

Customary marine resource knowledge and use in contemporary Hawai‘i

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Abstract

The Hawaiians of old depended on the sea for survival and, as a result, developed a sophisticated understanding of the natural processes regulating resource abundance and effective strategies to manage those resources. After Western contact, sociopolitical upheaval led to the breakdown of the traditional Hawaiian fisheries management system, though practice and knowledge continued. Even today, subsistence fishing is culturally and economically important to many communities throughout Hawai‘i but declining resources over the past century have raised concerns about their sustainability. To confront this issue, a number of communities are currently strengthening local influence and accountability for local marine resources through revitalization of local traditions and resource knowledge. This renaissance of traditional community-based management and rediscovery of traditional techniques offers great promise for improving the condition of Hawai‘i’s coastal marine environment and the management of its fisheries.

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Introduction

Marine resources were important to pre-contact Hawaiian societies for subsistence, cultural values, and survival. But in recent times, a number of factors have contributed to substantial declines in many highly prized and vulnerable species (Friedlander and DeMartini 2002, Williams et al. 2008). These declines are associated with intensive fishing pressure, land-based pollution, destruction of habitat, invasive species and other threats, which are driven at the underlying level by a growing human population, export-driven markets for resources, access to technological innovations (e.g., motorized boats and freezers for storing catch), introduction of new and overly efficient fishing techniques (e.g. inexpensive monofilament gill nets, SCUBA, GPS), and loss of traditional conservation practices (Friedlander et al. 2003). Further, there is poor compliance with state fishing laws and regulations and insufficient enforcement, which is partially attributed to lack of resources and capacity.

Owing to the failures of conventional marine management, there is a growing interest in exploring new approaches to conserve marine ecosystems and coastal resources for future generations in the Hawaiian Islands and other Pacific islands. Such approaches include shifts towards ecosystem-based management (Aswani et al. 2011), development of school curricula and university programs in natural resource management (Veitayaki and Robin South 2001), and integrating traditional ecological knowledge and customary management practices into contemporary marine management (Berkes et al. 2000; Johannes 2002). Traditional ecological knowledge (TEK) is defined as a cumulative system of knowledge, practice, and belief, which evolves through adaptation and is perpetuated through intergenerational cultural transmission (Berkes 1999). Customary marine tenure (CMT), in contrast, comprises a set of rights to use,

ownership, or access to marine areas, which are often community-based and related to indigenous forms of governance and kinship relations (Cinner 2005; Cinner and Aswani 2007).

In Hawai‘i, the incorporation of TEK and elements of CMT systems is gaining increased traction and interest from communities. This article reviews the historical development and erosion of TEK and CMT systems in Hawai‘i and explores how TEK, CMT and other Native Hawaiian cultural practices are currently being integrated into contemporary Hawaiian marine resource management in several communities. The impact this has on coastal communities and marine ecosystems may provide insights into better management practices and transitions toward sustainability in Hawai‘i and elsewhere.

MARINE RESOURCE USE, KNOWLEDGE, AND MANAGEMENT IN ANCIENT HAWAI‘I

Hawaiians of old (pre-western contact, <AD 1778) developed sophisticated and complex management systems for marine resources (Malo 1951; Kamakau 1976; ‘Ī‘Ī 1993; Kahā‘ulelio 2006). These societies depended in part on fishing and gathering for survival, which motivated them to acquire a sophisticated understanding of the factors that caused limitations and fluctuations in their marine resources. Based on their familiarity with specific places and through much trial and error, Hawaiian communities were able to develop social and cultural controls on fishing that fostered sustainable use of marine resources (Titcomb 1972; McClenachan and Kittinger 2012). Historical works by Native Hawaiian scholars (Beckley 1883; Malo 1951; Kamakau 1976; ‘Ī‘Ī 1993; Kahā‘ulelio 2006) documented many aspects of traditional knowledge systems and the customary management practices for marine resource stewardship, which were

later observed and recorded by non-indigenous scholars (e.g., Titcomb 1972, 1978; Stokes 1908, 1920).

In traditional Hawaiian society, the basic unit of land division and socioeconomic organization was the *ahupua'a*, which generally encompassed an entire land-to-sea watershed catchment, including interior uplands, valleys, and coastal oceans and was managed adaptively according to resource availability, life cycles, and fluctuations (Kirch 1989; Kaneshiro et al. 2005). *Ahupua'a* units were nested into districts (*moku*), and higher levels of sociopolitical organization that were hierarchical and roughly accord to biophysical attributes of island ecosystems (e.g. windward/leeward and wet/dry districts of islands) (Malo 1951). This governance system allowed for integrated management of society and natural resources – forests, agricultural land, shoreline, and ocean – by a single sociopolitical group at the local scale, with shared resources and management at district and supra-district levels (Kaneshiro et al. 2005).

At the local (*ahupua'a*) and district (*moku*) levels, fishing activities and catch distribution were strictly disciplined by a system of rules and regulations that were embedded in sociopolitical structures and religious systems (the *kapu* system). Harvest management was not based on a specific amount of fish but on identifying the specific times and places that fishing could occur so as to not disrupt basic processes and habitats of important food resources (Poepoe et al. 2007). By allowing fish populations to replenish themselves, and by not interfering with important activities such as spawning, traditional Hawaiian communities were able to maintain a high level of productivity and fisheries yield over several centuries prior to western contact (McClenachan and Kittinger 2012).

Land agents (*konohiki*) enforced customary management systems (*kapu*) at the local (within *ahupua'a*) level, on behalf of chiefs (*ali'i*). Knowledgeable of the lunar and seasonal cycles that cause resources to fluctuate, *konohiki* were often advised by *kūpuna* (elders) and *po'o lawai'a* (master fishermen). Master fishermen and fish watchers (*kilo i'a*) played a prominent role in the culture, were of a special lineage, and trained for years as apprentices. Their awareness of subtle changes in the environment made them sentinels of the entire ecosystem (Poepoe et al. 2007). Chiefs also limited access to specific resources available only to *po'o lawai'a*, such as large trees for canoe-building and materials for constructing fishing gears (Kittinger et al. 2011; McClenachan and Kittinger 2012).

Fishing activities and catch distribution were strictly disciplined by rules for which blinding or death was prescribed for severe transgressions (Titcomb 1972). Taking only so much as not to diminish the supply, and not disrupting spawning cycles, represented some of the foundational rules and social mores that governed fishing behavior (Kahā'ulelio 2006). The first fish of the catch were often reserved for offerings to the gods, ancestors, chiefs and community elders (*kūpuna*). For example, the first fish of the catch may be offered to Ku'ula, the patron god of special aggregation sites and fishing grounds (*ko'a*). These offerings were placed at shrines on land, which were associated with coastal fishing grounds and which were used by ocean fishers as alignment points to locate coastal fisheries habitats. Certain species such as *moi* (Pacific threadfin) were reserved only for the chiefs. Other food such as *ulua* (jacks), *kumu* (an endemic goatfish) and *honu* (turtles) were the embodiment of the gods and were restricted for consumption only by men of higher social classes. Many of these laws provided protection for important species and allowed Hawaiians to derive sustenance from the ocean for centuries (McClenachan and Kittinger 2012).

