance and should be considered in marine conservation strategies. Molokai also has the advantage of an active community-based marine and coastal management effort at Mo‘omomi as well as community-based efforts to restore fish ponds, and watershed partnerships formed to protect upland areas.

Experts reported that subsistence fishing is a major activity on Molokai. Reports from the Mo‘omomi community (approx. pop. 1,000) indicate that as much as 30% of the protein in their diet comes from wild caught fish. Local residents also practice limited commercial fishing. However, increases in both commercial and recreational fishing by people from other islands has been reported.

Fortunately, Molokai is not as heavily impacted by human caused threats as other islands. According to experts interviewed, Molokai’s comparatively moderate threat pressure does not suggest that Molokai is not at risk. Many people interviewed felt efforts should be made immediately to increase conservation action on this island before threat factors escalate.

Sedimentation is one of the most significant threats to the marine systems of Molokai. Lands degraded by ranching and over-grazing by alien species, such as axis deer, are dumping large amounts of sediment onto the South Shore reefs. Fortunately, existing watershed partnerships that are focused on the protection and restoration of upland areas may offer potential for extension to lowland and coastal areas and may offer some opportunities to limit sediment runoff in the nearshore environment.

Several species of alien algae are known to be present on Molokai, including *Acanthophora*, the most widespread and successful alien algae in Hawai‘i; *Gracilaria salicornia*, which is very successful in calm waters and competes with several native species. Fortunately on Molokai, alien algae are not believed to have caused phase shifts from a coral-dominated system to an algae-dominated one; however, the immediate eradication of as many alien algae species as possible is recommended before their populations impact Molokai’s coral reefs.

Overfishing in Molokai has potential to be a significant threat. Some local residents are concerned about fishers that come from other islands with extremely long gill nets. While adequate data is not available on the impact of commercial and recreational fishing on Molokai, anecdotal reports suggest that fishing on all shores is on the rise. One of the best strategies to address overfishing in the nearshore environment may be local community management as practiced in Mo‘omomi. Given that some community members have already expressed a concern about fishing by outsiders, it may be possible to assist these groups to organize management of their nearshore resources.

Given the combination of extensive reefs, important intact estuaries, undeveloped coastline, important nesting sites for marine turtles, and the general good condition of Molokai's marine resources, Molokai stands out as one of the greatest marine conservation priorities in the MHI.

Recommendations for possible conservation actions for Molokai include:

1. Synthesize existing knowledge about Molokai and conduct additional surveys to better understand the biodiversity as well as the condition of the marine resources.
2. Resource use assessments to understand human activities and their impacts.
3. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
4. Assessments of fishing pressure including tracking the origin and impact of fishing groups.
5. Discussion with community groups to investigate feasibility of expanding the Mo'omomi community-based management approach to other areas.
6. Full biological inventory of the Halawa Valley, stream, estuary, and nearshore marine environments (This was cited as one of the last natural functioning estuary systems in the MHI.).
7. Support monitoring efforts on alien species (especially algae) and investigation of ways to eradicate alien species that have already been detected on the island (South Shore reefs).
8. Formation of a marine partnership program for Molokai.
9. Study the origin and impact of sediments on the coral reefs of the south shore and the marine environment of the Northwest shore.
10. Extension of watershed partnership programs to include critical areas that are sources of sediment.

Maui

Maui is the second most developed island in the MHI. Experts stressed that Maui's marine environments are severely stressed, particularly in the heavily developed area of West Maui. Much of Maui falls within a wave shadow created by O'ahu and Maui's own northwest end. This barrier to wave action slows the high energy waves that limit coral development. As a result, Maui has considerable coral development.

During the past decade at least two major algae blooms have occurred threatening the marine area of West Maui. It is believed these are related to the levels of nutrients in the water from coastal runoff. However, efforts to ameliorate the amount of nutrients, including the upgrading of sewage treatment facilities have not been sufficient to eliminate outbreaks. An outbreak was going on during the months that this study was underway. Experts did not mention that many priority sites on Maui. As a result, the summary below is definitely inadequate. There are likely far more important sites on this island that simply were not mentioned by experts. It is recommended that a more detailed assessment of priority sites on Maui be synthesized or carried out.

Priority Areas mentioned by experts include:

Molokini: Molokini is the emergent part of a cinder cone located in the ‘Alalakeiki Channel between Maui and Kaho‘olawe. The area is home to rich coral reefs in the crater, which support diverse and abundant fish populations. It is a popular destination for divers and snorkelers with numerous operators taking tourists to the area. Many experts have suggested that the main conservation concern at Molokini is the ecological impact of past fish feeding and over diving. Fortunately mooring anchors have helped to alleviate anchor damage, but concerns around carrying capacity remain. Molokini is a MLCDD under state authority.

‘Ahihi-Kina‘u Nature Area Reserve: ‘Ahihi-Kina‘u is the only member of the Natural Area Reserve System in the state of Hawai‘i that includes a marine area. The area allows partial gathering rights for one native Hawaiian family. Otherwise, it constitutes a no take area. Human access is limited to non-motorized vessels and hiking trails.

Areas of north Lahaina, including Honolua and adjacent areas: Honolua Bay is part of the Honolua-Mokule‘ia MLCDD. The taking of any marine life in this MLCDD is prohibited; however, conservation management concerns at Honolua remain. The primary concern is the number of people using the area and associated impacts. Access to the area is currently extremely limited; however, large numbers of people still utilize it for marine recreation. It is important to consider the possible ecological impacts of improved access to the area. It is also important to research the role Honolua may play in providing recruits to other areas along this coast.

All the areas mentioned above are CRAMP monitoring sites. As a result, researchers and managers will have consistent data about changes to the area over the long-term.

Pa‘ia and surrounding areas: Pa‘ia and surrounding areas were mentioned as important for marine conservation. One expert suggested that local communities in this area are very likely to be supportive of marine conservation and therefore may assist in monitoring, coastal cleanups, and observation of fishing activity to aid enforcement.

In coming years DAR is planning to enhance marine protection in Maui County through the creation of new categories of marine managed areas. Over time priority sites of Maui may be more adequately managed through this process. Also, experts suggested that there are many opportunities for citizen and community based advocacy and marine conservation on Maui. According to experts many communities are concerned about degradation of marine areas but are not yet organized enough to support and encourage the protection of these resources. One expert suggested that NGOs with the capacity to engage and support community-based management would find numerous enthusiastic community members willing to work together for improved marine management.

Recommendations for possible conservation actions for Maui include:

1. Additional interviews with experts to identify other priority sites.
2. Surveys to better understand the biodiversity as well as the condition of the marine resources of Maui.
3. Resource use assessments to understand human activities and their impacts.
4. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
5. Enhanced research on the impacts of human activities on marine resources in Maui
6. Continued studies and monitoring of the spread of alien algae.
7. Extension of watershed partnership programs to reduce nutrient and sediment flows into the marine area.
8. Development of community partnerships with citizen groups and others across the island to support and encourage marine conservation actions.
9. Development of a multi-stakeholder strategy for the long-term conservation of Maui.
10. Support including education for roll out of new minimum fish sizes and other DAR regulations.

Hawai'i

Many experts consider the island of Hawai'i a very high priority for marine conservation. While the youngest island with the least developed coral reefs, Hawai'i is home to a number of healthy marine and coastal areas. Likewise, Hawai'i has not suffered the explosion of alien species that has occurred in O'ahu and Maui. The Big Island is also home to anchialine pools -- a unique coastal ecosystem that is one of the most threatened in the state. Anchialine pools are landlocked brackish ponds located close to the shoreline and connected to the sea via subterranean tunnels. Many rare plants and animals can be found in these ponds. Of the approximately 700 anchialine ponds found in the state, 480 are found on the Big Island. Unfortunately, as many as 95% of these have been impacted by human activity including the introduction of alien species. There are several restoration efforts ongoing in the state to restore anchialine ponds.

