SOCIAL AND ECONOMIC BENEFITS OF THE MAUNALUA BAY REEF RESTORATION PROJECT

- FINAL REPORT -

Photo: J. Kittinger

Paikō Drive Algae Removal Area: Maunalua Bay, 20 December 2010

"Maunalua Bay no ka oi"

Prepared on behalf of

The Nature Conservancy

by

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October 5, 2011

Aloha Dr. Ziemann,

Attached please find our final version of the report titled “Social and Economic Benefits of the Maunalua Bay Reef Restoration Project.” As specified in our original proposal, the report characterizes a variety of socioeconomic and sociocultural benefits resulting from the 2010 invasive algae removal (IAR) project administered by The Nature Conservancy (TNC) through the American Recovery and Reinvestment Act of 2009 (ARRA).

Over 150 persons were interviewed to aid in characterizing human uses of the marine environment, to examine local perspectives on environmental changes in the region, and to gauge direct and indirect social, economic, and cultural benefits associated with the IAR project. Research results indicate that the ARRA grant that supported the IAR work has resulted in significant social and economic benefits to project participants, to human communities adjacent to Maunalua Bay, and to the various non-governmental organizations involved in the effort.

We wish to thank you for your diligent oversight of this important research project, and we hope that the report and associated data prove useful to TNC and its mission in the Pacific Islands region now and in the years to come. Please feel free to contact us should you desire additional information or clarification of the contents of the attached report.

Mahalo nui loa,

Edward W. Glazier, Ph.D.
Vice-President and Principal Investigator

John Kittinger, Ph.D.
Lead Scientist and Project Manager

Acknowledgments

The authors wish to extend heartfelt thanks to the many research participants who gave their time and energy to this project. We especially thank Laura Thompson, Bruce Blankenfeld, Kini and Karen Gleason, and other kamaʻāina who so graciously shared their manaʻo – this project would not have been possible without their assistance. Nahaku Kalei and Bradley Wong contributed significantly to the development of the research design, data collection effort, and analytical phases of the work. Their efforts, too, are greatly appreciated. We also wish to extend our sincere thanks to Mālama Maunalua and lead staff members Alyssa Miller, Kimo Franklin, Carol Wilcox, Jennifer Taylor, Alika Winter, Tegan Hammond and Jolie Wanger; and to Pono Pacific and its staff, especially John Leong, Luke Estes, and Lei Leong. Finally, we wish to thank The Nature Conservancy for sponsoring this important project, and thanks especially to Manuel Mejia, Sean Marrs, David Ziemann, and John Parks. Any errors or omissions are the responsibility of the authors alone.

Table of Contents

List of Tables

List of Figures

Acknowledgments

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Social and Economic Benefits of the Maunalua Bay Invasive Algae Removal Project

1.0 Introduction

This report describes the objectives, methods, and findings of a study designed to examine the social and economic benefits of the invasive algae removal (IAR) project that was conducted in Maunalua Bay on the Island of Oʻahu during 2010. The report is based on research activities undertaken on behalf of The Nature Conservancy (TNC) through funding provided under the American Recovery and Reinvestment Act (ARRA) of 2009. As described in the following pages, assessment of IAR project benefits involved many hundreds of hours of ethnographic research and over 150 interviews with public officials, residents, and members of local organizations. The research makes clear that the IAR project improved local marine environmental conditions and generated numerous social and economic benefits.

1.1 Background and Purpose

The goal of the research described in this report was to provide TNC and its partners with a descriptive assessment of the social and economic effects of the Maunalua Bay Reef Restoration Project, with particular attention to the IAR component of the project. TNC contracted with Impact Assessment, Inc. (IAI) to conduct the research and analysis. IAI has specialized in maritime social and economic research since its inception in 1981.