EROSION OF THE TRADITIONAL SYSTEM

Following Western contact, a variety of sociopolitical factors led to the demise of the traditional system of marine resource management in the late 18th to early 19th centuries. The Native Hawaiian population declined precipitously due to introduced diseases, leading to widespread loss of knowledge and decline in the transmission of TEK. Because TEK was codified in oral traditions (e.g., dance, song, chants, legends), these knowledge forms were vulnerable to loss as knowledge holders succumbed to disease, resulting in a vast and unprecedented loss of cultural knowledge about coral reef ecosystems and the species they harbor. Knowledge loss was also heightened during the post-contact period when use of the Hawaiian language was discouraged. Western influences also altered the basic economic modes of production as export markets for island resources developed to fuel the acquisition of foreign goods and the beginnings of a cash economy.

In 1819 the indigenous *kapu* system was abolished, which initiated major changes in Hawaiian society (Seaton 1974; Ralston 1984), including the removal of customary restrictions on consumption of reef taxa and cultural regulations governing marine resource extraction (Kittinger et al. 2011). From an economic perspective, the *kapu* abolition represented the first steps in the transition in the basic mode of production from a concentration on subsistence production of resources and materials to a cash-based economy where specific resources were commoditized and urban centers became the nexus for economic production. Foreigners also introduced western conceptions of property rights, which contrasted greatly with indigenous Hawaiian conceptions of stewardship of lands and resources and excluded explicit rights of

ownership (Meller 1985; Miller 1989; Beechert 1991). Despite these changes, outside of the major urban centers, traditional subsistence practices still dominated as the major mode for supplying basic necessities in the early to mid 1800s (Coulter 1931; Newman 1970) and into the early twentieth century prior to WWII (McGregor 2007).

In 1839, Kamehameha III formally defined customary fishing rights and practices for nearshore coral reef environments in the Constitution (MacKenzie 1991). The King distributed the fishing grounds and resources between himself, the chiefs and the people of the land, granting fisheries access rights from nearshore to the deep ocean (Maly and Maly 2004). Notably, pelagic and deep-reef benthic zones were excluded from private fisheries' ownership and the freeing of this zone from chiefly control constituted a major change in customary marine tenure. The codification of Native Hawaiian fishing rights in the Constitution secured these fisheries in the evolving western legal system of the Hawaiian Kingdom.

After the abolishment of the *kapu* system, the Hawaiian kingdom was under intense pressure from foreign powers to alter common property regimes codified in communal indigenous land and sea management to the fee-simple standard of western nations, which would allow foreign mercantile interests to secure rights to resources and safeguard economic development opportunities (Kuykendall 1938; Miller 1989). In 1848 the Māhele 'Āina enabled foreigners to purchase and own land, ushering in the plantation era, and resulting in an influx of different ethnic groups (Chinen 1958; Cooper and Daws 1990). While this led to the breakdown of the *ahupua'a* system, laws granting management of the nearshore fisheries resources by the *konohiki* remained (Maly and Maly 2004; MacKenzie 1991).

The annexation by the United States and the Organic Act of 1900 that followed resulted in the erosion of traditional *konohiki* fishing rights, which would ultimately create open-access to coastal fisheries for residents and non-residents alike. The Organic Act initiated a process whereby the Territorial government condemned private fisheries rights in nearshore waters and compensated their owners for their value (Frear and Morgan 1898; Meller 1985; Kosaki 1954; Tanaka 2008; Porter 2010). Despite this, many owners successfully retained their fishery rights throughout the first half of the 20th Century (Kosaki 1954) and some littoral owners actively excluded outsiders from their fisheries up to the 1940-50s (Anonymous 1923; Cramer 2010) (Figure 1). As a result of the actions of the territorial government, private fisheries rights were largely marginalized by the time Hawai‘i became the 50th US State in 1959. Nonetheless, *konohiki* fishing rights remain enshrined in the State of Hawai‘i constitution (Hawai‘i Revised Statutes 2010; Porter 2010), and many rights to coastal fishponds are still retained by private owners (Meller 1985; Kosaki 1954). Despite this fact, there are no examples of state-sanctioned *konohiki* fishing rights currently in place.

The early 1900s saw the centralization of economic activities and fisheries markets in Honolulu and large increases in the commercial landing of marine resources (Cobb 1902; Bell and Higgens 1939). Commercial markets employed fishers, merchants and middlemen, but too few fishermen were engaged to supply the demand, particularly in growing urban centers, and fish had to be imported (Miller 1989). After the turn of the century, Japanese fishermen supplanted Native Hawaiians as the dominant commercial fishers (Schug 2001), but their focus on pelagic and deep-reef species took pressure off nearshore reef species, which remained a focus primarily for subsistence fishing and a small proportion of commercial fishers (Kittinger et al. 2011). Just prior to World War II, commercial fishing in Hawai‘i was a multi-million dollar industry that

employed hundreds of people directly and thousands indirectly. But immediately after the war, many fishermen were unwilling or unable to return to commercial fishing (Pooley 1993). The post-war growth in population, increases in boat ownership, introduction of export-driven fisheries (e.g., for the aquarium trade), and other technological advances such as refrigeration fueled increased subsistence and commercial fishing pressures in reef areas, which continue to present.

Recent decades have witnessed Hawai‘i’s rapid growth in tourism, an increasingly urban resident population, and the continued development of shoreline areas for tourism and recreation. Coastal fisheries are now primarily dominated by recreational and consumption-oriented fishers and a greater number of part-time commercial fishers who curtailed their fishing to take advantage of more lucrative economic activities.

CONTEMPORARY MANAGEMENT OF MARINE RESOURCES IN HAWAI‘I

Today, myriad state and federal authorities provide for the management of Hawai‘i’s coastal resources (Lowry et al. 1990) and primarily rely on Western science approaches implemented by government resource agencies and managers. As compared to traditional forms, contemporary fisheries management strategies are based on principles of maximum sustainable yield and conserving species at current levels. Knowledge is accrued through quantitative studies of single stocks with people considered separate from the natural world, and information is transmitted in the published literature, technical reports, and through public planning meetings as required by law. The centralized, top-down approach, methods of assessment, fishing controls, and planning horizons for contemporary management differ greatly from customary Hawaiian strategies (Table 1). These two systems may have contrasting goals, institutional arrangements, social and

ecological benefits inferred, employ different incentives and deterrents, and act on different spatial and temporal scales of management. Table 1 provides a comparison between customary and contemporary marine resource management in Hawai‘i and ideas for integrated approaches that draw on existing or proposed actions.

Hawai‘i’s coastal resource management today is reflective of the historically sectoral-based governance of oceans in the United States, where at least 20 federal agencies implement over 140 ocean-related statutes (Crowder et al. 2006). The gaps and overlaps associated with contemporary marine management are well-documented (Young 2002). Centralized, top-down, and sectoral, contemporary ocean management tends to address single species or single-issues rather than the system holistically (Leslie and McLeod 2007). In Hawai‘i’s geography, centralization means that most marine management is developed in a “one size fits all” manner by managers in urban Honolulu, far removed from local communities of the neighboring islands. However, state biologists and managers stationed on neighbor islands have been instrumental in supporting community-based initiatives.