Hawai'i is also home to several feeding and resting areas for green sea turtles and two nesting sites for hawksbill sea turtles. While several nesting sites fall within protected areas such as Volcanoes National Park, there are many nesting areas that are unprotected and fall victim to predation by feral animals. Several experts suggested the need to more adequately protect nesting beaches for marine turtles in the MHI.

Hawai'i is also home to one of the best examples to date of an effective marine managed area initiative. The Kona coast Fisheries Management Area and Fisheries Replenishment Areas have been highlighted by the majority of experts as one of Hawai'i's marine conservation success stories (see Box 5 on page 68). Having observed the formation of these protected areas, other communities have also now become interested in developing their own marine management areas.

Experts placed an emphasis on the Kona coast as being important for marine conservation almost in its entirety. Several areas along the Kona coast were emphasized as important for conservation. The Ka‘u coast was also emphasized as an important, relatively natural coastal system and a high priority for conservation.

Specific sites mentioned by experts included:

Makalawena: This area was identified by experts as important coastal habitat for native plants and important for anchialine ponds.

Kiholo Bay: This bay is important both for anchialine ponds and the Kapoho tide pools.

Puako: Puako was mentioned as an area that is important for tide pools. This area also has almost 100% coral cover in certain areas. Puakea is already a Fisheries Management Area but was cited as a place that could use additional conservation management. Currently, this area is not a full no take zone, and as a result, some experts have suggested more complete protection for marine life in this area.

The Ka‘u Coast: This coast is also reported as an important area for hawksbill turtles, which nest both here and in south Kona. Fish populations are reported to be relatively healthy in Ka‘u, as a result of the rough seas and low human population in the area.

Kealakekua Bay: Experts mentioned Kealakekua as an important area for coral and other marine life. A state MLCB is located in the Bay and protects 315 acres. One subzone allows some take of marine life, while some types of take are allowed in another subzone. Some experts interviewed felt the entire MLCB should be off limits to resource harvesting.

In general, experts indicated that areas that are remote even on the Big Island, which is one of the least-developed islands, are generally the most important for conservation.

Recommendations for possible conservation actions for the Big Island are similar to those for other islands and include:

1. Additional interviews with experts to identify other priority sites.
2. Surveys to better understand the biodiversity as well as the condition of the marine resources of Hawai‘i.
3. Resource use assessments to understand human activities and their impacts.
4. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
5. Enhanced research on the impacts of human activities on marine resources in Hawai‘i.
6. Continued studies and monitoring of the spread of alien algae.
7. Development of a multi-stakeholder strategy for the long-term conservation of Hawai‘i.
8. Support, including education, for roll out of new minimum fish sizes and other DAR regulations.

Kaho‘olawe

While Kaho‘olawe is believed to suffer from the greatest sedimentation of any Hawaiian island, it remains a major priority for marine conservation for several reasons. Because the area has been off limits to fishing for as much as 50 years, the fish populations and ecosystems that support them are in relatively good shape. There is evidence that the islands use as a bombing target did affect the marine environment, yet much of the area’s marine systems remain largely intact. Likewise, sedimentation from the island, while severe, remains largely limited to natural drainage areas. As a result, extensive reef and marine systems escape the worst of the sedimentation. Fortunately, protection of the marine resources of Kaho‘olawe will continue as long as the area is well managed by the Kaho‘olawe Island Reserve Commission (KIRC). It is possible that the area could be opened up for fishing, in fact several individuals have already started lobbying for rights to fish in the area. To date however, those requests have been denied and the area remains under a no fishing regulation, with the exception of very limited fishing by native Hawaiians. However, experts have indicated that ‘opihi have already been depleted in certain areas suggesting that these areas have been over-harvested.

As part of its program, the KIRC is undertaking regular marine monitoring. Unfortunately, these monitoring reports were not accessed s part of this study.

Recommendations for Kaho‘olawe:

1. Cooperative surveys with KIRC to better understand the biodiversity as well as the condition of the marine resources of Kaho‘olawe.
2. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
3. Development of a multi-stakeholder strategy for the long-term conservation of Kaho‘olawe.
4. Support, including education, for roll out of new minimum fish sizes and other DAR regulations.
5. Ensure that current monitoring efforts are able to track appearance of alien species (especially fish and limu).

Lana‘i

Lana‘i was not mentioned by many experts, although those that did mention it suggested that the Northern coast is an area that may be a priority for marine conservation. The channel between Lanai, Maui, and Molokai contains significant precious coral resources. The main suggestion was to undertake surveys to better understand the extent of the resources and the condition of the resources in Lana‘i. One expert emphasized that Lana‘i is likely to be a high priority for marine conservation but there are many areas that have not been surveyed. Experts also suggested this area may be important because it has a low human population, and there is likely to be less fishing there than in other parts of the MHI. However, Lana‘i suffers from the same sedimentation stress as Molokai and

Kaho‘olawe, and has suffered from algal blooms in the past. Fortunately, some Lana‘i residents have expressed an interest in better understanding how marine protected areas could improve local fishing conditions.

Recommendations for Lana‘i (recommendations remain general as very little information was provided by experts):

1. Discuss with owners their interest in possible marine conservation efforts. (Note the potential interest of community members in marine conservation as a means to improve fishing conditions.)
2. Surveys to better understand the biodiversity as well as the condition of the marine resources of Lana‘i.
3. Resource use assessments to understand human activities and their impacts.
4. Threat and opportunity assessments to better understand how to more effectively develop conservation programs.
5. Development of a multi-stakeholder strategy for the long-term conservation of Lana‘i.

Appendix II: Enhancing The Management Of Aquarium Fish Species In Hawai'i

Co-authored by Jan Dierking

Executive Summary

The following assessment of the aquarium fishery in Hawai'i was completed at the request of the Harold KL Castle Foundation and the Hawai'i Community Foundation. The assessment articulates the main threats to aquarium fish species, outlines current obstacles to effective management of these species, discusses progress that has been made to date on management of these species, and provides a set of recommendations that we believe, if followed, will greatly enhance management efficacy of the aquarium fishery and will hopefully lead to improved populations of target species. The assessment was completed based on interviews and discussions with experts involved in the aquarium fishery including collectors, biologists, resource managers, representatives of non-governmental organizations, representatives of the State of Hawai'i's Division of Aquatic Resources, and others. By no means is the assessment comprehensive. There are numerous other individuals who could have provided important information but could not be interviewed due to time constraints. In addition, this assessment focused attention on the West Hawai'i fishery. While this fishery comprises nearly 60% of the total fishery in the state there remain important factors from other islands that must be taken into consideration in future assessments.

The majority of aquarium fish species caught in the U.S. are from Hawai'i. In turn, the West Coast of the Big Island is the current center for aquarium fish collection in the state. In recent years, controversy over the impact of aquarium fish collection has led to closure of 35.2% of the West Hawai'i coast to collection. While these closures represent a major milestone in marine conservation in Hawai'i, threats and obstacles to effective management of aquarium fish species remain. Recent research indicates that commercial collection of reef fishes is having a negative impact on populations; however, data is very limited and more studies are needed to determine the exact nature and extent of the impacts. Other potential threats include the use of destructive gear, direct catch and by-catch by other near shore fisheries, alien species, habitat alteration, coastal development, sedimentation, and pollution. While each of these may have an impact, most experts agree that the most significant threat to aquarium fish populations is direct capture. Obstacles to more effective management include a relatively weak regulatory regime, scarcity of scientific knowledge about aquarium species, and the fishery, illegal take of aquarium fish fueling continued controversy, and numerous constraints to effective enforcement including financial and human resource limitations.

