

**INTEGRAL MARINE ECOLOGY:
COMMUNITY-BASED FISHERY MANAGEMENT IN HAWAII**

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Successful fishery management requires a dynamic balance of disciplines provide a fully integrated approach. I use Integral Ecology to analyze multiple-use conflicts with an ornamental reef-fish fishery in Hawai'i that is community-managed via the implementation of a series of marine protected areas and the creation of an advisory council. This approach illustrates how the joyful experiences of snorkelers results in negative interactions with fish collectors and, thereafter, produce social movements, political will, and ecological change. Although conflicts were reduced and sustainability promoted, lack of acknowledgment of differing worldviews, including persistent native Hawaiian cultural beliefs, contributed to continued conflicts.

KEYWORDS: Integral Ecology, fishery management, aquarium fish, Hawaiian culture.

INTRODUCTION

Marine ecosystems are renowned for their abundant and seemingly endless resources. However, despite the long-term importance of these ecosystems in protecting shorelines, controlling climate, and providing food and inspiration, the world's oceans are currently in crisis (POC, 2003). This situation is particularly clear with respect to fisheries, which are declining

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globally (NRC, 1999). Commercially important species are under increasing fishing pressure and ecosystem structure and function are compromised (Jennings & Kaiser, 1998). Efforts to manage fisheries have met, largely, with failure. These management failures are primarily due to our limited understanding of marine ecosystems, uncertainties between fishing intensity and stock depletion, underestimation of the complex interactions with social systems, and lack of political will (Botsford et al., 1997). Catches are primarily driven by economic forces which eventually overwhelm slowly replenishing stocks. In some cases, specific stocks have been so severely overexploited that they are now listed as endangered species.

This article illustrates a new approach to fishery management using Ken Wilber's Integral Theory (Wilber, 1995) to examine community-based management of marine protected areas (MPAs). A major goal of MPAs is to establish a network of areas closed to fishing (marine reserves) that promote sustainable fisheries outside their boundaries (Murray et al., 1999). MPAs are currently of wide national and international interest (NRC, 2000) as they have been shown to benefit fishery populations, support fishery management, enhance non-extractive human activities such as tourism, protect ecosystems, and increase scientific understanding of marine communities (Murray et al., 1999).

Community-based management is a process that empowers local communities to manage their resources by letting individuals in the community contribute to decisions that affect local resources. One of the major benefits of community-based management is the development of strategies compatible with the unique environment, with the specific resources, and with the cultural and historical context of the local areas). Community-based management also aids in resolving conflicts over limited fishery resources among multiple stakeholders (Capitini et al., 2004).

Integral Ecology and Fishery Management in Hawai'i

Environmental conflicts are notorious for their complexities stemming from a combination of biological uncertainty, multiple stakeholders and issues, multiple and unique values and worldviews, and clashes between scientific and traditional knowledge (Daniels and Walker, 2001). Effective conservation and management requires the dynamical incorporation of multiple disciplines including biology, ecology, political-economy, and sociology to create an integrated management approach (Holling 1978, Michaelidou et al., 2002).

In 1995 Ken Wilber published *Sex, Ecology and Spirituality* and presented an integral model which described evolution as co-occurring in four dimensions or quadrants: the exterior-individual (behavioral) quadrant, the exterior-collective (systems) quadrant, the interior-collective (cultural) quadrant, and the interior-individual (experience) quadrant. Within each quadrant lies an unfolding holarchy of components that embrace and transcend each other in complexity. Integral Ecology (IE) is one application of Wilber's Integral analysis applied to ecological issues (Wilber, 2000). IE can also provide effective tools for addressing ecological issues through increased explanatory power by integrating divergent domains and by connecting with Wilber's comprehensive research. The approach used here is to explore and acknowledge each of the quadrants with all of their attendant complexity, thereby applying the AQAL (all quadrants-all levels) model (Wilber, 1995). The IE AQAL approach to ecological issues takes into account all perspectives and their respective knowledge claims, thus examining all interests, and providing recommendations for solutions that honor each perspective while maximizing the sustainability of the system as a whole .