Maunalua Bay[1] is located between Kawaihoa promontory (Koko Head point) and Kūpikipikiʻō (also known as Black Point) along the southeastern coast of Oʻahu in the Main Hawaiian Islands (Figure 1.2). With a shoreline span of 12 kilometers (~8 miles) and nearshore waters totaling some 17 square kilometers (~6.5 square miles), Maunalua is one of the largest natural embayments in Hawaiʻi.

The Maunalua Bay area constitutes the eastern portion of Kona Moku and includes numerous ahupuaʻa and associated watersheds. From west to east, these include: Waiʻalae nui, Waiʻalae Iki; Wailupe, Niu, Kuliouou, Kuliouou Iki, and Maunalua. Maunalua encompasses numerous additional valleys, including Kaʻala kei, Hahaʻione, Kamilo Nui, Kamilo Ike, and Kapakahi.

Expansion of urban Honolulu began to significantly affect the landscape and demography of the Maunalua Bay region during the 1960s. Today, the general area is populated by some 60,000 residents (Mālama Maunalua 2008). Kalanianaʻole Highway provides an east-west transportation route and access to numerous densely populated residential areas on both the mauka and makai sides of the highway. Residential neighborhoods in the area include: Kāhala,

[1] Pukui, Elbert, and Mookini (1974) translate Maunalua literally as "two mountains" in reference to Koko Head and Koko Crater. Maunalua Bay is defined to include the nearshore area east of Laeʻahi (Diamond Head) and west of Koko Head. The area was also known and may sometimes be referred to as Waiʻalae Bay.

Waiʻalae, Waiʻalai Iki, Waiʻalae Nui, ʻĀina Haina, Niu, Kuliʻouʻou, Hawaiʻi Kai and others. Numerous beach parks are located along the bayfront.

Popular contemporary activities occurring in and around Maunalua Bay include shoreline fishing, boating and boat-based fishing, parasailing, kiteboarding, outrigger canoeing, jet skiing, and surfing, among others. The waters immediately adjacent to the shoreline are relatively shallow and coral-laden, making for marginal recreational conditions close to shore. Most board-oriented recreational activity occurs along and beyond the fringe reef, which ranges from as little as 75 yards offshore in the westernmost portions of the Bay to as much as 450 yards or more offshore along the easternmost portions.

Natural reef passes and man-made channels allow for passage of shallow draft vessels in various locations. Numerous inshore reef areas are exposed during lower tides but can be navigated (again with shallow draft vessels such as outrigger canoes) during higher tides. Boat-based fishing tends to occur along the outer margins of the fringe reef, spearing and capture of heʻe (octopus) occurs throughout the nearshore and outer reef areas, pole and line and throw net fishing occurs from the shoreline and along the inshore reef areas, and picking of limu (edible seaweed) and gleaning of other species occurs along the shallow intertidal reef zones.

The land and nearshore areas in this region have been subject to various anthropogenic stressors for many decades. These include: shoreline alteration and coastal development; outflow of pollution generated on land; sedimentation; and over-harvesting of certain marine species (Mālama Maunalua 2009; Wolanski et al. 2009), among others. The deleterious effects of invasive alien algae, especially those of the highly disruptive siphonous green alga known as *Avrainvillea amadelpha* - or leather mudweed – constitute a significant threat to the ecological status of Maunalua Bay.

Leather mudweed was first identified in Maunalua Bay in the early 1980s (Brostoff 1989). By covering holes and cracks in the coral substrate and by trapping sediment, the alga tends to alter the normal functioning of nearshore coral reef ecosystems and constrain recruitment of various nearshore fish species, mollusks, and other creatures. The alga is also known to displace the relatively rare indigenous sub-tidal sea grass known as *Halophila hawaiiana*. *Avrainvillea amadelpha* tends to grow on sandy flats and coral rubble, and the species appears to be most prolific in relatively calm waters, such as along the shoreline side of fringe reefs. The alga has- in recent years- affected at least 270 acres of coral reef in Maunalua Bay. Given a lack of predators or other natural ecological controls, leather mudweed remains a significant threat to coral ecosystems throughout the Hawaiian Archipelago (Godwin et al. 2006).