Recommendations from experts were divided into three categories: Enhancing Management Actions, Filling Knowledge Gaps through Research, and Pursuing Opportunities to Enhance Sustainability. The primary management actions that were recommended included: ensuring that fishers follow existing regulations such as catch reporting requirements; creation of an airport inspection program; creation of a limited entry system,; support for multi-stakeholder management and the West Hawai'i Fisheries Council; support to the collectors to revive their industry association; assistance to

collectors to develop alternative livelihoods; investigation of the feasibility of a permit buy-out scheme; strengthening regulations on other fishing in the Fishery Replenishment Areas; and pursuing the management of the West Hawai'i coastline and other relevant coastlines from an integrated ecosystem approach. Recommended research activities included: ongoing monitoring for the next several years; studying the basic biology of aquarium fish species; studying the impact of aliens species; studying the impacts of other fisheries and marine recreation; studying the impact of coastal development, run-off, sedimentation and pollution; and the development of a socioeconomic research agenda. Recommendations to enhance sustainability included: studying the applicability of Marine Aquarium Council certification, creating sustainable financing mechanisms to fund the recommended management and research activities, and addressing urgent human resources needs to enhance management.

Experts from all walks of life were positive about our ability to more effectively manage this fishery in the long-term. There appears to be great opportunity to continue to work together to create Hawai'i's flagship fisheries management success story and in doing so benefit fishers, the local environment, and society overall.

I. Background

The following assessment was compiled at the request of the Harold K.L. Castle Foundation and the Hawai'i Community Foundation (HCF). Building on a previous HCF assessment of marine conservation issues in Hawai'i, it was recommended that the aquarium fish fishery be assessed in more detail.

The goal of this assessment is to synthesize the opinions of experts and provide a series of recommendations that, if followed, are very likely to enhance the effective management of aquarium fish stocks and our near shore environment in general. One expert provided an eloquent vision for the future of the aquarium fishery. He suggested that our collective goal should be to create a fishery that is appropriate for Hawai'i, that benefits fisherman, but also ensures the long term viability of this common property resource. This will include creating a situation where fishing and other non-extractive uses do not come in conflict, where the fishers themselves become the primary stewards of the resource because they fully recognize that their livelihoods depend on careful management of a finite, commonly-held resource.

Methodology

The timing of this assessment was opportune, as both a researcher funded by the Hawai'i Coral Reef Initiative and The Nature Conservancy had recently commissioned two independent studies of the aquarium fish industry. Both studies were undertaken by Jan Dierking, who is a co-author on this assessment. The first report focused on the economic analysis of the industry. The second was a profile of the industry with particular emphasis on potential for Marine Aquarium Council (MAC) certification. Both of Dierking's reports were based on detailed interviews with about half of all active aquarium fish fisherman and seven of eight wholesalers on the West Hawai'i Coast. Interviews with collectors and wholesalers were open ended but focused on

understanding how the industry functions, the number of fish collected, the value of the industry, collectors attitudes toward Marine Aquarium Council Certification, and their feelings regarding current and future management practices.

The assessment presented in this document has built on Dierking's earlier studies by interviewing other individuals closely involved with aquarium fish management. People interviewed include: biologists, resource managers, representatives of non-governmental organizations, representatives of the State of Hawai'i's Division of Aquatic Resources (DAR), and others. These interviews focused on understanding threats to aquarium fish species, current management practices, perceived gaps in management, perceived obstacles to more effective management, and expert recommendations on how to improve management of the fishery in the long-term. The combination of interviews with collectors and wholesalers as well as other experts provides a relatively inclusive understanding of stakeholder perspectives about the industry.

To protect confidentiality of those interviewed, we do not provide specific citations but instead refer to all people interviewed as "experts". The assessment focuses on the Big Island, the most important catch area in the State of Hawai'i with 58% of the statewide catch on average (Miyasaka, 2000). It is recommended that future assessments, as well as management strategies, more fully incorporate elements of the fishery from other islands, particularly O'ahu and Maui.

II. Current Situation

Seventy percent of the marine ornamental fish originating in the U.S. are collected in Hawai'i. Hawai'i is well known for its high rate of endemism, including a large number of endemic reef fish and invertebrates. For nearly 30 years, public concern over collecting aquarium species has highlighted the need for increased study and regulation of this industry (Tissot and Hallacher, 1999). In 1973, public pressure influenced the DAR to start requiring monthly collection reports to better regulate the industry (Taylor and Nolan, 1978). Since the inception of these monthly collection reports the industry has more than quadrupled from a catch of 90,000 fish collected in 1973, to over 400,000 collected in 1999 (Miyasaka, 2000). It is important to note that these numbers are based on official DAR catch reports. However, actual catch numbers are believed to be much higher.

In fiscal year (FY) 2002, there were 52 commercial permits issued by DAR for the Big Island of Hawai'i. The variability of permit numbers from FY 1999 till FY 2002 is shown in Figure 1.

Big Island Commercial Permits

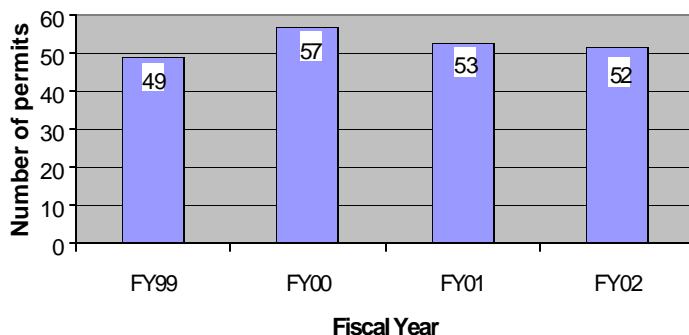


Figure 1: While active permits have remained close to 50 in any one year, it is important to note that less than half of the permit holders were actually actively fishing in 2002 (DAR unpublished data, information from interviews by Dierking). The reasons for this include:

- There are people who apply for a permit, try collecting, find it hard, and stop, while their permit remains valid until a year later.
- There are a number of collectors who were active in the past and still renew their permit annually, possibly to keep the option of going out open.
- A number of businesses try to hire new divers. Oftentimes either party ends the working relationship after the first couple of weeks, but the permit remains valid and in the files.

Because people constantly enter and leave the industry, the number of active collectors fluctuates. Divers may also switch to other companies, e.g. because a higher price per fish is paid. Change is facilitated by the fact that all divers are independent contractors and not bound by contracts.

Although more than 100 different species of fish are caught in the fishery, it is centered on approximately a dozen species. On the Big Island, the Yellow Tang alone accounts on average for 78% of the total of all collected fish. The four most caught species together (in order of importance; Yellow Tang, Kole Tang, Achilles Tang and Naso Tang, in this report termed “the big four”) make up over 90% of the catch. This high intensity collection of a small number of species raises questions about the sustainability of the harvest. The industry also targets extremely rare or endemic species. Many of these species are naturally found in very small populations, therefore entire populations may be at risk due to aquarium collecting.

Figure 2 clarifies relative importance of the “Big Four” and the remaining 6 species of the top ten Big Island species in terms of numbers.