IE is particularly well suited to examine the complex interactions associated with the management of coastal fisheries. Most studies of fishery management acknowledge the roles of biology, ecology, sociology, economics, and politics while paying little attention to important

cultural dimensions (Dyer and McGoodwin, 1994; Friedlander et al., 2003). Furthermore, no one, to my knowledge, has integrated experiential or spiritual dimensions into the discussion. In this paper I use IE to analyze a coral reef fishery in Hawai'i that uses community-based management of MPAs as a process to resolve conflicts and develop sustainable resources. The example presented is unusual in scope and complexity in that it involves the harvesting of live reef fish for the aquarium trade in areas where viewing reef fish is part of local recreation and a high-volume tourist business. Thus, in addition to the normal complex interactions associated with fishery management, there exists an additional multiple-use conflict over the extraction of these resources that involves differing worldviews regarding the appropriate use of the coral reef fishes. Intermeshed with these issues are the sociological, cultural, and spiritual dimensions of native Hawaiian culture, which persists in many of the more rural communities of Hawai'i.

AQUARIUM FISHERY IN WEST HAWAI'I

Global trade in marine ornamental fishes is a major international industry involving an annual catch of 14-30 million fish (Wood, 2001). Almost all tropical marine ornamentals are collected live from coral reefs and many originating from the United States are captured in Hawai'i, which is known for its high-quality fishes and rare, high-value endemics (Wood, 2001). In the 1970's aquarium collectors along the west coast of the island of Hawai'i (hereafter, West Hawai'i) first developed conflicts with the rapidly growing dive-tour industry selling views of fishes on the reef. The conflict developed around the perception by the dive-tour industry that colorful reef fishes were dwindling due to collecting activities, thus diminishing the aesthetic value of the reef -- a classic clash of conservationists' (i.e., sustainable yield) versus preservationists' (i.e., aesthetic beauty) worldviews (Capitini et al., 2005). One rallying point of

Integral Ecology and Fishery Management in Hawai'i

the conflict for preservationists in voicing their concerns was the abundant, colorful yellow tangs (*Zebrasoma flavescens*) that forms large schools at natural high densities and swarm over the reefs. Yellow tangs account for over 72% of the aquarium trade harvest in West Hawai'i and thus numerically dominate the collector's take (Miyasaka, 1997). Significantly, the dominant and aesthetic presence of these bright yellow schools of fish along the coastal reef is one reason why West Hawai'i is often referred to as the "Gold Coast."

By 1997 the situation had grown into a serious multiple-use conflict bordering on violence (Dybas, 2002). Because the state agency charged with managing fishery resources, the Department of Land and Natural Resources' Division of Aquatic Resources (DAR), repeatedly failed to resolve the conflict, pressure by local citizens' groups resulted in several bills submitted to the Hawai'i state legislature to ban collecting or to establish MPAs. In 1998, one of these bills passed to become Act 306, creating a fishery management area along the entire 120 km coastline of West Hawai'i and mandating substantive involvement of the community to help manage reef resources. One of the specific mandates required that a minimum of 30% of the West Hawai'i coastal reef be designated Fishery Replenishment Areas (FRAs) – MPAs that specifically prohibit aquarium fish collecting (Tissot, 1999).

To create the FRAs DAR established the West Hawai'i Fisheries Council (WHFC), a community-based group composed of the diverse stakeholders associated with reef resources in West Hawai'i (Capitini et al., 2005). The Council included aquarium collectors, an aquarium retail store-owner, commercial dive-tour operators, a hotelier, commercial and recreational fishermen, shoreline gatherers, recreational divers, and several general community representatives some of whom were members of the Lost Fish Coalition, a grassroots organization that aimed to shut down the aquarium industry (Capitini et al., 2005) Two council

Integral Ecology and Fishery Management in Hawai'i

members had fishery degrees, and 40% of the council identified themselves as native Hawaiian. In addition to stakeholder representation, the WHFC also attempted to balance membership among the diverse geographic areas in West Hawai'i (Walsh, 1999) based in-part on traditional Hawaiian land divisions or *ahupua'a*, thus building one aspect of the council on the community- and *'ohana* (extended family)-based traditions of Hawaiian culture. *Ahupua'a* are ecological, sociological, and political land divisions created by native Hawaiians and are generally delineated by natural watersheds running from the mountains to the sea and out onto the reef. (Kirch, 1984).

One of the major goals of the WHFC was to establish the location of the FRAs using a consensus-based approach (Capitini et al., 2005). Thus, the Council provided not only a process to generate the location of the FRAs, but also a means to resolve conflicts among the diverse group of stakeholders. After considerable, often contentious debate, the council proposed to DAR that a series of nine FRAs be spread out along the 120 km coastline of West Hawai'i (Figure 1). The West Hawai'i community rallied around the proposal, providing a 93% approval at a public meeting. The proposal was then approved by the Governor's office and, as a result, the series of FRAs were officially closed to collectors in January, 2000 (Walsh, 1999).