In 2006, TNC, Mālama Maunalua, and partner organizations developed a Conservation Action Plan (CAP) to address principal threats to the nearshore ecosystem(s) of Maunalua Bay, including invasive leather mudweed (Mālama Maunalua 2009). The CAP calls for concerted effort between TNC, Mālama Maunalua, government agencies, and local residents to: (1) reduce land-based pollution that could otherwise negatively impact marine resources around Maunalua Bay; (2) regulate unsustainable harvest of living marine resources; and (3) halt the spread and localized effects of invasive algae through manual removal.

It is widely believed that removal of *Avrainvillea amadelpha* is highly beneficial to marine ecosystems and associated resources (cf. TenBruggencante 2009), and it is clear that improved conditions benefit persons who use the ocean for recreation, food gathering, commercial charter operations, and other purposes. IAR work itself generates economic benefits to persons employed in this line of work, many of whom also report a sense of accomplishment in having worked to improve the marine environment– a particularly important public trust resource in Hawai‘i. These and other social and economic benefits of environmental restoration work, and the nature of the work itself, are described in the following pages of this report.

1.2 Organization of the Report

Following this introductory discussion, Section Two describes the sampling approach and field research methods used during the course of the project. Section Three provides background discussion of the research problem and setting, including a brief history of the Maunalua Bay area and review of the recent IAR project. This is followed by presentation of quantitative and qualitative research findings in Section Four. Section Five summarizes project findings and provides concluding discussion. Cited and useful references follow.