Average importance of common species

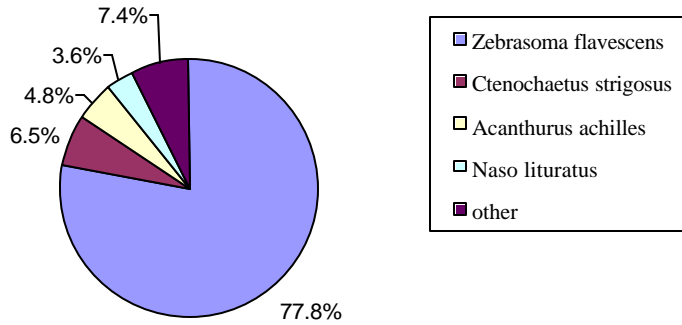


Figure 2: Average relative importance of common species in % of total catch number, FY 95-99 (data from Miyasaka 2000). The diagram shows that the “Big Four” on average, make up over 90% of the catch. In terms of value, the four species contribute 87.2% to the total. The difference is caused by the fact that the rarer species usually have a higher than average price on the market.

Progress In Managing The Aquarium Fish Industry In Hawai‘i

In recent times the aquarium fishery on the West Hawai‘i coast has experienced the most management attention in the state. This area has seen a large increase in collections in the early ‘90s, and has developed into the most important catch area in the State of Hawai‘i. The background science on the impact of collections is very thin, but perceived decreases in fish abundance were attributed by many to the collection activities of the aquarium fishery. As a result, public pressure to better manage the fishery mounted in the mid-1990s. In 1998, this public pressure resulted in the passing of ACT 306 by Hawai‘i’s legislature. The act mandated the setting aside of at least 30% of the West Hawai‘i coast as Fish Replenishment Areas (FRAs). Also in 1998, the West Hawai‘i Fisheries Council was established and tasked by State law with community-based management of West Hawai‘i’s marine resources. The council determined nine locations for FRAs in 1998. In a public hearing process, the locations and dimensions of FRAs were further discussed, and the areas went into effect in January 2000. The nine FRAs comprise 27.8% of the nearshore habitat along the West Hawai‘i coastline. Taking into account the areas that were already protected prior to the FRAs, a total of 35.2% of near shore habitat of the West Hawai‘i coast is now closed to collection.

Historically, the aquarium fish industry has been largely unregulated. Filing of monthly catch reports by collectors to the DAR has been required by law since 1973, but was not enforced. As a result, from January 1998 to July 1999, 59% of catch reports were not filed and another 19% of reports said “no catch”, although some of these collectors had been observed on the water collecting (DAR, unpublished data). Therefore, precise

monitoring of the industry catch is, at this time, not possible, and valuation of the industry has to be based on estimates. Experts believe that the current self-reporting system underestimates the harvest of aquarium fish, highlighting the need for more effective methods of harvest assessment.

It is also important to note that this fishery may be inherently more sustainable than other capture fisheries because it targets non-reproductive age fish and breeders of small size rather than the larger reproductive age individuals that produce high amounts of eggs. While this does not guarantee enhanced sustainability, this factor makes the fishery unique and should be taken into consideration as management and research activities proceed.

Economic Value Of The Aquarium Fish Industry

Estimates of the total value of the aquarium fish industry in Hawai'i vary widely. The last official DAR industry value estimate was for fiscal year 1994 and estimated the annual value of the industry at \$844,843 (Miyasaka, 1997). From the review of catch report summaries it appears that previous estimates were severely underestimating the industry value. They did not take the structure of the Hawaiian market sufficiently into account and as a consequence used export ratios and price estimates that were too low. Up-to-date price and industry structure information (e.g. export ratio of catch) from the interviews were linked to the available catch information (i.e. catch numbers per island and statewide) from DAR catch report summaries (e.g. Miyakaka, 1997; Miyasaka 2000), and led to a recalculation of the total industry value at more than three times the previous official estimate. For the Big Island, a total industry value of roughly \$1,840,000 was estimated, while for the State of Hawai'i, the estimate was close to \$3,200,000. While the new value does appear to give a more accurate picture of the industry, there are a number of limitations of the current estimate due to limitations in data. It is important to continually update the estimate as more data becomes available. Likewise, it is important to recognize that the fishery has an indirect positive economic impact on the local economy. This impact has not been calculated.

The Impact Of The Aquarium Fishery: Our Current State Of Knowledge

The opinion of most experts is that the aquarium fishery does have a negative impact on populations of aquarium fish. The most thorough and recent scientific evidence is supplied by the West Hawai'i Aquarium Project (WHAP) and indicates that these perceptions are accurate. WHAP is a large-scale monitoring study of sites in areas open and closed to aquarium fish collection along the entire western coastline of the Big Island. WHAP has been operating since 2000 and preliminary findings show significant differences between fish abundance in collected and uncollected areas. While it is very likely that aquarium collection has an impact, the effects and the magnitude of the impact are not fully understood. Further research in fishery biology will be necessary to understand if collection is causing decreases in populations that will eventually lead to depletion, or if the populations in collected areas are smaller than in FRAs but remain

stable. Many experts, therefore, advise caution and stress the imminent need for additional research.

Maximum Sustainable Yield

No conclusive data currently exists on maximum sustainable yield (MSY) of the aquarium fish fishery in Hawai'i, including the catch area of the West Hawai'i coast of the Big Island. While an evaluation of MSY is not possible at present, a prediction of industry trends is possible. In the eyes of experts it is unlikely that populations will suddenly crash, considering that a relatively constant number of collectors has generated a stable catch for about 10 years on the Big Island. This does not say whether the catch is sustainable at present level or not. Experts estimate that recent collecting levels are likely to characterize the level that will predominate in the near future (3-4 years). They feel that socio-economic factors (e.g. industry age structure, current market demand, wholesale business infrastructure and others) will likely limit major increases or decreases in collection. It remains unclear however, if these collection levels represent the MSY for the fishery. More basic fisheries biology studies are badly needed to help in the determination of MSY.

III. Threats To Aquarium Fish Species

There are a number of threats to the sustainability of aquarium fish species populations. There is little doubt among those experts (other than collectors) that the single largest threat is overexploitation from the aquarium fishery. However, it is important to stress that other threats to these populations do exist. These include destructive gear types and by-catch from other nearshore fisheries, aliens species, and a number of threats tied to the rapid increase in population and tourism, e.g. habitat alteration due to coastal development, pollution, sedimentation, and several others.

Overexploitation

Overexploitation is believed to be the most severe threat to aquarium fish species. The volume of fish removed from Hawai'i's reefs is believed to be very high compared to other aquarium fisheries throughout the world. As mentioned the impacts of fishing high volumes of aquarium fish are not fully understood. However, the most recent studies on the populations of ornamental species indicate there is a negative impact on populations. The results of a study by Tissot and others indicated that aquarium fishing is having a significant impact on eight of ten commonly collected species (Tissot and Hallacher, 1999). However, the researchers reported that additional knowledge is needed about the location and intensity of collection to be sure if the changes in abundance of fish recorded are clearly the result of collection activities.

The establishment of the FRAs is an outstanding step in improved management. However, it is important to recognize that the FRAs have reduced the potential catch areas, yet there are currently no regulations in place to manage open areas or to limit volumes of fish being collected. As a result, the potential for overfishing in the areas that remain open has actually increased since the creation of the FRAs.