[figure 1 about here]

After the FRAs designation but before their closure, I helped organize and coordinate a group of researchers focused on the design and development of a coral reef fish monitoring program in and around the designated FRA sites. The resulting West Hawai'i Aquarium Project (WHAP) was created to evaluate the effectiveness of the FRAs in recovering depleted aquarium fish stocks (see <http://coralreefnetwork.com/kona/>).

After four years of closure, the overall abundance of aquarium fishes significantly increased in the FRAs, including the yellow tang, the hallmark of the aquarium industry in West Hawai'i (Tissot et al., 2004). Equally important, the catch and catch-per-unit-effort of aquarium fishes in West Hawai'i has not significantly declined after FRA establishment, indicating a productive aquarium fishery can coexist with a large network of FRAs (Walsh et al, 2003).

In order to illustrate the IE components of the West Hawai'i aquarium fishery, I will provide an AQAL analysis of the issues surrounding the aquarium fishery. I include in the analysis components of native Hawaiian culture that played a role in the complex process.

[Table 1 about here]

BEHAVIORAL DIMENSION (EXTERIOR-INDIVIDUAL)

The behavioral dimension explores the behaviors of individuals within the system. These may include the actions and movements of fish and humans. For example, the tendency of yellow tangs to form colorful schools of “golden” fish at high densities is an indicator of natural high abundances. When reduced by collecting pressures the absence of these schools impacts the aesthetic quality of the reef overall eliciting protests by people viewing the fish on a regular basis. The response of different stakeholders to abundant tangs and other reef fishes also invoked differing behaviors. Tourists and locals enjoy observing the fish in their natural environment – a preservationist view. In contrast, aquarium collectors react to an abundant resource by harvesting – a conservationist view. Furthermore, individual collectors take different approaches to capturing live fish. Some collectors are yellow tang specialists and use barrier nets to capture high numbers of fish for the bulk wholesale market. Conversely, other collectors target

uncommon or rare fishes of higher individual value such as Tinker's butterflyfish (*Chaetodon tinkeri*).

Concomitantly, varying collecting strategies impact specific sectors of the dive tour industry in different ways. A major component of West Hawai'i's dive tour industry consists of large vessels transporting hundreds of novice snorkelers out to the reefs to experience the reef and its organisms as a whole. In contrast, other dive operations specialize in repeat, quasi-professional SCUBA divers that target specific organisms for new species sightings to add to their dive logs and for marine photography enthusiasts. In the latter case, value is placed on dive operations that have detailed, long-term ecological knowledge of the locations and habits of rare marine species. Therefore, when collectors target and remove rare, resident fishes off the reef, the more specialized dive tours are directly affected. Conversely, the bulk removal of whole schools of yellow tangs and other colorful reef fishes has a more pronounced effect on the larger-scale diving operations and ultimately on the snorkelers' aesthetic experience on the reefs. Thus, the behaviors of individual fish species and human user-groups have direct consequences on each other and play a major role in the kinds of interactions between stakeholders in West Hawai'i.

SYSTEMS (EXTERIOR-COLLECTIVE)

Another dimension included in an integral analysis is the overlapping natural, social, and political systems, and their interactions. This dimension is well recognized and analyzed in traditional fishery management.

At the ecosystem level, yellow tangs are herbivorous fishes that may play an important regulatory role in controlling the abundance of algae in coral reef communities. However, although several groups used this interplay to oppose aquarium collectors, there are no observed

Integral Ecology and Fishery Management in Hawai'i

increases in the abundance of algae in areas subjected to aquarium fish harvesting (Tissot and Hallacher, 2003). On the human level, local aquarium collectors are a small component of a large international trade network involving wholesalers, retail store-owners, and worldwide hobbyists. Fish collected on reefs in Hawai'i are sold to local wholesalers for \$1.50 each and then shipped cross-country and can, for example, end up in a store in Kansas retailing for more than \$60 each. In West Hawai'i there are approximately 50 active collecting permits and, based on voluntary reporting, the annual harvest in 2001 was 708,000 fish at a total value of \$1.06 million (Walsh et al., 2003). However, it is likely that the catches and values are underrepresented and the actual value of the fishery may be considerably larger than reported (Walsh, et al., 2003).