Figure 1.1 IAR Project Workers Make Ready for a Day on the Reef, Winter 2010

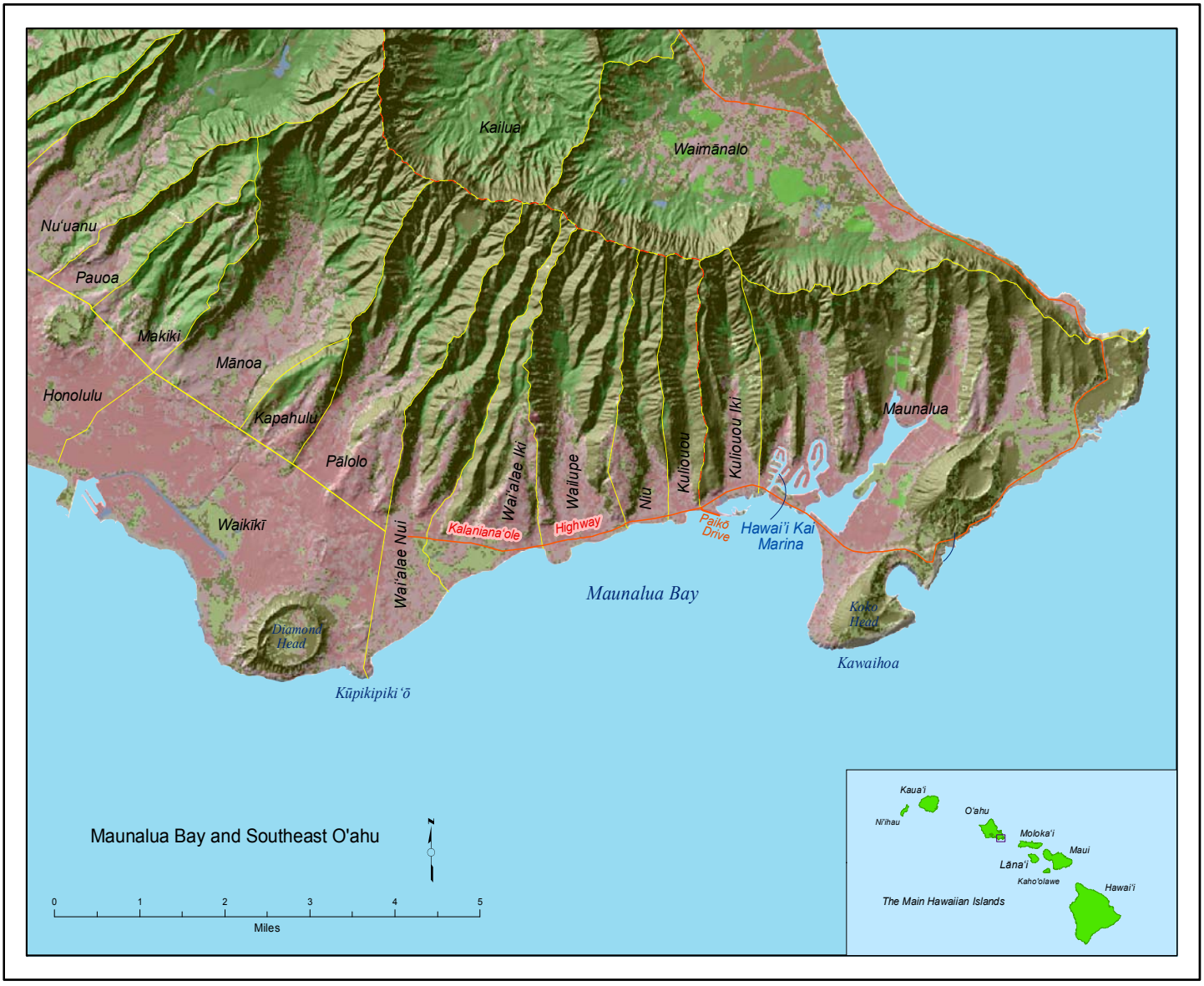

Figure 1.2 Maunalua Bay and Surrounding Areas

2.0 Research Approach

IAI undertook assessment of the ARRA-funded IAR project during August 2010. Analysis of incoming field data was initiated in January 2011, and field research activities continued through April 2011. Data collection was finalized during early spring 2011, whereupon the research team finalized the analysis and drafted a report on project findings. Below, we outline the process through which the research approach was formulated, provide an overview of the social science methods used, and describe more fully the collection and analysis of archival information and data deriving from ethnographic fieldwork.

2.1 Building a Collaborative Research Plan

IAI worked closely with local organizations to assess key social dimensions of the IAR project. Initial planning meetings were held between IAI, TNC, local organizations, and public officials during August and September of 2010. A research plan was created, based on the scope of work developed by TNC, the proposal submitted by IAI, and initial conservations with key persons in the study area. Given the level of dedication of all parties to restoration work in Maunalua Bay, it was clear that the research effort would necessarily involve extensive interaction and close coordination between project partners and residents of the affected area.

During initial project planning meetings, representatives of TNC expressed interest in involving two Marine Conservation Fellows in the project. A Marine Conservation Fellowship program had been launched by TNC in 2008 through a two-year program that trains emerging professionals to "to use a wide range of marine stewardship skills and work directly with communities to manage local marine resources." IAI agreed that the research fellows would complement the collaborative nature of the project while gaining practical research experience.

2.2 Overview of Field Methods

Socioeconomic and sociocultural assessment of the IAR project involved use of a network-based sampling approach, extensive observation in the study area, and in-depth interview research. Purposive sampling was used to identify individuals known to possess understanding of environmental and social aspects of the Maunalua Bay study area and the IAR project.

Purposive sampling is a social science research strategy in which particular settings, persons, or events are selected for the information only they can provide (Maxwell 1997). The approach is commonly employed in studies seeking to characterize specific issues or cognitive domains (Bernard 1988). Purposive sampling does not necessarily compromise the extent to which findings can be generalized to a larger population since the sample can be stratified to include persons with a variety of experiences and perspectives.