Destructive Methods, Other Nearshore Fisheries, And By-Catch

Destructive fishing methods carried out both by aquarium fishers and others pose a threat to aquarium fish populations. These include use of chemicals, disruption of habitat to access fish, and the use of indiscriminate fishing gear, such as gill nets. The use of chemicals, such as bleach, has been cited in Hawai'i but is not believed to be common in any fishery. There is no indication that the use of cyanide and other chemicals common in Southeast Asia occurs in the Hawaiian aquarium fishery. Destroying or disturbing fish habitat by crow barring and breaking corals has been reported throughout the state. It is common that aquarium fish may hide in coral as they are driven towards barrier nets. There are reports that collectors break coral in order to scare fish into the open water again. Fortunately, only a minority of collectors seems to use this approach and it is not believed to be a major threat. Another concern is the improper use of barrier nets. Some collectors are known to "walk the reef" when setting the nets, which can cause breakage of corals. Most experienced collectors do not seem to use this practice.

Direct interaction between nearshore food fisheries and aquarium fish is not believed to pose a major threat to aquarium fish species. With the exception of a few species such as the Achilles Tang, food fisheries do not target fish that are also used in the aquarium trade. Likewise, food fishers typically fish in areas where there are not abundant populations of aquarium fish or use specific methods such as spears to capture species of coral reef fish. As a result, the amount of by-catch of aquarium fish in the food fishery is believed to be low. However, it is true that indiscriminate fishing methods used in the food fishery, such as leaving lay nets unattended, is likely to have some impact on aquarium fish species. No studies have been done to date on aquarium fish by-catch in nearshore food fisheries.

Ecosystem-Level Impacts

As populations decline due to the threat of over-harvesting and other factors, there is a serious possibility of ecosystem-level impacts. Ecosystem dynamics on coral reefs are not well understood and it is very possible that large-scale removal of key species could cause ecosystem cascade effects that impact other levels of the food chain. For example, the removal of herbivorous fish may enable an explosion of algae that in turn could affect coral recruitment. While these types of impacts have not been documented to date, experience around the world suggests ecosystem level impacts are directly related to changes in population dynamics. Reefs in the main Hawaiian islands are known to have greatly altered community structures as a result of overexploitation and other factors. Continued overexploitation due to the aquarium trade is likely to play a role in exacerbating these impacts to ecosystem dynamics and community structure.

Damage Caused By Inexperienced Fishermen/Divers

Several aquarium fisherman and others have observed direct impacts to the ecosystem as a result of inexperienced fisherman. New divers may have limited control of their bodies and equipment and, therefore, can break corals, tangle nets, and disrupt other habitat

elements. While the average collector has over a decade of experience and, therefore, minimizes impact, there is considerable turnover in the pool of collectors and new collectors join the industry every year. It is also typical that each year new people join the industry and subsequently drop out. This regular stream of new collectors is believed to result in impacts to the coral reef habitat (although no one knows how significant these impacts may be).

Alien Species

In recent years many people have suggested that alien species, particularly species of fish including ta`ape (*Lutjanus kasmira* or Blue lined snapper) and roi (*Cephalopholis argus* or Peacock grouper) may have impacts on aquarium fish species. Both species are carnivorous and have become extremely common in the nearshore environment. At this stage only limited studies have been carried out; however, there is currently no evidence that suggests that either species has a significant impact on aquarium fish species. Ta`ape tend to feed in areas over sand flats and in deep water where most aquarium fish species are not present. Gut content analysis of ta`ape has not, to date, indicated the presence of Yellow Tang, at a minimum suggesting there may be little if any interaction between ta`ape and the single most important aquarium fish. Roi has not been studied as much as ta`ape but similarly, gut content analysis of roi shows very little fish content. Roi stomachs are often found empty. Researchers suggest that the energetic requirements of roi are likely to be very low and as a result predation levels on aquarium fish are also likely to be low. There is no doubt that more studies are needed to better understand the relationship between alien fish species and aquarium fish. But at this stage, the best available knowledge suggests alien fish species are not a major cause of aquarium fish declines.

Other alien species including algae and mollusks may have indirect impacts on aquarium fish populations by contributing to the degradation of the coral reef environment. On O`ahu, for example, alien algae have caused major impacts in some areas turning coral reef dominated ecosystems into fields of alien algae. Fortunately, this has not happened yet on the Big Island. If this was to occur in the main aquarium fish collection areas, such as the Kona Coast and key parts of O`ahu and Maui, it could have significant impact on aquarium fish populations.

IV. Obstacles To More Effective Management

Limitations In Management

Many experts believe that nearshore fisheries in Hawai`i are not sufficiently managed. The main management tools for the aquarium fishery are commercial permits and the requirement to file monthly catch reports. The permit system has no limitations on entry and, therefore, in essence anyone could enter the fishery. The only control is, therefore, by socio-economic factors. For example, successful entrants may be prevented by the fact that collections are a physically demanding job and because it may take years to become an effective collector without a mentor. Therefore, there are typically new entrants every year but most fail to make a successful business out of collection.

According to DAR data, 59% of collectors did not file reports in a recent period, and it is thought that some of the reports that are filed are underreporting the actual catch. No system is in place to ensure that catch reports reflect the true catch by a collector. This potentially important management tool is not working in a way that allows reliable monitoring of the industry. Currently, efforts by DAR are underway that have great potential to enhance management within the next 1-2 years if they are realized. Measures include improvement of the catch report forms currently in use, revision of the filing process, and the creation of an up to date database of the industry.

Scarcity Of Scientific Knowledge

Scientific knowledge of aquarium fish biology and knowledge of the impacts of the fishery are very limited. Currently, there is extremely little information about the life history of most aquarium fish species including age at first reproduction, life span, recruitment patterns, dispersal envelopes, replenishment rates, and many other factors. Likewise, little information exists about the ecological processes that ensue after collections, e.g. potential species shifts, re-population of areas, or ecosystem changes such as increases in algae. In addition, the failure of collectors to submit catch reports makes it very difficult to obtain details about the fishery in terms of catch, catch area, and other important factors. As a result, the fishery is difficult to manage from both a biological and socioeconomic standpoint. As outlined below, a major recommendation of this assessment is filling major gaps in biological and socioeconomic knowledge about aquarium fish species and the fishery.

Poaching In Fishery Replenishment Areas And Marine Life Conservation Districts

Poaching is not believed to be widespread; however, it is known to occur with some regularity. It is believed to be uncommon near populated areas but much more common in remote areas. Several people believed to be fishing illegally in FRAs and MLCDs have been observed and reported to DOCARE. In addition, one boat has been apprehended and its occupants prosecuted for fishing illegally. While it is uncertain how serious an impact is caused by poaching, poaching clearly undermines the intent of the FRAs, which is to improve fish stocks with the possibility of eventually improving catch throughout the coast. Illegal fishing not only limits the efficacy of fisheries management but fuels conflicts that could perpetuate divisions between individuals and entities regarding aquarium fish management. In most cases, both fishers and other interested parties want the same outcome, which is simply “more fish” in both the short and long term. Improved fish populations have been proven to occur as a result of “no take areas” throughout the world. As a result, it is critical that all individuals refrain from poaching to enable the community at large to test whether or not FRAs can improve fish populations and eventually improve catch outside the FRA boundaries.

Constraints To Effective Enforcement

A number of people interviewed indicated that funding and personnel are much too low to enable adequate enforcement. Due to these constraints, DOCARE agents are almost never out on the water. However, experts believe that the regular presence of DOCARE boats would discourage poaching right away. Likewise, the current rules regarding the FRAs make it very difficult to convict an individual for poaching. Currently there are no buffer zone so fishers can anchor directly on the boarder of an FRA and conceivably can fish within the FRA with little chance of detection. Likewise, it is not illegal to have fishing gear or aquarium fish in an FRA so the poacher must be caught in the actual act of poaching to enable prosecution. As a result of the current rules, poaching that is not observed “in the act” usually cannot lead to convictions, because poachers can get away with the excuse that the fish were caught elsewhere and the fishermen were only spear-fishing in the FRA (which is allowed). Fortunately, the West Hawai‘i Fisheries Council is already pursuing new rules to address these issues. The establishment of these rules should be supported by all relevant stakeholders.