Contemporary marine management in Hawai‘i is complicated by further problems. Sociocultural and ecological heterogeneity of Hawai‘i’s marine resources, biogeography, and local communities is not well-suited to centralized, top-down management and are incongruent with traditional place-based management strategies that were historically developed and implemented at the community level. Further, issues surrounding political appointments, failed management strategies like rotational closures (Williams et al. 2006), and some of the U.S.’s lowest levels of resource management funding contribute to the failure of contemporary management. Together these factors have led to dramatic declines in coastal fisheries, particularly around the more

populated islands around the state (Shomura 1987, Friedlander and DeMartini 2002, Williams et al. 2008, Kittinger et al. 2011).

RENAISSANCE OF CUSTOMARY MANAGEMENT IN HAWAI‘I

Over the past several decades, there has been a renaissance of customary management in the Pacific region, leading to the rediscovery and revitalization of traditional techniques for marine resource management of fisheries in the region (Johannes 2002; Cinner and Aswani 2007; Aswani and Ruddle 2013). Governments in many Pacific Islands are recognizing customary governance systems and their associated rights, and many initiatives have been developed to facilitate localized management of marine resources (see Cinner and Aswani 2007 for a review). In Fiji, for example, a national network of non-governmental and government organizations supports over 200 locally managed marine areas that are leading to the revival of traditional resource practices to improve management and maximize benefits to local communities (Veitayaki et al 2003). In Palau, the traditional practice of *bul* involves the Council of Chiefs placing reef areas off limits to fishing during known spawning and feeding periods (Johannes 1981; Putney 2008). This traditional *bul* system has become the basis for Palau's network of protected areas and its Protected Area Network law.

A meta-analysis of 42 co-management arrangements across five countries in the Indo-Pacific shows that: (i) co-management is largely successful at meeting social and ecological goals; (ii) co-management tends to benefit wealthier resource users; (iii) resource overexploitation is most strongly influenced by market access and users' dependence on resources; and (iv) institutional characteristics strongly influence livelihood and compliance outcomes, yet have little effect on ecological conditions (Cinner et al. 2012). These successes are not restricted to the Pacific

Islands, and indeed are found in many other regions around the world (Berkes et al. 2000, Cinner et al. 2009).

In Hawai‘i, there is increased interest among communities and coastal stakeholders in integrating aspects of Native Hawaiian knowledge systems and customary practices into contemporary management. One of the major challenges to successfully incorporating TEK and CMT, however, is that these systems have suffered from more than two centuries of erosion associated with the history of Hawai‘i and influences of foreign cultures and governments. As a result, TEK systems are often incomplete or fragmented, and the multicultural demography of Hawaiian communities means that cultural knowledge systems and practices can vary widely. Further, CMT systems vary in terms of their recognition and acknowledgment at the community level, there is variability in policy recognizing CMT at different levels of governance (local, county, state, federal), and even though some aspects of CMT are legally enshrined, they are generally not prevalent in terms of their enforcement or practical implementation on the ground.

Despite these challenges, there remain pockets of cultural continuity in Hawai‘i where TEK and cultural practices have persisted intact since historical times (McGregor 2007). “Cultural *kūpuka*” represent areas of (usually rural) Hawai‘i where traditional livelihoods, cultural practices and lifeways have persisted relatively untouched, and which provide the seeds by which Native Hawaiian culture is regenerated, re-learned and revitalized in contemporary Hawai‘i (McGregor 2007). In these places, TEK is intact and transmission of knowledge continues, serving as places where *kūpuna* and knowledgeable practitioners can be engaged as holders of expert knowledge. This process of re-learning and developing new knowledge within the corpus of existing TEK systems is a fundamental aspect of sustaining Hawaiian cultural identity, spiritual connections to

land and place and community well-being (McGregor et al. 1998, 2003; Kikilo'i 2010). The continuance of subsistence fishing activities and associated sociocultural practices is one important way that knowledge, values, and identity are transferred to succeeding generations.

Although some practices and knowledge systems have been lost, many remain in cultural *kīpuka* in Hawai'i, and these systems provide seeds for spreading and regenerating knowledge. For example, the revitalization of Polynesian voyaging occurred from knowledge gained through a traditional navigator from Micronesia (Finney 1991). In a similar manner, knowledge transfer between communities in Hawai'i may help in the revitalization and application of TEK in communities where these systems have been eroded.

TEK is gaining attention in Hawai'i and elsewhere because despite conventional management efforts, ocean resources continue to decline, threatening ecosystem structure and function. Persistent ecological decline, threats to the transmission of TEK, as well as the increase in power and political voice of Native Hawaiian people represent potential reasons for the increasing attention to TEK. Hawaiian scholars have recorded TEK with attention to environmental change and practices (e.g., Kamakau 1976, Maly and Maly 2004; Nogelmeier et al. 2010), and cross-cultural and interdisciplinary teams are beginning to elicit TEK to integrate traditional and Western scientific perspectives (e.g., Poepoe et al. 2007; Jokiel et al. 2011). As a result of these efforts, community involvement in marine resource management has increased markedly in the past several years. Below, we summarize efforts to at the State level to incorporate customary governance systems and indigenous knowledge. Next, we review case studies of local communities engaged in incorporating aspects of TEK and CMT systems into contemporary management at the local scale.

INTEGRATING TEK AND CMT THROUGH CO-MANAGEMENT

Communities have increasingly explored the development of co-management partnerships between State resource management agencies and community groups to incorporate aspects of TEK and CMT and to devolve some management authority to local scales where it was traditionally based. Co-management can take many forms, but generally involves shared management authority and responsibility between resource users or community groups and the government (Berkes 2010). This shared authority has been shown to have several advantages, including increased collaboration and learning among partners, the development of place-based management plans and increased stakeholder buy-in and stewardship (Berkes 2009).

In Hawai‘i, communities can partner with the State to co-manage coastal fisheries by collaborating with the State of Hawai‘i’s Department of Land and Natural Resources (DLNR) to amend or repeal existing rules or adopt new ones. Communities can enter into a co-management relationship with the State of Hawai‘i either through the legislative process (e.g., as a stand-alone legislative act) or by working directly with the DLNR through its administrative rule-making process to establish a Community-Based Subsistence Fishing Area, for the purposes of reaffirming and protecting fishing practices customarily and traditionally exercised for purposes of native Hawaiian subsistence, culture, and religion (Kittinger et al. 2013). Efforts to integrate TEK and CMT into co-management approaches are not short of challenges, and several barriers exist to the successful incorporation of customary knowledge systems and approaches in the modern context. These barriers include: (1) asymmetries in power and politics (Shackeroff and Campbell 2007); (2) disparities in community capacity, resources and willingness to engage in co-management (A. Ayers, unpublished data); (3) post-colonial legacies (Tuhiwai-Smith 1999);

(4) epistemological differences in management approaches (Agrawal 2002; Jokiel et al. 2011); and (5) differences in the management scales and institutional arrangements of these systems (Cinner and Aswani 2007). As a result of these barriers, only a few communities or districts have successfully developed co-management arrangements with the State, though interest in developing local-state partnerships and devolving authority to community levels remains very high among coastal stakeholders. Below, we provide an overview of various community-based management programs (Figure 2) that are incorporating TEK and CMT in contemporary Hawai‘i.