At odds with the aquarium industry is the much larger tourism industry, which is the second largest generator of revenues for the State of Hawai'i. A major component of tourism in Hawai'i centers on marine dive tours which account for a large component of the \$3 billion a year ocean industries revenue in Hawai'i (DBEDT, 1989). Dive tour operations are closely linked to a wide variety of other industries that capitalize on the beauty of local reefs including hotels and restaurants, apparel, jewelry and art, and ecotourism that combines land and sea tours. Over the last 30 years both the dive tour and aquarium industries have experienced dramatic growth in Hawai'i (DBEDT, 1989; Miyasaka, 1997). Overall, however, revenues from dive tourism dwarf those of the aquarium industry which may well explain why aquarium collectors were unable to develop the political support to oppose the establishment of FRAs in West Hawai'i.

The legislature became involved because the West Hawai'i community strongly protested the lack of effective management of the aquarium fishery by DAR. In 1997, the Lost Fish

Integral Ecology and Fishery Management in Hawai'i

Coalition presented a 4000-signature petition to state legislators and requesting a total ban on collecting. Thus, during the 1997-98 legislative session there were two competing bills moving forward: one creating a total ban on collecting in West Hawai'i and another mandating a minimum of 30% of closed areas managed with community participation. Understandably, the collectors endorsed the latter, joined the WHFC, and helped influence the location of the FRAs.

Several University-affiliated marine biologists also played an important role by conducting a study to document the extent of harvesting by aquarium collectors in West Hawai'i and provide objective data to the legislature and the public. The results of the study documented significant 38-75% declines in seven of the 10 aquarium fishes studied (Tissot and Hallacher, 2003). The results of both studies were presented to DAR, the Legislature and the West Hawai'i community and summaries were provided during committee hearings and at public meetings. Moreover, once the FRAs were demarcated, studies were established by WHAP to monitor the effectiveness of the management plan to replenish aquarium fishes and provide information to all stakeholders (Tissot et al., 2004.)

Significant contributions to the conflict resolution process were also made by acknowledging and building upon aspects of traditional native Hawaiian fishery management. The concept of resources management is implicit in native Hawaiian culture and was traditionally embedded in the over-arching socio-political and spiritual construct of *pono*, or "balance" within the community and the ecosystem. *Pono* is recognized as the dynamic balance between the *Ali'i nui* (high chiefs), the common people, the gods, and the sacred 'aina (land and sea), from which all food and water and thus all life is provided and maintained by the just rule of the *Ali'i* through strict laws and rituals, and ancient, sacred traditions. Thus *pono* is consistent

Integral Ecology and Fishery Management in Hawai'i

with the purposeful management of natural resources to promote sustainability; a concept clearly at odds with modern fishery management in Hawai'i today (Friedlander et al., 2003).

Recognizing the importance and value of these traditional concepts, the WHFC membership and FRAs are associated with traditional Hawaiian *ahupua'a* and with native Hawaiian populations that supported the aquarium ban and provided community-based support for enforcement, which is severely lacking in Hawai'i (Friedlander et al., 2003). Moreover, periodic closure of fishing grounds was a common fisheries management technique in ancient Hawai'i, where *nā kapu* (strict laws) were used, in resources management to enforce no-take areas, to restricted hunting and fishing seasons, and to establish sacred or forbidden species, often with severe penalties for violating such laws -- including banishment and death. These laws were passed after the *konohiki* (a resources manager/steward appointed by the *Ali'i*) consulted with the *po'o lawai'a* (master fisherman) who had generations of intimate knowledge of the status of marine resources in their *ahupua'a*. Two functions of the WHFC mirrored this arrangement by allowing a two-way flow of information from individuals in the community to the Council, scientists and DAR, and from these groups back to the community. The attempt to provide near real-time data from WHAP to the WHFC with representation of individuals from multiple *ahupua'a* recognizes the value of and builds on the flow of information in this traditional model.

CULTURAL DIMENSION (INTERIOR-COLLECTIVE)

The cultural dimension includes collective attitudes and beliefs that shape the behaviors and action of groups within the systems. Although this dimension is acknowledged in the arena of environment conflict resolution it is a complex and is an often neglected dimension of fishery management that deserves significantly more attention.