Social network-based sampling is a type of purposive approach, often used to identify persons particularly knowledgeable of or experienced with specific research topics (Lin 1999; Hanneman 2001) – in this case, with social and environmental aspects of Maunalua Bay. The approach is useful for assessing the relative extent of cultural understanding or knowledge possessed by each person in the sample (Romney et al. 1986); the degree to which each informant is socially

connected with others in the group; and each person's degree of social status within the group or community being examined. Hanneman (2001) provides detailed discussion of the rationale for and statistical underpinnings of social network-based sampling.

Once target populations were identified through social network sampling, ethnographic methods were used to identify and examine salient research topics. These methods included direct observation, exploratory interviews, and in-depth ethnographic interviews. Each of these methods generates data which can be cross-validated to enhance validity and reliability (Bernard 2006). The methods also serve to identify important issues and categories of information that may be explored in greater depth through subsequent research effort.

2.3 Phase I Research Activities

Phase I research was initiated during late spring 2010 and finalized in November 2010. This work involved the following: (a) interaction with project partners and public officials to discuss research needs and important aspects of the study area, and to enable entrè into the study area; (b) identification of and initial interaction with key persons in the study area; (c) identification of important research questions and development of research protocols needed to address them; (d) initiation of the social network sampling process; (e) unobtrusive observation and documentation of relevant aspects of life in the study area; (f) attendance at local meetings; and (h) ongoing archival research. The objectives of these activities were to: (1) build a comprehensive list of key respondents and stakeholder groups to target for in-depth interviewing; (2) characterize the social-environmental interface in the Maunalua Bay area; (3) identify social networks that have developed in association with the restoration project; and (4) identify important topics of relevance to the IAR project and culturally appropriate ways to elicit local understanding about such topics.

2.4 Phase II Research Activities

Field-intensive Phase II research activities were initiated in December 2010. Ethnographic protocols were pre-tested among a small group of respondents and were subsequently implemented among a larger sample of persons in the study area. Interviewing was combined with observational work; the latter included participant observation, wherein the ethnographers actually participated in the IAR project for a period of time. All interviews were conducted in-person and typically lasted an hour or longer. Interviews followed accepted social science research methods and techniques (Miles and Huberman 1994; Bernard 2006). The anonymity of individual informants and the proprietary nature of certain information were safeguarded throughout the course of the project.

Interview research was initiated among persons identified through social network sampling as having experienced direct economic benefits from the IAR project: these included employees of the firm contracted to remove the invasive algae. Other individuals were also interviewed at this time, including: persons who regularly use Maunalua Bay on a recreational basis, such as avid fishermen; tenured residents; local researchers and educators; representatives of community organizations and institutions; Native Hawaiian cultural practitioners; and local farmers.

The interview protocol consisted of guidelines for eliciting discussion of specific social, economic, and environmental dimensions of the IAR program. Topics included: (1) the mission and nature of local organizations; (2) background information about the respondent and his or her relationship with Maunalua Bay; (3) perspectives on the IAR project and its benefits and liabilities; and (4) perspectives on environmental change. Respondents were also encouraged to talk freely about relevant topics of their own choosing.

Both qualitative and quantitative data were generated during the interview process. Quantitative data were transcribed from interview notes and entered into a spreadsheet. The information was reviewed for accuracy and subsequently imported into a statistical software package. Descriptive analyses were generated, and in some cases linear regression was used to describe relationships between specific data categories (see results section).

Qualitative data were analyzed using a grounded theory approach (Glaser and Strauss 1967; Martin and Turner 1986). This allows the researcher to develop theoretically relevant suppositions about the topics being addressed while simultaneously grounding the results with empirical observation (Schatzman 1991; Robrecht 1995; Thomas and James 2006). Responses were coded and examined in relation to select attributes of the respondents, such as age, length of residence, and manner of participation in the IAR project.

Figure 2.1 Workers Remove Invasive Algae from the Papa at Maunalua Bay, Winter 2010

3.0 Background

Archaeological findings, historical documents, oral history, and recent publications provide insight into the long history of human activity in and around Maunalua Bay. This section briefly describes historic aspects of life in this part of Oʻahu, and some of the human factors and social processes that have led to ecological problems in the area.