Mo‘omomi Bay, Moloka‘i

The community in the Ho‘olehu Hawaiian Homesteads on the island of Moloka‘i is actively engaged in managing their resource as well as educating users about traditional methods. Subsistence activities, including farming and fishing, supply about one-third of the food needed by the approximately 1,000 Hawaiian residents of this community. The 1994 Hawai‘i State Legislature created a process for designating community based subsistence fishing areas. In response to this legislation, the Hui Malama o Mo‘omomi prepared a fisheries management plan for the northwest coast of Moloka‘i (Hui Malama o Mo‘omomi 1995). Although the State has yet to act on this plan, the community has developed a code of conduct to help guide *pono* (righteous, necessary, appropriate) fishing practices in the absence of formal rules. These behaviors are reinforced through peer-pressure and community meetings.

Community resource monitors emphasized high resolution monitoring using traditional observation methods that provided the basis for understanding local fisheries dynamics and adjusting fishing effort so that resources are not harvested at the wrong times and places

(Friedlander et al. 2002, Poepoe et al. 2007). By identifying peak spawning periods for important resource species, closures can be applied so as not to disturb the natural rhythms of these species. By observing spawning behavior and gonad development, community monitors were able to develop a calendar identifying the spawning periods for the major resource species that can be used to validate the establishment of seasonal *kapu* to protect spawners.

An example of this strategy is the life cycle model developed for *moi*, an important resource both in ancient times and today. Ancient Hawaiians recognized that *moi* changed sex and had names for each life phase (Figure 3). Traditional Hawaiian conservation principles for *moi* included restrictions on harvest of large females, depending on population structure, and restrictions on harvest during the spawning season. Minimizing the disturbance to spawning and nursery habitats was another important conservation practice.

Community-sanctioned norms for fishing conduct are reinforced through continual feedback based on site resource monitoring, education, and peer pressure. The most effective means of eliciting proper conduct of fishing is through education of young people in the community to understand that they have responsibilities, as well as rights, for marine resource use. The continuation of traditional Hawaiian practices in and around Mo‘omomi Bay helps to maintain social and cultural identity and provides reinforcement of values shared by the Ho‘olehua community.

Kaho‘olawe

For 50 years this island functioned as a *de facto* natural reserve since it served as a military bombing range until 1990. In 2003 access to Kaho‘olawe was returned the State of Hawai‘i and the Kaho‘olawe Island Reserve Commission (KIRC) was established to manage the island and

the surrounding waters in trust for the general public and the future Native Hawaiian sovereign entity. This commission fosters access for native Hawaiians to practice cultural, spiritual, and subsistence activities on the island and in the adjacent marine waters. The ocean management plan outlines fishing areas, cultural and subsistence activities, and enforcement policies that aim to integrate traditional practices with contemporary management.

Kaho‘olawe Island Reserve Commission only allows subsistence fishing and marine gathering by participants in cultural stewardship activities organized by a stewardship organization (currently, the Protect Kaho‘olawe ‘Ohana) for consumption and *ho‘okupu* (offerings) only while on the island. For two weekends each month, limited trolling is allowed in the Reserve waters. Vessel owners must register their vessel with the KIRC, apply for a permit, and file catch reports. Activities within the reserve requested by applicants seeking to exercise traditional and customary rights and practices must be approved by the commission after review and consultation with cultural practitioners. Enforcement for the reserve is conducted by state and federal agencies with additional surveillance provided by cultural practitioners. The KIRC mission also includes monitors the status of the ocean resources surrounding Kaho‘olawe and improving the health of offshore areas.

Miloli‘i, Hawai‘i

The predominantly Native Hawaiian village of Miloli‘i in 2005 secured State Act 232, establishing a community-based subsistence fishing area (CBSFA) and thereby allowing the community to regulate its local coastal waters based on Native Hawaiian principles. Act 232 directed the DLNR to develop proposed rules to ensure sustainable stocks of fish to preserve the traditional Hawaiian lifestyle of the Miloli‘i community. Although a CBSFA has been designated, rules have yet to be enacted although the community has developed self-imposed

guidelines to help manage the area until such time as official rules are developed. The State has shown some willingness to recognize TEK in rulemaking but has had difficulty in implementing it to date.

The Miloli'i community was once famous for the fishing of *'ōpelu* (mackerel scad). While *'ōpelu* is still fished by a few community members, traditional technology and practices have not been in regular use for over fifty years. Numerous traditional practices associated with *'ōpelu* fishing helped to maintain healthy stocks. These included using only vegetable matter as chum, because fish-matter chum caused more rapid decomposition of dried fish and attracted predators that disrupted the spawning aggregations. Additional practices were returning a minimum of two reproductive fish to the water with each net haul, using nets that were not capable of removing entire aggregations, restricting fishing during spawning periods, and strictly enforcing seasonal closures. Other aspects of traditional fishing for *'ōpelu* included an intimate knowledge of the aggregation sites (*ko 'a*) and regular feeding of these *ko 'a* prior to fishing. *Ko 'a* would be tended at least three days per week by feeding vegetable matter to the aggregating fish. Certain *ko 'a* were tended and subsequently fished by certain families. Tending would continue for approximately two months prior to fishing season. The fishing season would close during the seasonally rough winter months.

Today, some members of the Miloli'i community have started to fish *'ōpelu* again in the traditional way as part of an effort to teach youth about traditional practices and instill a sense of responsibility towards resource stewardship for many nearshore fisheries. One immediate manifestation of this effort is that for the first time in over 60 years, a traditional *'ōpelu* canoe is now being used to fish in ways that once sustained both people and the fish stocks upon which

they depended. Additional activities that accompany these efforts include teaching youth and other community members how to monitor biological resources in their areas, collecting historical knowledge from *kupuna* about changes in the area's marine resources, and teaching youth how to collect, document, and present marine resource knowledge through film, as well as being founding forces in the Makai Watch program

(<http://www.hawaiiicoralreefstrategy.com/index.php/local-action-strategies/makai-watch>). Key community members believe that the sharing of traditional knowledge and values with youth will help build a solid foundation for future wise choices in resource management (Walter Paulo, pers. comm.)

Kalaupapa, Moloka'i

The remote Kalaupapa Peninsula on the island of Moloka'i achieved notoriety in 1865 when the Kingdom of Hawai'i instituted a century-long policy of forced segregation of persons afflicted with [Hansen's disease](#), also known as leprosy. Former Hansen's disease patients still live at Kalaupapa, and public access to this community is very limited because of regulations safeguarding privacy.