Integral Ecology and Fishery Management in Hawai'i

The origins of the conflicts over aquarium collecting and the lack of complete resolution were intricately intertwined with the different ethics/values, or belief systems, of the various stakeholders. Although few people in Hawai'i take issue with catching reef fish for consumption, collecting live fish for exportation is viewed as a wholly different matter. At issue are several divergent ideas. One is the local acknowledgement that supplementing your family's food by living off of the land is a common and accepted life style in Hawai'i and for many *'ohana* today, subsistence catch still provides a vital component to the household food budget. However, the practice largely involves eating or sharing with your neighbor what you catch, and never taking more than you need. Clearly, selling live fish for solely economic gain stretches the more traditional Hawaiian concept of subsistence catch. In addition, some communities more heavily dependent on subsistence catches wanted collectors banned due to a perceived competition for food fish (Walsh, personal communication) and because collectors may have been perceived as "greedy" in a Hawaiian cultural context, when compared with the local subsistence fishermen.

Another issue often debated in the public and presented in the newspapers was the potential negative effects of fish harvesting on the reefs. Collectors held that their industry was sustainable and not causing harm to the reefs, a contention partially supported by scientific study (Tissot and Hallacher, 2003). However, collectors were frequently attacked with accusations that their collecting activities caused long-term reef damage and that their operations promoted unsustainable fisheries. Thus, the lack of clearly demarcated opinions, ethics/values, and cultural perspectives, combined with a community-wide debate over the issues confounded and prolonged the conflict.

Ethical conflicts also emerged in the consensus-based approach used to develop the FRAs. One of the major goals of the WHFC was to achieve a consensus among stakeholders on

Integral Ecology and Fishery Management in Hawai'i

the location of the FRAs and simultaneously resolve the multiple-use conflict using an alternative environmental dispute resolution process, or EDR. Alternative EDR is a growing field wherein the psychology and behavior of conflicting interest groups is recognized and developed into self-generated conservation tactics that acknowledge and preserve personal goals (Daniels and Walker, 2001). When conflicts are complex, as was the case in West Hawai'i, they can occur at multiple levels, each of which needs to be acknowledged, understood, and honored. Conflicts often revolve around different levels of perception of the issues: so called interest vs. value-based conflicts (Capitini et al., 2005). In West Hawai'i the interest-based component of the conflict, a dispute over the allotment of fish resources between collectors and tour boats, was clearly recognized and understood. Although framed as a sustainability issue by many, this conflict was resolved by designating the FRAs, which prohibited collectors from operating in areas containing popular dive sites, while leaving the majority of the coastline open for harvesting. In contrast, value-based components are often more complex and derived from long-standing differences and concerns, and stem from psychology, culture, and threatened beliefs (Rothman 1997). Known also as identity-based conflicts, these disputes are characterized by an unclear determination of their parameters and boundaries as they stem from deeper personal values (Rothman 1997). In West Hawai'i, differing beliefs on the appropriate use of fish on the reef, were not necessarily clearly recognized nor understood, and were a continued source of discord and dissention on the Council.

Aquarium collectors were dismayed by what they viewed as a small harmless industry unfairly singled out and criticized for utilizing what they perceived to be a largely untapped, abundant, and seemingly limitless resource (Capitini et al., 2005). Some collectors boasted of harvesting 1000 fish per day (Walsh, personal communication). Here, again, different values and

Integral Ecology and Fishery Management in Hawai'i

beliefs about the ocean contributed to conflict in West Hawai'i. While many view the ocean as boundless and unlimited in its productivity and potential uses, others hold the ocean sacred for sustaining life. This dichotomy represents a classic conflict between the Judeo-Christian worldview that resources are for our use (i.e., the Garden of Eden) and the Hawaiian philosophy of *mālama ʻāina* (caring for the land)

Thus, embedded in this controversy were threads of native Hawaiian cultural practices and traditions that still exist in the West Hawai'i community. Although present, these beliefs are often fragmented, misunderstood, and occasionally misrepresented or misapplied in modern Hawaiian communities. One such belief is *aloha ʻāina*, or love of the land, a traditional Hawaiian value that connects the people to the place where they live and work (Pukui et al., 1972). *Aloha ʻāina* serves to reinforce the concept of *pono*, the balance between people and the ʻāina, but also gives rise to the concept of *mālama ʻāina*, or caring for the land.