V. Balancing The Needs Of Multiple Stakeholders

According to several experts that were interviewed, at certain points during the past several years some people have debated sustainability in the aquarium fish fishery as an all or nothing proposition. In other words, either the fishery is inherently unsustainable and, therefore, should no longer be allowed to continue, or it is unquestionably sustainable and, therefore, should not be regulated. It is impossible to defend either position, simply because there is not enough information. It is also unlikely that either extreme position can be accommodated under a management regime. In other words, it is unlikely that the industry would be completely closed and similarly it is unlikely that the industry would be completely unregulated. Fortunately, in recent years there has been greater tendency toward compromise and a recognition that it may be possible to manage the fishery sustainably and balance the interests of numerous stakeholders. Several collectors support enhanced management; however, they have expressed a desire that this management be based on scientific research and data, not on inference. This argues for greatly increased research to more fully understand the fish and the fishery.

The West Hawai‘i Fisheries Council is a multi-stakeholder body with broad representation of a number of critical interests, including government, commercial fishing, non-governmental organizations, the recreation industry, and several other groups. However, there remain significant constraints to adequate multi-stakeholder participation in management of the aquarium fishery. The West Hawai‘i Fisheries Council currently has no representation from the aquarium fish collection industry. Likewise, the industry itself has no organizational means through which to participate in management. Until recently, industry members were organized through the Hawai‘i Tropical Fish Association. However, this entity ceased to function in 2000, thus further fragmenting the industry and making it hard to address the industry as a whole. Some industry participants have recently indicated their desire to reorganize some kind of industry body to represent their interests. However, one constraint is the time of industry

members to do so. Likewise, some collectors indicated that the entity largely ceased to function because of a perception that it did not adequately represent the industry and had little voice in the proceedings of the West Hawai'i Fisheries Council. As a result, several have recommended that any revived Association must be organized to more adequately represent the industry and must have a seat on the Council. Several recommendations below provide suggestions as to ways to more adequately ensure multi-stakeholder cooperation in management of this fishery and the nearshore environment in general.

VI. Recommendations

This recommendation section attempts to provide an effective course of action to improve management of populations of aquarium fish. It is based entirely on suggestions made by experts who were interviewed for this assessment and for the assessments carried out by Jan Dierking. As a result, the recommendations are not the opinion of the authors but rather our best attempt at a synthesis of the opinions of people involved in management and use of aquarium fish species. It is critical to recognize that aquarium fish species will be best managed in the context of effectively managing the entire near shore environment. As a result, any management regime that strives to manage the aquarium fishery must also manage other nearshore fisheries and threats. The West Hawai'i Fisheries Council is mandated to do just that and is making excellent progress. For example, the Council has developed regulations for gill nets that are likely to make a very significant positive impact on all nearshore species if they are adopted and adequately implemented.

An overarching recommendation is the development of a collective strategy to enhance the management of aquarium fish and other ornamental species across the state. Many current activities are a step in the right direction and should be enhanced, but a collective strategy would also provide a road map and framework to guide and coordinate all activities and to allow a better evaluation of progress and hopefully success.

Enhancing Management Actions

Some experts interviewed suggested that their preferred course of action from a conservation standpoint is complete closure of the fishery. They expressed that this is the best way to ensure sustainable populations of aquarium fish species. However, even the most extreme advocates of closures that were interviewed also expressed that it is critical to take the livelihoods of aquarium fishers into account and were open to considering better management rather than full closure. Other experts viewed the aquarium fish industry like any other capture fishery and felt that it simply must be better managed. They saw no reason for closure but instead recommended a much tighter management system, which includes some "no take areas".

Many of the aquarium fish collectors that were interviewed by Dierking recommended better management of the fishery and supported numerous elements of the recommendations that are provided below including limited entry, enhanced scientific management, and feasibility studies for Marine Aquarium Council Certification. The overall tone of the recommendations suggests that it is very possible to improve

numerous aspects of management and that the following recommendations can be successfully pursued.

Given the current lack of data in this fishery, the precautionary approach to management is by far the best approach. While there is clearly some debate as to what the approach entails, the recommendation section attempts to outline a course of action that will hopefully, in time, result in much improved populations of aquarium and other fish and a healthy, albeit limited, fishery. Unfortunately, Hawaiian fisheries management has tended toward open access and high levels of exploitation rather than the precautionary approach. As a result, movement toward a more precautionary approach may require some reductions in volumes of aquarium fish that are collected and also much stronger regulations on other nearshore fisheries. There is no doubt that some elements suggested below may be controversial to some people. However, experience throughout the world indicates that the multi-stakeholder approach can be a very effective way to improve management and to smooth out controversy. As a result, multi-stakeholder involvement in management is a major recommendation of the study.

Adequately Enforce Existing Regulations

Several experts indicated that a major step in improving management of the aquarium fishery would be for DAR to require full compliance with all existing regulations. For example, to obtain a permit, a fisher must agree to submit monthly catch reports. However, DAR records indicate that there is as much as 50% and more failure to submit reports. Experts also believe there is considerable underreporting of catch volumes. The responsibility for submitting catch reports falls with the fishers themselves and it is critical that they recognize that it is their legal obligation to submit the reports. However, as with any regulatory system there are some individuals who will choose not to meet their legal obligations. Therefore, it is critical that DAR also have a system in place to enforce this requirement. Some experts suggested that consistent failure to submit catch reports should result in forfeiture of one's permit for a significant period of time. Strict enforcement of this regulation would reward those aquarium collectors that have been working in good faith to assist in the active management of this fishery. Experts suggest that DAR must be encouraged at the highest level to strictly enforce the requirement of submitting catch reports. If DAR does, in fact, pursue stronger enforcement of catch reporting, they should first inform collectors that they will be changing their approach on this issue so collectors have the opportunity to come into compliance before being punished. Perhaps a warning could be issued to all fishers the next time they renew their permits that if they fail to submit catch reports, their permit could be denied the next year. Direct discussions with DAR on the best way to assist them to overcome the problem of catch reports should be pursued. Likewise, one expert has recommended that when collectors apply for a new permit, they should be required to fill out a form providing basic information in order to facilitate monitoring of the industry. Questions could include whether applicants act as a collector or wholesaler or both, which boat they work on and what kind of catch method they use. For wholesalers, additional questions could be where they export to and which divers they buy from, and for collectors, which wholesaler they work for.

Create an Airport Inspection Program

One way to be more certain about the number of fish leaving our reefs is to establish an airport inspection program. The Marine Aquarium Fisheries Enhancement Project, a DAR project in West Hawai'i is working to create an airport inspection program. Such a program would develop a protocol for inspection that would cause minimal impact on the fish but would provide accurate numbers of fish that are being taken from the reef. Those fish that die before they are shipped would remain undetected but would hopefully be reflected in catch reports. This system would be an excellent way to check the validity of catch reports. Those fishers found significantly under-reporting their catch could be fined or their permits could be revoked. Currently, DAR is investigating legal options for setting up such a program. If the legal mechanisms could be put into place, this program will likely require an initial infusion of outside funding to get it going. Agencies that need to be involved currently do not have sufficient budgets to add inspection agents. A possible option is for donors to fund a pilot effort and if it is successful, the system be included in state appropriations in subsequent years.