Owing to its isolation and unique political structure, Kalaupapa has some semblance of local management and control of its resources. Residents abide by state regulations but visitors are restricted to pole fishing only. Violations of the Kalaupapa fishing policy or state regulations result in the visitor being declared unwelcome and banned from future visits to Kalaupapa. Boats can come within one mile of the shoreline but the community often expresses their displeasure with these actions.

Ni‘ihau

Ni‘ihau, the smallest inhabited island in Hawai‘i, is privately owned with a resident population of about 130 Native Hawaiians. The only Hawaiian island where the Hawaiian language is the primary spoken language, Ni‘ihau has no stores and inhabitants fish and farm for subsistence (Tava and Keale 1989). Ni‘ihauan’s feel the commoditization of marine resources elsewhere in Hawai‘i has led to serious resource declines, and therefore they allow no commercial harvest by residents. Fishing is limited to cast nets, spears, and pole-and-line. Other conservation strategies include taking only what is needed, rotating fishing areas, and fishing a variety of species so as not to deplete certain locations or stocks. Boats from Kaua‘i often come to Ni‘ihau but intensive fishing by these outsiders is discouraged. Although no formal rules have yet to be established on Ni‘ihau, the community has developed general guidelines for permitted fishing activities within the community through local peer pressure and others from outside the community are encouraged to conduct themselves in a similar manner while on island.

Hā‘ena, Kaua‘i

Hā‘ena is a rural community on Kaua‘i’s north shore that has long sustained itself through taro farming and fishing the area’s fringing reefs and lagoon areas (Andrade 2008). Due to the history of the Hui o Hā‘ena up into the 1960s, people alive during that time still supported themselves through the traditional ahupua‘a system, which is why Hā‘ena is a center for TEK collection, utilization, and transmission today. The contemporary sharing of natural resources from subsistence harvest within the Hā‘ena community providing a means of perpetuating vital functions of disrupted social-ecological systems, from access to customary food sources, to cultural perpetuation and self-reliance, to strong social networks, and collective insurance through reciprocal exchange (Vaughan and Vitousek 2013). The Hui Maka‘ainana o Makana

was formed in 1998 by key members of the community in Hā‘ena, with the goal of restoring Hawaiian values and stewardship practices within the area. They became a 501(c)(3) (federally recognized non-profit) in order to develop a memo of understanding with the State Park system, which is under DLNR and controls a large portion of the *ahupua‘a*.

In 2006, Governor Lingle signed into law SB2501 SD1 HD1 CD1: “A Bill for an Act Relating to Fishing” (Act 241), thus establishing, “a community-based subsistence fishing area for the ahupua‘a of Hā‘ena.” The goal of the Hā‘ena Community-Based Subsistence Fishing Area is to sustainably support the consumptive needs of Hā‘ena’s people through culturally rooted, community-based management that recognizes and responds to the connection between land and sea and strives to restore the necessary balance of native species. The Hā‘ena community worked more than 5 years to develop a proposed management plan and fishing regulations, which were submitted to the DLNR for approval in June 2011 (Hā‘ena Fisheries Committee 2010), but have yet to be approved.

These case studies illustrate both the parallels in renewed traditional resource management, as well as heterogeneity in their practical application. In such cases, one of the more common tools used to help regulate fishing effort and timing is the moon calendar. Hawaiians of old developed this tool for holistic understanding of marine and terrestrial environments (Edith Kanaka‘ole Foundation 1995), and is used today in select communities (Poepoe et al. 2007; Hanalei Watershed Hui 2012). The moon calendar emphasizes certain repetitive biological and ecological processes (e.g., fish spawning, aggregation, feeding habits) that function at different time scales (e.g., seasonal, monthly, and daily). Fishermen can use the moon calendar by validating it at specific locations and regulating effort accordingly.

WAYS FORWARD

The return to the local scale of management represents a form of contemporary adaptation of traditional management practices to modern governance contexts. Every community has a unique social-ecological context, which bears on the challenges and opportunities for integrating TEK and CMT at the local scale, and partnering successfully with higher levels of governance for co-management of marine resources. For a host of political, ethical, and historical issues, it is not possible to directly implement traditional practices in the contemporary context (Shackeroff and Campbell 2007). Instead, reviving traditional practices most often represents a case of adaptation of traditional with contemporary practices rather than direct transference (Cinner and Aswani 2007). Environment, history, and resources will all dictate what type of management regime is most suited for each individual community. In areas where community capacity, social cohesion and institutions are weak, more contemporary forms of management may be more appropriate. However, interest in devolution of management to the community level will likely continue to grow due to heightened interest among community members in revitalizing cultural practices and traditional rights to resources and because community-based management provides a mechanism for participatory democracy, capacity building, and collaborative stewardship that state-level management has had difficulty in achieving. Thus the promise of co-management provides much allure and potential for transitioning toward sustainability and achieving beneficial social and ecological outcomes for marine resources and coastal communities.

Efficacy of Community-Based Management

Scientific surveys of various locations around Hawai‘i show that locations under community-based management with customary stewardship harbor fish biomass that is equal to or greater

than no-take marine protected areas (Figure 4). Both of these types of management had significantly greater biomass ($p < 0.05$) compared with partially protected areas and areas open to all fishing. From this analysis, it is clear that community managed areas can be as effective as no-take areas in protecting higher biomass of reef fish communities. Additionally, partial protection (rotating closures) is no more effective than open access areas with little to no regulation. Owing to the lack of formal rules associated with many of these community-managed areas, enforcement is typically through local peer pressure. A number of these locations are in remote areas with limited access, thus allowing the community greater control over these resources but also reducing overall fishing pressure. Although some MPAs suffer from poor enforcement and poaching, most function much better than other forms of management in Hawai'i (Friedlander et al. 2007).

The ability of community-based management to produce both ecological and social benefits in Hawaiian communities mirrors findings from research in other places around the world where co-management has been successfully implemented (e.g., Basurto 2005; Cinner et al. 2005; Gelcich et al. 2010). In the context of coastal communities and small-scale fisheries, co-management is associated with increased collaboration and learning among partners, integration of traditional ecological knowledge and place-based approaches, higher compliance with regulations, community empowerment, and increased stakeholder buy-in and stewardship (Jentoft et al. 1998, Jentoft 2005, Pomeroy et al. 2007, Berkes 2009, Gelcich et al. 2010). Co-management approaches that are inclusive of stakeholder groups can help to implement resource management in a culturally sensitive manner to increase compliance, efficacy of conservation actions, and the ability of the management arrangement to withstand social, political and environmental change. It is also important to note, however, that if improperly

planned and implemented, efforts to integrate these systems may do more harm than good by eroding confidence in conventional science and management as well as traditional authority (Gelcich et al. 2006; Yandle 2008). For example, attempts to develop customary management into co-management arrangements have undermined and weakened traditional authorities and reduced the adaptive capacity of customary management institutions in Chile and the Cook Islands (Gelcich et al. 2006; Tiraa 2006). Inadequate understanding of local power structures and the sociocultural aspects of customary institutions and local resource users can thus lead to sub-optimal outcomes (Kittinger et al. 2012).