3.1 A Brief History of Maunalua Bay

The lands above Maunalua Bay are relatively dry, and archaeological evidence suggests that people once primarily used the mid-valley areas for agricultural purposes. People tended to live along the coastal zone and utilized the rich marine resources there (Thomas 1995; Cordy 2002).

The first European visitors to the area portrayed it as well-populated and with ample food resources (Portlock and Dixon 1789; Stevens-Gleason and Hammatt 2008). For instance, during his visit to Maunalua Bay in 1787, Captain Nathaniel Portlock reported that "soon after our arrival several canoes came off and brought us cocoa-nuts and plantains, some sugar cane and sweet root; in return for which we gave them small pieces of iron and a few trinkets" (Portlock and Dixon 1789:69).

Traveling through the area as missionaries in the early 19th century, Mathison (1825) described a large fishing village near Maunalua fish pond, and Chamberlain (1826) described three settlements between the pond and the school house at Waiʻalae. Productive fishing and agricultural activities apparently continued in association with functioning ahupuaʻa (traditional land division that typically ran from the mountain to the sea), under the leadership of konohiki (local land manager) well into the nineteenth century (Stevens-Gleason and Hammatt 2008). Sterling and Summers (1978:275-276) provide entries from an early Hawaiian newspaper which describe the nature of life at Waiʻalae Nui prior to the Great Mahele:

> Many people lived along the shores and they worked at farming and fishing. Plants grew. There were taro patches, tobacco, sweet potatoes, bananas and sugar cane. There were ever so many people on the shores when the chiefs came to spend a while with the common people.

The Great Mahele led to a significant reordering of life in the region, as it did across all the islands. This was undoubtedly a challenging time for the indigenous residents of Maunalua Bay. Kameʻelehiwa (1992) describes the concepts underlying the Mahele as foreign to Native Hawaiians past and present:

> It was and is a difficult thing for the Hawaiians to understand. . . ʻāina is something that all Hawaiians need to live. How can it be divided for exclusive use? It is like dividing the air that we all breathe, or the water we all must drink.

Despite radical differences between Hawaiian and haole (foreign) perspectives on land and how it should be used, foreign interests and philosophies forced a parceling of the land and

designation of private property rights throughout the islands. In concise terms, this eventually led certain individuals and families then living in ahupua‘a along Maunalua Bay to gain ownership of small parcels of land in the mid-valley areas and along the shoreline. For instance, during the Mahele, 50 claims were made and 35 were awarded in Wailupe, and 21 claims were made and 16 were awarded around Wai‘alae Nui.

Records describing land use patterns subsequent to the Mahele indicate extensive cultivation along the flat coastal zone, use of small fishpond-like enclosures along the shoreline, and a tendency for dwellings to be constructed relatively close to the ocean. Only a scattering of habitation sites have been documented in the upland zones (Ogata 1992; Jones 2001).

While the population of nearby Honolulu began to burgeon during the early 20th century, Maunalua Bay remained relatively isolated and sparsely populated, as it was accessible only by ocean and by the rugged, two-lane dirt road then called Wai‘alae Road (Stevens-Gleason and Hammatt 2008:49). Ocean access was limited, since mooring of large vessels was difficult in the characteristically shallow nearshore zone.

In historical times, traditional forms of marine tenure determined access rights to nearshore marine resources. With the imposition of private landownership, access rights began to evolve away from the traditional and toward the formal-legal. That is, after the Great Mahele, nearshore fisheries were transformed from being implemented via communal rights nested within the boundaries of traditional ahupua‘a, to rights nested in the purchase of real property. Although this situation began to constrain residents living in the mauka (inland) portions of the ahupua‘a from accessing nearshore marine resources, it was often the case that access was granted in keeping with traditional customs and social ties between residents of mountain and shoreline.