Create a Limited-Entry System

The Division of Aquatic Resources, conservation agencies and most collectors have recommended the creation of a limited-entry system. A limited-entry system would control the number of permits issued and, therefore, control the fishery. This is very likely the least controversial and easiest way to improve the management of the fishery. While limited-entry systems can be set up in different ways, some experts interviewed suggested that during the establishment of the limited entry program, only those fisheries who have been obeying existing regulations should be eligible for a permit. In other words, fishers that have consistently failed to submit catch reports and, as a result, have violated the terms of their permit would not be eligible for permits. This would quickly create a fishery that is comprised primarily of operators who are responsible enough to follow regulations and may also be interested in participating in management. Experts also recommended that the limited-entry system have a downward ratcheting mechanism to decrease the number of collectors to a level that is believed to be sustainable. In other words, when a fisher leaves the industry or has their permit revoked, another permit would not be issued to replace that person so the fishery is decreased by one individual. This target number could be calculated over time as more information about the maximum sustainable yield and catch per permit is acquired.

Support the West Hawai'i Fisheries Council and Ensure Multi-stakeholder Representation in Management and Enforcement

As mentioned, the West Hawai'i Fisheries Council is an outstanding multi-stakeholder body and needs additional support to carry out its mandate. There is a need for funding to support travel of participants and also a full time Program Officer would greatly enhance the work of the Council. Likewise, it is very important to note that there is currently no representation of the aquarium fish industry on the Council. It is critical to include adequate representation of this industry on the Council as quickly as possible. Likewise, enforcement is currently only carried out by DOCARE. Throughout the world multi-stakeholder initiatives have been very successful in enhancing maritime enforcement. For example, in the Philippines, enforcement at Tubbataha Reefs World

Heritage Site is carried out by a multi-stakeholder team that includes the local government, the local enforcement agency, local fisherman, and local non-governmental organizations. This arrangement has been extremely successful as a natural synergy of roles has developed. A multi-stakeholder approach to enforcement that involves local citizens has great potential in Hawai'i and should be explored and supported financially by various donors.

Assist the Industry to Organize an Association

Many collectors have expressed their interest in organizing the industry to allow more effective internal communication and better involvement of the industry in management decisions. As mentioned, the West Hawai'i Tropical Fish Association was active until 2000 but was disbanded. Many collectors have expressed an interest in reviving this association. Once revived, the association itself could then put forward a representative to serve on the Fisheries Council. Providing support to revive the Association would be a solid investment in encouraging industry participation in management decisions which in turn is critical to effective compliance with regulations.

Assist Fishers to Develop Alternative Livelihood Programs to Shift Away from Aquarium Fishing

Throughout the world, conservation organizations have been successful in enhancing conservation of natural resources by assisting local community members to pursue alternative livelihoods. In combination with a limited-entry system, an alternative livelihood program that creates new job opportunities for fishers could be successful. A training program could be developed and opportunities could be created in the dive and other industries. Also, it is possible that fishers could be employed as enforcement agents. This has been done successfully in the Philippines but it is critical that the fishers work as part of a team that involves others such as conservation organization representatives so that all actions of the team are consistent with the enforcement mandate.

Investigate the Feasibility of a Permit Buy Out Scheme

Some experts discussed the idea of a permit buy-out scheme. These types of programs have been used successfully in other areas of the world. However, they must be carefully structured and have covenants that prevent fishers from being bought out, then joining another destructive fishery. Likewise, these systems tend to be the most successful if used in combination with a limited entry system and an alternative livelihood-training program. At this stage a buy out of the industry is not a top priority but it should be carefully studied and kept in mind as a possible strategy to be used in combination with the other strategies outlined here.

Strengthen Other Fishing and Collection Regulations in the FRAs

The Fishery Replenishment Areas have established an excellent framework from which to enhance the management of the nearshore marine environment in West Hawai'i. The West Hawai'i Fisheries Council is pursuing additional regulations within these FRAs including enhanced restrictions on gill netting, spear fishing on scuba, night spearing and others. These efforts and new efforts to create full no-take areas should be pursued and supported as fully as possible. West Hawai'i stands to be one of Hawai'i's most

important areas for marine conservation and management if adequately supported. Currently, there is an immediate need for at least one more full-time person to work with local communities to help them clarify their goals for marine conservation and develop proposals. As more regulations come into force and more areas are designated for protection there will also be a need to enhance education, outreach, and enforcement capacity. A key approach is to work with the West Hawai'i Fisheries Council to fully develop a comprehensive strategy for the management of West Hawai'i. This strategy should in turn be first funded by donor support and in time be incorporated into state appropriations and sustainable finance schemes.

Pursue the Management of the West Hawai'i Coast (and other coastlines, such as Wai'anae, as appropriate) as Integrated Coastal and Nearshore Management Zones

Managing coastal areas in an integrated fashion provides great opportunities for rapid progress in conservation and sustainable development. Currently, the West Hawai'i Coast is the only place in Hawai'i that has a regulatory and political context from which to manage the coastal system as a whole. This is embodied within the Fisheries Management Area (FMA) that was also designated under ACT 306. Likewise, the West Hawai'i Fisheries Council plays a critical role in the management of the entire coastline.

In association with strategy development, a critical step is to also vest greater management authority in the West Hawai'i Fisheries Council. The council should either have direct rule-making authority or a relationship with DAR in Honolulu so that rules it develops are put into place. Other coasts stand out as candidates for similar integrated-management regimes. These include Wai'anae, West and South Maui, and several others. Without a doubt, bodies such as the West Hawai'i Fisheries Council should be replicated on all islands with sufficient collective jurisdictional coverage to ensure that every stretch of nearshore environment in Hawai'i has a local management council directly addressing its fisheries issues and simultaneously developing mechanisms for effective integrated coastal management.

Filling Knowledge Gaps Through Research

There is a great deal of biological and socioeconomic information about the fishery that is currently not well understood. Ongoing critical research currently is not sufficiently funded and there are numerous additional research topics that need to be studied. Research agendas for both biological issues and socioeconomic factors need to be developed and pursued. It is critical to involve aquarium fishermen in this research to the greatest degree possible. This will not only further involve them in management but will also encourage them to accept research data that is collected.

Fully Fund Ongoing Research

The West Hawai'i Aquarium Project (WHAP) has been monitoring the impact of the FRAs for the past two years. This research is absolutely critical to enhancing the management of the fishery; however it is subject to annual appropriations and a competitive application process of the Hawai'i Coral Reef Initiative. This program should be fully funded for a number of years so that researchers can do their work

without constantly worrying about funding support. In time, the monitoring must be included as part of regular state appropriations.

Additional Research Topics

Study the Basic Biology of Aquarium Fish Species

Currently there is very little known about the basic biology of most aquarium fish species. Unknowns include life spans, first age at reproduction, recruitment patterns, larval dispersion and several other critical factors. Fortunately the Hawai'i Coral Reef initiative has recently funded an effort to understand recruitment and dispersal of key nearshore fish species including some aquarium fish. Likewise, proposals have been prepared to study rates of replenishment of aquarium fish species in areas that are under rotation by the aquarium fish industry. In addition to these planned studies, there is a need to develop a research strategy that will yield information on other key aspects of the basic biology of several of the key aquarium fish species. It is recommended that the basic biology of the big four and some of the extremely rare species should be studied in the short term. Critical studies include: lifespan, age at first reproduction, average fecundity, dispersal patterns, replenishment rates, water quality thresholds for health and reproduction, and several others.

Study the Impacts of Alien Species

While initial studies indicate that alien fish species are not likely to be a major cause of mortality in aquarium fish species, it is very important that studies be undertaken to test this initial finding. These studies would help to understand the relative roles of outside factors and direct harvest in sustainability of aquarium fish. It will be particularly important to involve aquarium fishermen in these studies as fisherman often claim that alien species are a main cause of aquarium fish mortality.