Knowledge-sharing and capacity-building

A variety of community-based initiatives have emerged to ensure multigenerational knowledge-sharing and to build capacity across the State to protect and perpetuate traditional knowledge. Non-profit organizations, state and federal agencies, and communities are working in concert towards these ends. The Managing Better Together Learning Network (*E Alu Pū*), a project that brought together community marine practitioners to work toward improving their practice through sharing lessons and strategies (Hawai‘i Community Foundation 2009), exemplifies knowledge-sharing and capacity-building efforts occurring among Hawaiian communities. Since 2003, the network has grown from 13 to 22 participating communities, fostered by community-based organizations such as the Community Conservation Network and KUA (Kua‘Āina Ulu ‘Auamo, formerly the Hawai‘i Community Stewardship Network) (Hawai‘i Community Foundation 2009). At the request of local communities, KUA helped to create *E Alu Pū* (<http://www.hcsnetwork.org/ealupu>). *E Alu Pū* is a network linking more than 30 communities from around Hawai‘i to increase their effectiveness in managing local environmental heritage.

KUA brings together these communities for training workshops and meetings, where they share lessons and ideas while building the skills they need to better manage resources.

Enforcement

Much lore and intrigue surrounds the traditional Hawaiian system of *kapu*, known for harsh enforcement of fishing infractions, sometimes with blinding or death. Traditionally, enforcement was enacted at the local level by *konoiki* acting in response to real-time observations such as seasonality and population status. Contemporary communities in Hawai‘i commonly complain about the lack of enforcement of marine regulations (e.g., Kittinger et al. 2013). To better enforce existing regulations, community-based enforcement programs have been initiated across Hawai‘i, with Maui’s ‘Ahihi-Kīna‘u Natural Area Reserve in 1997, and later in 2003 with the Reef Stewardship Program at Wai ‘Opae and Coast Watch at Miloli‘i. These efforts resulted in “Makai Watch”, a formal partnership between the State and nonprofit organizations that focuses on caring for near-shore marine resources with the active participation of local communities. Modeled after the Neighborhood Watch program, Makai Watch volunteers in over ten communities statewide serve as the ‘eyes and ears’ for conservation and resource enforcement officials. While not specifically a program integrating TEK, it represents a return to local enforcement and draws institutional parallels to traditional Hawai‘i.

In the United States, the landscape of federal ocean policy and management is undergoing dramatic change. The US’ new approach to ocean management, as articulated in the national ocean policy implementation plan, provides a framework and standards for implementing ecosystem-based approaches and a marine spatial planning framework throughout U.S. waters (Executive Order 13547; National Ocean Council 2012). Integrating TEK into marine

management through collaborative stewardship and co-management has been shown to produce tangible social and ecological benefits. It will be particularly important to ensure that TEK and traditional knowledge-holders are engaged appropriately – ethically and politically. A number of Pacific Island nations have developed formal and legal mechanisms for community tenure over their marine resources, which has led to improved stewardship. Hawai‘i is in the early stages of revitalization of TEK and community-based resource management, but the large number of communities currently engaged in the process provides hope that lessons from the past and elsewhere around the Pacific will help restore customary management practices, where appropriate, around the State.

Despite numerous anthropogenic stressors, many of Hawai‘i’s coral reefs, primarily in remote areas, are still in fair to good condition compared to elsewhere around the world (Friedlander et al. 2008). It is therefore urgent to develop management strategies that can alter the current trajectory of resource declines and improve the quality of these resources for future generations before a tipping point is reached (Hughes 1994; Kittinger et al. 2011). More engagement with traditional knowledge and community are critical to achieving these goals.

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Table 1. Comparisons of customary and conventional marine resource management in Hawai'i and application in integrated approaches. Adapted from Cinner and Aswani (2007), McClenachan and Kittinger (2012), and Jokiel et al. (2011).

Customary Management	Description	Conventional Management	Integrated approaches
Spatial	Areas closed to fishing (kapu zones), can be temporary or permanent (e.g., during Makahiki; rotating Aku/Ōpelu kapu)	Marine protected areas, temporary fisheries closures	Community managed marine areas, with established kapu zones to replenish resources if needed
Temporal	Restricting fishing/harvesting activities during specific times. Often short duration, specific to certain species, and for specific events (e.g., religious ceremonies, protect spawning aggregations)	Closed seasons	Community-based moon calendars showing which species are spawning and should be kapu
Gear	Restrictions on certain harvesting methods or techniques; Chiefly control of materials for fishing gears and boats, which limited access to some fisheries resources	Gear prohibitions	Restrictions on certain gears (e.g., for laynets, or no spearfishing with SCUBA)
Effort	Limits on access to certain areas (e.g., only residents of ahupua'a could access adjacent reef); Limiting who can harvest certain species, use certain gears, or fish certain areas	Permitting; Territorial user rights systems for fisheries (TURFS); Limited entry fisheries	Community-based subsistence fishing areas with rules developed in an inclusive, place-based manner; Permitted access for local families or residents in a district (moku)
Species	Prohibitions on consumption of certain species, often related to class, gender, or lineage	Protection of vulnerable or endangered species	Bans on certain species until populations regenerate; Limits on harvest for culturally significant species or resources that contribute significantly to local food security
Catch	Restricting the quantity of harvest; Social norms discourage wasting and other harmful practices	Total allowable catch; Individually transferable quotas (ITQs)	Communal harvest events to sustain connections to local resources; Educational and outreach programs to connect community members and build social capital
Aquaculture	Creation of fishponds, stocked with wild caught juveniles, which sequestered nutrients from uplands and served as insurance against famines	Modern aquaculture	Rebuild and revitalize fishponds to provide fisheries resources to communities; Explore creation of Community Supported Fisheries (CSF) models to connect communities to local fishponds
Enforcement	Violations of customary restrictions resulted in sanctions or punishments that could be severe	Fines; Penalties; License revocation	Develop and implement a penalty schedule of graduated sanctions that includes community service by violators in restoration activities