Mālama ʻāina involves asking permission prior to fishing, taking only what you need, sharing your catch with your extended ʻohana or community, and having respect for the sacredness of the process. Clearly, harvesting live fish for economic gain and shipping them in bag for a long, convoluted odyssey, potentially resulting in mortality and waste, violates the very core of these traditional values. Thus, the Hawaiian cultural worldview, expressed in various forms and at various levels in the communities of West Hawai'i, contributed to a conflict with ornamental reef fisheries. In the conflict resolution process, a lack of acknowledgment and understanding of these cultural values likely presented a fundamental conflict in developing a consensus-based approach to fishery management on the WHFC.

EXPERIENTIAL DIMENSION (INTERIOR-INDIVIDUAL)

The experiential dimension includes the subjective realities of all beings at all levels of awareness. These include the emotions and motivations of humans and their spiritual experiences, which are generally not considered in fishery management. It also involves the forms of experience and perception available to the fishes on the reef. For many individuals snorkeling over a coral reef in Hawai'i is a rich, joyful, and occasionally a spiritual, transformative experience. Floating freely with hundreds of brightly colored fish swarming over an intricate web of coral has inspired many people during their experiences to learn to value the reef and its organisms. These experiences may also involve the development of personal connections between people and individual organisms on the reef. Some reef organisms are known to inhabit the same areas of the reef for extended periods of time. Butterflyfish, for example, form permanent mated pairs that establish territories on the reef for life. Thus, it is not uncommon for people to form long-term connections or relationships, with individual fish, in specific areas, for extended periods of time. For example, in *Wai o`pae* in East Hawai'i the establishment of a 'no take' marine reserve, generally a difficult and contentious process in Hawai'i, was greatly facilitated due to the mayor of Hawai'i island having a long-standing personal relationship with a fish in the proposed reserve. These connections, and the associated sharing of feelings with the plight of fish captured on the reef, played strongly into the animosity against aquarium collectors that developed in West Hawai'i.

People gasped in horror at the thought of beautiful fish being captured and transported off their native reef, never to return. Capture and transportation of live fish is described as a litany of horrors with often less than 10%, successfully surviving the journey to their intended destination, and even then, often dying alone in aquariums due to inexperienced owners (Baquero, 1995).

This emotional connection with the plight of the reef fish was the principle driving force behind the Lost Fish Coalition, whose hallmark was a dead yellow tang in a baggie. Armed with their preservationist convictions and the powerful image of the dead fish, the Lost Fish Coalition was largely responsible for spearheading the passage of Act 306 through the legislature (www.lostfishcoalition.org). Thus, personal joy on the reef, transformed into horror, sadness and eventual anger as their favorite fish disappeared, became the principal motivation to limit or eliminate the actions of aquarium collectors.

DISCUSSION

The IE approach provides a far broader and deeper view of the biology, conflict, resolution, and management process in West Hawai'i than has previously been presented (Table 1). The principle strength of the AQAL approach is that it provides a means to acknowledge and understand the complexity and depth of issues and beliefs in each quadrant and to appreciate the interconnections among quadrants. This approach clearly captures and illustrates how individual experiences on the reef were transformed into social movements, political will, and eventual ecological change. Moreover, the example serves to illustrate the role of scientific research and education in providing informed decision making at all levels. However, some of the complexity in the system, which perhaps resulted in the failure of the WHFC to reach complete consensus on a management solution, may have been lost by not acknowledging, understanding, or honoring the differing worldviews represented by the various stakeholders. In this respect, there were fundamental values-based or ethical conflicts in the community, and subsequently among members of the council, that were not sufficiently explored nor discussed. Moreover, the IE

Integral Ecology and Fishery Management in Hawai'i

approach helps clarify and strengthen the overall sustainability of the system and provide a model of fishery management for the rest of the Hawai'i.

In the case of the WHFC, building on Hawaiian social and cultural traditions helped promote solutions to management issues that, previously, may not have been possible. Native Hawaiians developed a management system based on a system of social and cultural controls, and more specifically on a code of conduct and set of laws for fishing that was strictly enforced and provided for sustainable harvests of natural resources. One of the major components of this system was/is the beliefs that marine resources are limited and, as a result, there was/is a strong social obligation to exercise self-restraint through the process of nurturing and respect (Titcomb, 1972; Friedlander et al., 2003). These traditions and beliefs, although fragmented, are still present in modern Hawai'i and are a source of strength for the fishery management approach in West Hawai'i. The AQAL model explicitly honors modern ecological and social approaches -- the incorporation of monitoring, conflict resolution, and fishery councils in the approach -- along with honoring the existing Hawaiian models by incorporating the cultural concepts of *ahupua`a*, *konohiki*, *kapu*, *pono*, and *mālama `āina*.