It does not appear that other alien species are currently creating any problems for the aquarium fish stocks. However, efforts to control the spread of alien algae, mollusks, and other species are critical as these species do have potential to completely destroy the coral reef environment. Along with eliminating over fishing, the management of alien species is one of the top priorities for marine conservation in Hawai'i.

Study Impacts of Other Fishing and Marine Recreation

There is no doubt that other nearshore fisheries have some direct and indirect impact on aquarium fish. Likewise, there is some potential for dive and snorkel recreation, boating, and other activities to effect fish populations. Fortunately neither nearshore food fisheries nor marine recreation are believed to be a major source of impacts on aquarium fish species. Nonetheless they are often cited by collectors as a source of impact. As a result, it is very important to carry out studies to better understand if these activities have any significant impact.

Study Impacts of Coastal Development including Run-off, Sedimentation, and Pollution

Coastal development, run-off, sedimentation, and pollution are potential sources for changes in the nearshore marine ecosystem and could have impacts on aquarium fish species. Currently, the studies that have been conducted on the Kona Coast do not indicate any major changes in water quality in the nearshore environment as a result of

these factors. Most impacts appear to remain relatively localized and the high flushing rate of the nearshore environment around Kona appears to keep water quality very good. These factors may have a much more significant impact on O‘ahu and Maui where their sources, including urban areas and denuded landscapes are more abundant. Overall, these factors currently appear to be less significant sources of impact than direct capture. Nevertheless, it remains very important to design and conduct studies to understand the impacts of these factors as they have great potential to grow over time and could be a very serious source of impact on all nearshore marine species.

Develop a Socioeconomic Research Agenda

Understanding of the socioeconomic factors in the aquarium fishery and regarding aquarium fish has increased in recent years. WHAP’s work with local fisherman, the efforts of the Marine Aquarium Fisheries Enhancement Project, and the assessments carried out by Dierking are all contributing to increased knowledge about the socioeconomic features of the fishery. Likewise, a parallel project to record historical knowledge regarding fishery abundance and cultural importance of fisheries resources will play a big role in understanding how fish populations have changed over time and their importance to the local culture and economy.

However, our knowledge base in the socioeconomic realm is largely based on the poor collection data from catch reports. As a result, estimates on catch, income, and value of the fishery are all likely to be inaccurate. The majority of socioeconomic factors regarding this fishery will not be well understood until there is a proven system for ensuring that catch reports are accurate.

Other socioeconomic factors that do not entirely depend on accurate catch reports should be studied as well. These include: the importance of the fishery to individual livelihoods, willingness of individuals to pursue other livelihoods, the importance of the fishery to the local economy, the importance of these species to Hawaiian communities, trends in fisheries activity that may manifest as additional threats over time, and several other factors.

Pursuing Opportunities To Enhance Sustainability

Study the Feasibility of and Pursue Marine Aquarium Council (MAC) Certification

The Marine Aquarium Council (MAC) is developing a third-party, independent system to certify aquarium fish collection as environmentally responsible. This includes standards for collection, handling, shipping, holding facilities, ecosystem management, and other critical elements of the aquarium fish trade value chain. These standards represent World’s Best Practice in the aquarium fish collection industry and will contribute significantly to reducing mortality and improving conservation management at the field level.

It is critical to understand that at this stage MAC is not able to verify environmental sustainability but is only able to verify that a collector is following environmentally responsible practices. The reason for this inability is simply because there is insufficient

biological understanding of these organisms to ensure that particular collection techniques or volumes will result in sustainable populations. As long as basic fisheries data remains unavailable, it is impossible to know if application of MAC standards will guarantee sustainability.

However, pursuing MAC certification will play a major role in increasing collectors involvement in management, will provide collectors with a stronger voice on management issues, will help to reduce mortality, will help to enhance environmentally responsible practices, and will set a solid foundation for achieving environmental sustainability once the key biological factors that constitute the sustainability are understood. The Nature Conservancy, and other partners are working on a joint effort to understand if MAC certification is possible in Hawai'i. To a large extent it depends on the collector's interest and willingness to participate. Recent interviews by Dierking indicate that as many as 64% of collectors/wholesalers believe that there is a potential role for MAC certification in Hawai'i and are willing to discuss it further.

Establish Sustainable Financing Mechanisms

The recommendations outlined in this document will require significant funding and human resources. It is recommended that a comprehensive funding strategy be developed and that both grant funding and the involvement of the private sector be considered as financing sources. Priority and short-term activities should be pursued in the short term through grant funds, while long-term research, enforcement, education and outreach, and stewardship should be pursued with sustainable financing sources. Sustainable financing strategies can include guest contribution programs with key industries, such as the dive and snorkel industries, the local cruise industry, and the large cruise lines. These should be pursued as quickly as possible as the programs can take a long time to set up. It is expected that the majority of activities recommended in this assessment will need to be pursued with grant funds for the next three to five years while sustainable financing schemes are set up.

Enhance Human Resources

One of the greatest unmet needs in the management of the aquarium fishery and the nearshore environment in general is adequate human resources. There are very few individuals employed full time in conservation management and these are invariably overwhelmed with work. An ideal scenario would put at least three new people in place in the short term to assist with various aspects of management. One would focus on filling gaps in biological knowledge, another would work with communities and local people to encourage their increased participation in management and the third would work across all issues to provide adequate assistance to the West Hawai'i Fisheries Council. Since it is unlikely to put this many people in place in the short term, it is recommended that at least one full-time conservationist be put in place to help support conservation management in West Hawai'i.

Conclusion

As with any fishery or common property resource, a number of stakeholder interests must be taken into consideration when managing the Hawai'i aquarium fish industry. The

progress that has been made over the past decade represents Hawai'i's greatest success story to date in term of effective marine management. It is clear from expert opinion that the job is not over; however, the creation of the FRAs and the West Hawai'i Fisheries Council are both outstanding steps in a positive direction. Likewise, the increasing willingness of industry participants to consider new approaches to management is also very positive. We hope the recommendations articulated in this assessment will contribute to efforts to enhance the sustainability of this fishery. Collectively, it appears very likely that interested parties can achieve the vision of a sustainable fishery that benefits the collectors, the local environment on the Kona coast, and society overall.

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LIST OF EXPERTS INTERVIEWED

Non-Governmental Organizations

Lu Eldredge: Bishop Museum
Stephanie Fried: Environmental Defense Fund
Alan Friedlander: Oceanic Institute
Eric Gilman: National Audubon's Living Oceans Program
Scott Godwin: Bishop Museum
Isaac Harp: KAHEA
Cindy Hunter: Waikiki Aquarium
Linda Paul: Hawai'i Audubon Society
Dave Raney: Sierra Club/Reef Check
Cha Smith: KAHEA
Nainoa Thompson: Polynesian Voyaging Society
Ellyn Tong: Western Pacific Fisheries Coalition

Division of Aquatic Resources

Athline Clark
Bill Devick
Dave Gulko
Bob Nishimoto

Department of Land & Natural Resources

William Aila
Sam Lemmo

National Marine Fisheries Service

Rusty Brainerd

U.S. Environmental Protection Agency

Wendy Wiltse
Susan Polanco

U.S. Fish & Wildlife Service

Kevin Foster
Jim Maragos
Chris Swenson (Coastal Zone Program)

University of Hawai'i:

Celia Smith
Chuck Birkeland
Mike Hamnett
Cheryl Anderson
Eric Brown
Gordon Grau (Sea Grant)
Sarah Peck (Sea Grant)

Individuals

Mark Hodges