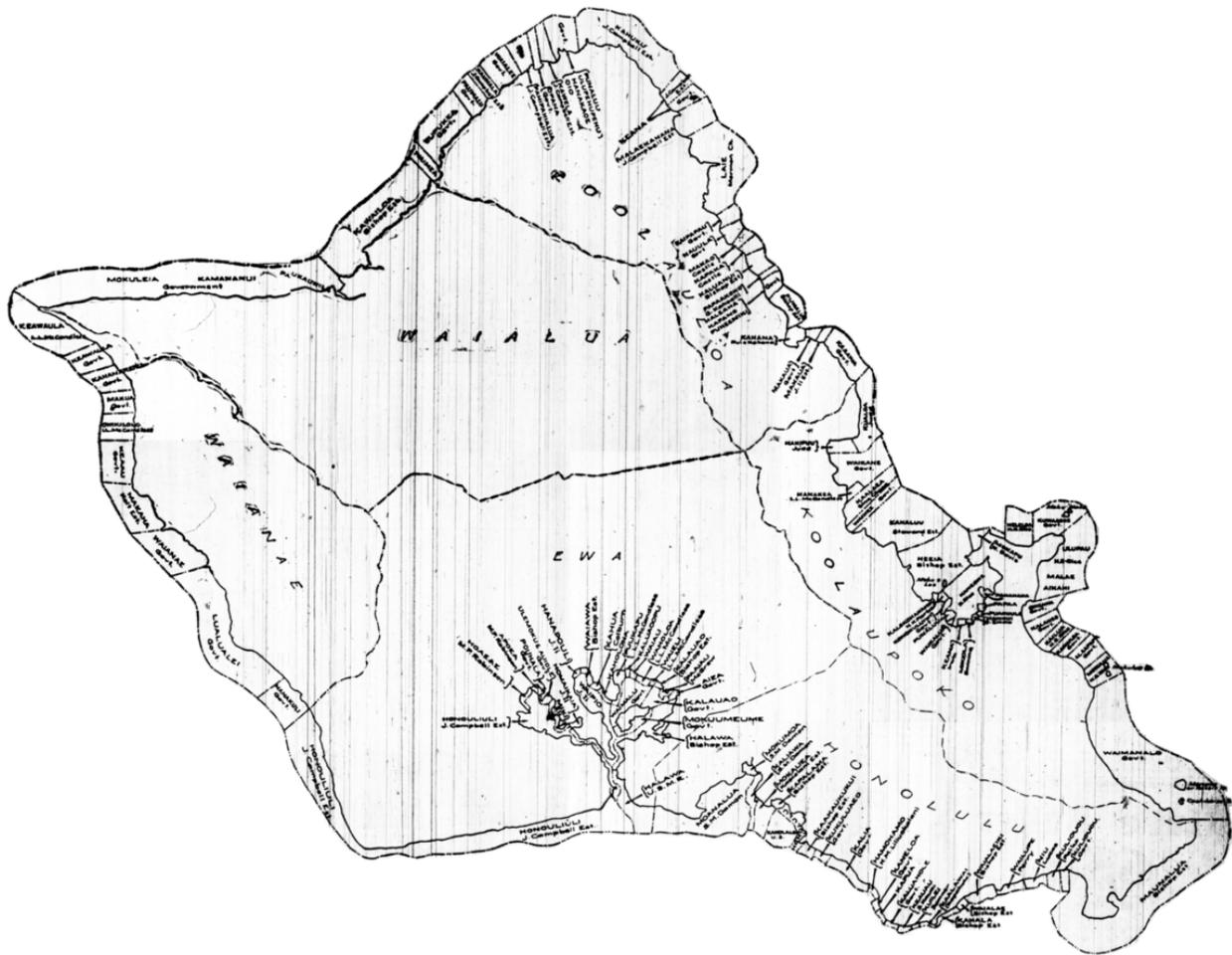


Figure 1. A historical map of traditional fishing rights (konohiki fisheries) in nearshore waters surrounding the island of O‘ahu, Hawai‘i, published in the Honolulu Advertiser article “Fishing Rights of Hawaii Date Back to Grants of Kings,” 11 March 1923 (Anonymous 1923, and reprinted in Cramer 2010). Moku, or districts, are indicated as regions on the map with capital letters. The fine print lists names of individual owners of konohiki fishing rights, which are represented on the map as a coastal fishery zones adjacent to land parcels on the island of O‘ahu.

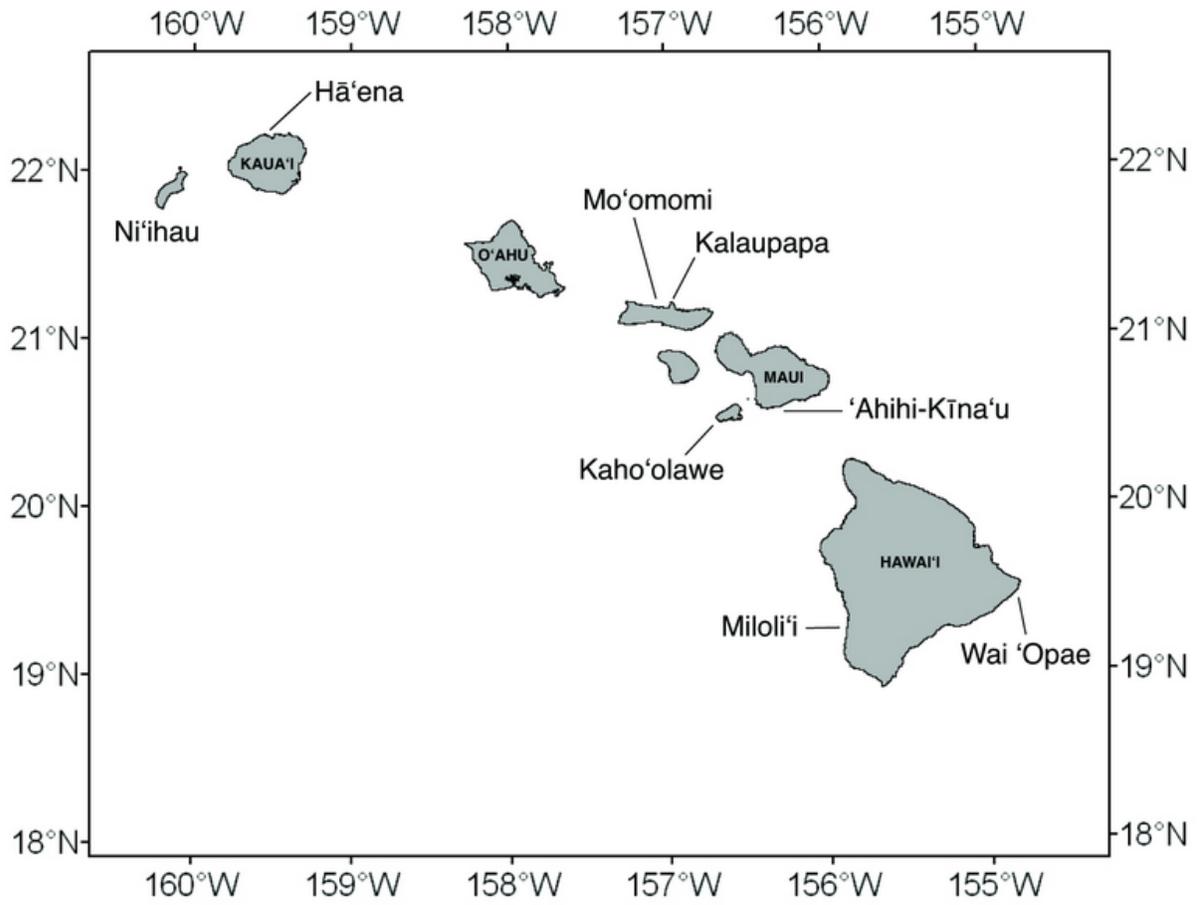


Figure 2. Map of the Hawaiian Islands identifying community-based management areas.