In smaller communities, such as on the Ho`olehu Hawaiian Homesteads on the rural island of Moloka'i, effective integration of modern and traditional cultures has allowed the community to adapt their management strategies to the specific environmental conditions of their area and develop scientific assessments alongside a traditional Hawaiian moon calendar to help govern harvesting of reef fish (Friedlander et al., 2003). Based on the success of Ho`olehu community, one recommendation for the WHFC would be to decentralize into smaller community governing boards associated with individual *ahupua`a* or *`ili* (groups of *ahupua`a*) thereby potentially facilitating an easier flow of information to and from the community,

Integral Ecology and Fishery Management in Hawai'i

providing for more specific knowledge of reef resources, and allowing local communities a more direct role in the management of their resources.

Another challenge is to more thoroughly acknowledge and incorporate traditional knowledge from communities to complement scientific assessments. Efforts should be made to recruit and support *po'o lawai'a* (master fisherman) and provide an avenue for the recognition and application of their knowledge by the regional boards. For example, one of the major questions of MPA design is where to locate protected areas in order to maximize the productivity of the ecosystem. This task is particularly difficult due to high levels of fishery exploitation in Hawai'i and thus a lack of understanding of natural, pre-exploited population levels. One idea in addressing this question is to design MPAs using information from traditional Hawaiian fishing areas. Hawaiians marked their productive fishing grounds, often based on centuries of observation, with fishing sacred shrines, or *ko'a* (Titcomb, 1972), some of which are still present in Hawai'i (Whitcraft and Levin, 2003). Archeological and historical research on the location of *ko'a*, combined with modern scientific assessments and the extensive knowledge of living *po'o lawai'a* and *kupuna*, could provide an effective means of designing networks of MPAs.

Finally, in the conflict resolution process, greater attention should be given to exploring and acknowledging the identity- and value-based conflicts present in West Hawai'i and on the WHFC. The use of a professional facilitator trained to tease out and identify these complex issues might go a long way toward resolving the conflicts still present (Capitini et al., 2005).. In conclusion, the complexity illustrated using the IE approach clearly opens up a variety of new possibilities for resolving conflicts and promoting sustainability in resources management.

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Integral Ecology and Fishery Management in Hawai'i

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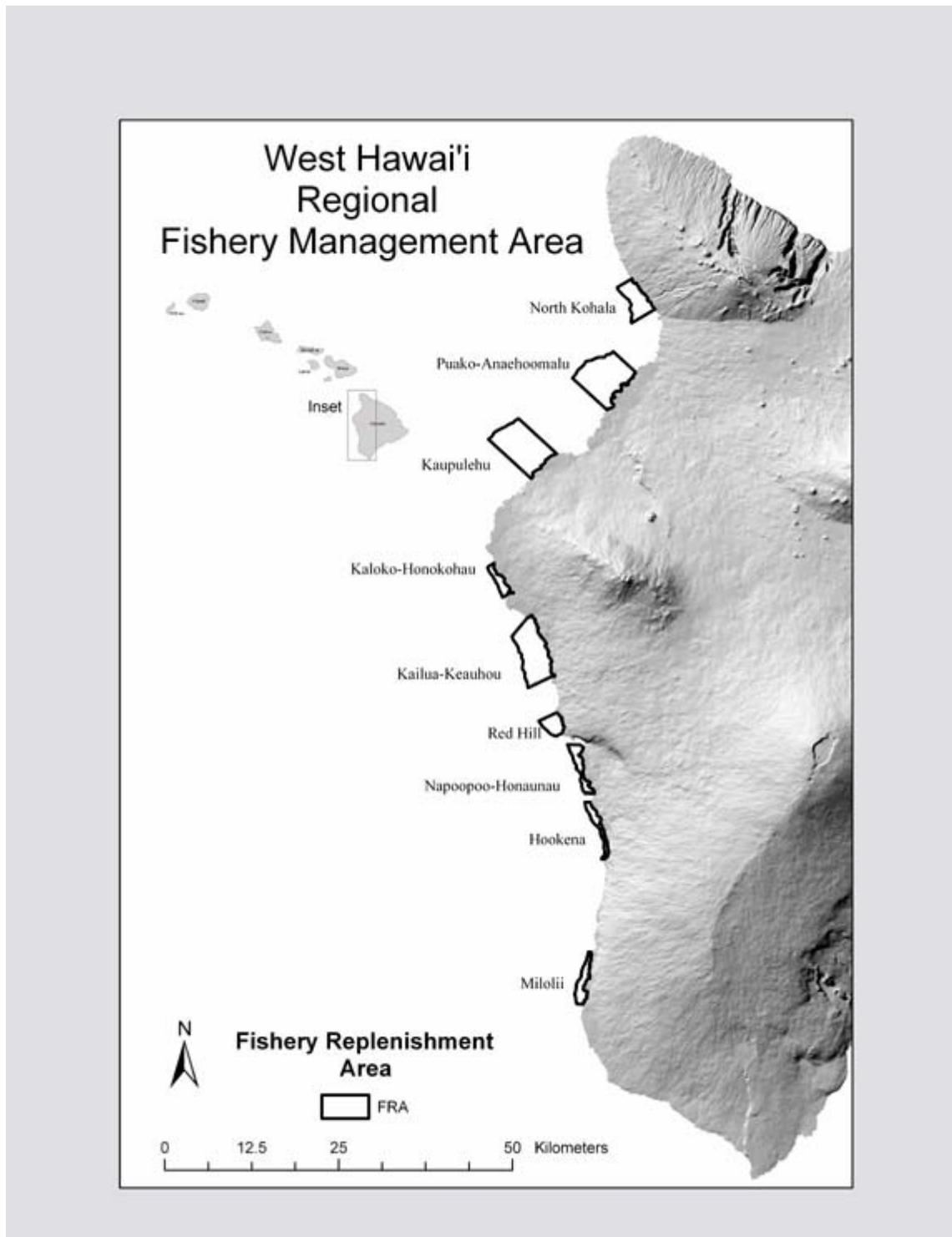