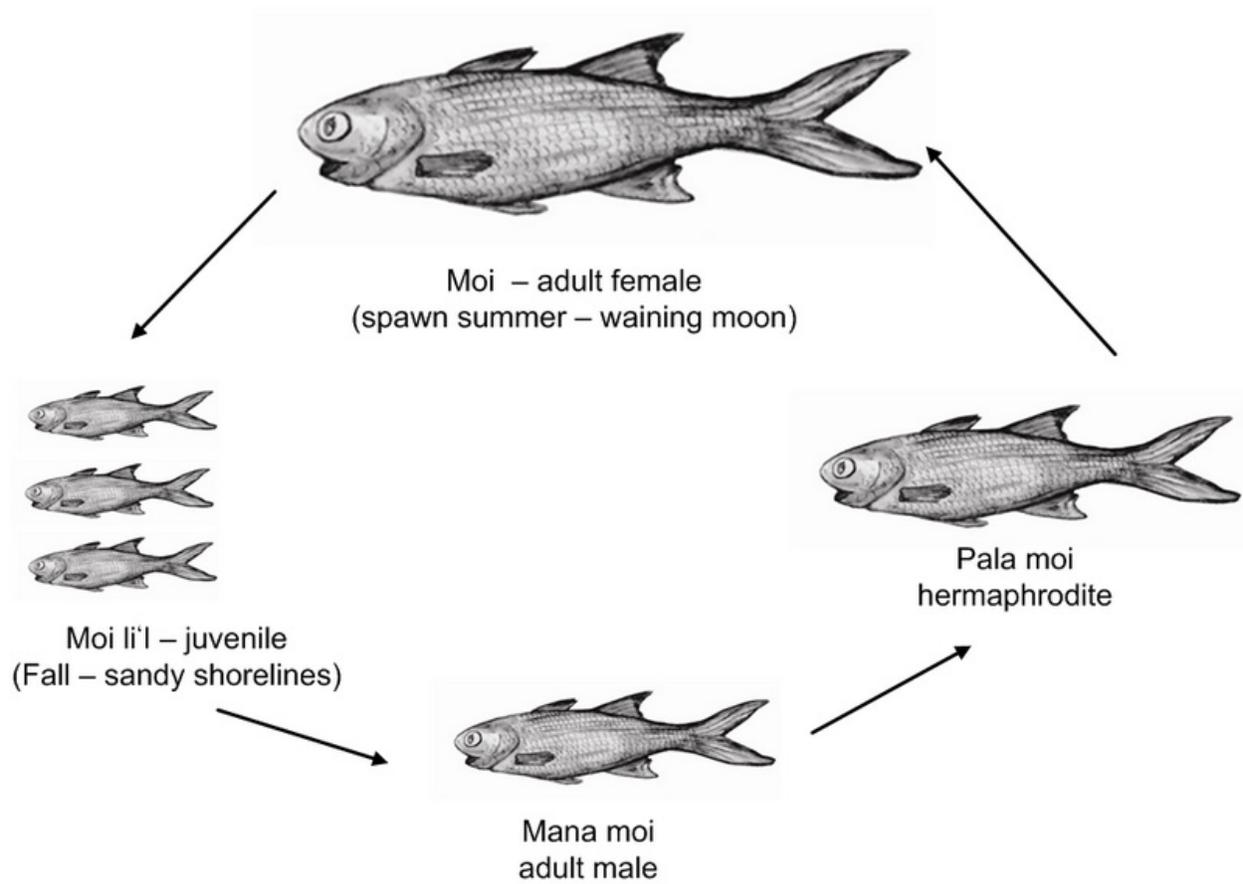


Figure 3. Life cycle for *moi* (Pacific threadfin), a sex changing species that was reserved for the chiefs in ancient Hawai‘i. Model identifies times and locations to restrict harvest (see text for details).

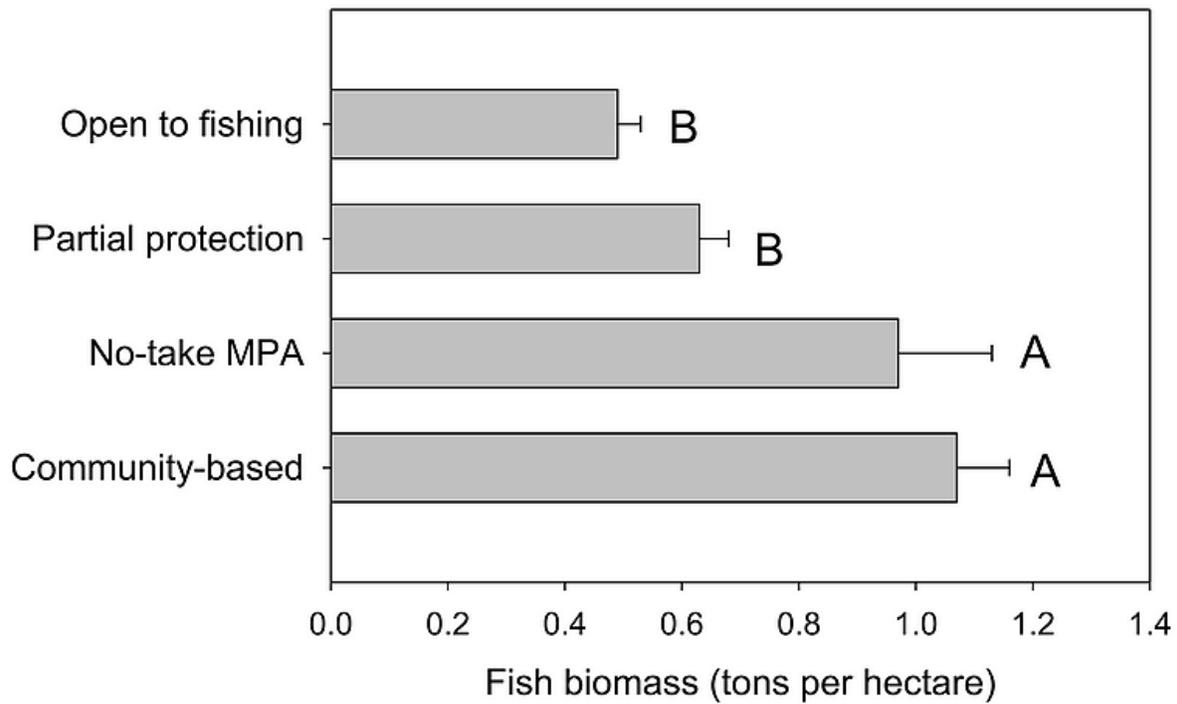


Figure 4. Comparison of fish biomass under various management regimes in Hawai‘i based on 1344 surveys at 143 locations (open to fishing = 94, no-take MPA = 9, community-based = 18, partial protection = 22). Types of management are significantly different ($F_{3,142} = 3.65$, $p=0.01$). Management types with the same letter designation are not significantly different ($p>0.05$). MPA = marine protected area. Data from Williams et al. 2008 and Friedlander et al. 2007.

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