Figure 1. Map of West Hawai'i illustrating the location of the nine Fishery Management Areas (FRAs).

Integral Ecology and Fishery Management in Hawai'i

<p>Interior-Individual</p> <p>Psychological</p> <ul style="list-style-type: none"> • Joy in viewing colorful fish on the reef • Anger when missing local fish. • Horror of connecting with fish's journey to aquarium. • Anger and frustration of collectors singled out by community. <p>Spiritual</p> <ul style="list-style-type: none"> • Connections between people and marine life. • Connection with ancestral spirits or <i>nā`aumakua</i>. 	<p>Exterior-Individual</p> <p>Behavioral</p> <ul style="list-style-type: none"> • Schooling behavior of yellow tangs at high density. • Novice snorkelers that observe schools of colorful fish. • Professional SCUBA divers that target rare fishes and behaviors. • Aquarium collectors that target abundant tangs and other fishes. • Aquarium collectors that target rare and endemic fishes of high value.
<p>Cultural</p> <ul style="list-style-type: none"> • Aquarium collectors concept of sustainability clashing with preservationist attitude of fish viewers. • Interest vs. identity based values in conflict resolution process. <p>Religious</p> <ul style="list-style-type: none"> • <i>Hawaiian Kumulipo</i> and connection with nature. • <i>Aloha`aina</i> reinforcement of <i>pono</i>. • <i>Mālama`aina</i> concept of taking only what is needed with respect. 	<p>Ecological</p> <ul style="list-style-type: none"> • Response of ecosystems to decline in herbivorous aquarium fish abundance. <p>Economic</p> <ul style="list-style-type: none"> • Importance of marine tourism to economy. <p>Political</p> <ul style="list-style-type: none"> • Failure of DAR to manage the aquarium fishery. • Pressure by citizen's groups to create laws to develop FRAs. <p>Educational</p> <ul style="list-style-type: none"> • Research on collector harvesting. • Monitoring of the effectiveness of FRAs to replenish aquarium fishes. <p>Sociological</p> <ul style="list-style-type: none"> • Representation of individuals in traditional <i>ahupua`a</i>. • Establishment of FRAs in traditional <i>ahupua`a</i>. • Availability of information on marine resources to WHFC representatives and local community. • Recognition and integration of <i>pono</i>, <i>ahupua`a</i>, <i>konohiki</i>, to reinforce management approach.
<p>Interior-Collective</p>	<p>Exterior-Collective</p>

Table 1. Four quadrant analysis of West Hawai'i Community-Based Management of the aquarium fishery.