By the 20th century, fishing rights were elements of “konohiki rights,” drawing from the word used to describe managers of the resources of land and sea under the old ahupua’a system (Kosaki 1954). Konohiki rights were serially eroded by the territorial government over time (cf. Cobb 1902). Nonetheless, a konohiki system prevailed in the Maunalua Bay area until around the mid-20th century, with residents enforcing local customs and limiting use of resources by outsiders (Cramer 2010). Konohiki rights remain part of the State of Hawai‘i constitution (Meller 1985), but are not widely recognized.

Construction of the Kalaniana‘ole Highway project began during the 1920s, and improvements continued through the 1940s and beyond (Stevens-Gleason and Hammatt 2008). This and the commercial subdivision of land led to an increasing number of homes along the shoreline of Maunalua Bay, and eventual expansion of the population into the valleys and developable portions of the uplands.

A number of large-scale development projects altered Manalua Bay. For instance, the loko i‘a (fish pond) at Wailupe was filled during the late 1940s to facilitate construction of a residential area. Similarly, the roughly 523-acre Kuapā fishpond, one of the largest fish ponds in Polynesia, was converted into Hawai‘i Kai Marina in the early 1960s. Further, the coral reef around what is now Koko Head Marina was altered to enable boat access, and the dredged materials were used

to construct Maunalua Bay Beach Park (Clark 1977). Kupapa, an important fish pond at the ocean terminus of Niu ahupua‘a, was filled during the same period in order to accommodate development of the Niu Iki circle neighborhood (Wolanski et al. 2009). The degradation of fish ponds and other nearshore habitats altered the input of freshwater from the uplands and disrupted historic circulation patterns.

Following the Great Mahele and into the 20th century, Native Hawaiian families residing in the Maunalua Bay area continued to rely in part on acquisition and sharing of local marine and agricultural resources. They were eventually joined in such pursuits by persons of other ethnic ancestries, and some immigrant families eventually asserted their own area-specific use rights in Maunalua Bay. This situation is indicative of the social changes and ethnic struggles that have occurred over the last centuries in the Hawaiian Islands, and which have gradually led to a uniquely diversified yet largely integrated local culture and society (Glazier 2007).

It is notable in this regard that Clark (1977) describes the Paikō area of Maunalua Bay not in terms of use by its original inhabitants, but rather in relation to fishing families who had migrated to O‘ahu from Portugal. Clark writes about an important fisherman who married into a Hawaiian family and assimilated indigenous concepts about land use, including kuleana rights to a portion of Maunalu Bay:

> The island of Pico, one of the Azores, consists mainly of the lofty, 7,613-foot mountain for which the island was named, *pico* meaning hill in Portuguese. From that island, a young man who had been christened Manuel found his way into the Pacific as a whaler and eventually jumped ship in Hawai‘i. He took his family name from his home island. Thus, Manuel Pico became one of the 400 or 500 Portuguese whalers who settled in Hawai‘i before the first group of contract laborers arrived. The majority of the Portuguese people who migrated to the Hawaiian Islands came between 1878 and 1899. The first group came from Fuchal, the capital of Madeira, in September 1878.
>
> When Pico first arrived in Hawai‘i, he encountered some difficulty with his last name. *Pikō* in Hawaiian, pronounced the same as *pico* in Portuguese, means umbilical cord and figuratively also refers to the genitals. The Hawaiians felt very uneasy about calling this man Pikō, so they altered his name to the inoffensive Paikō. Pico accepted this variation and used it officially; his last will and testament, for example, was made out Manuel Paikō.
>
> In 1877, Paikō was appointed Superintendent of Roads on Maui. His professional ventures, however, centered a good deal on acquiring land, not only on Maui, but on Kaua‘i and O‘ahu as well. In 1874, he leased 400 acres of Crown Land in Kuli‘ou‘ou-Iki, and in later years he purchased some of this property. He made his home there until he died on April 8, 1890. His will, now in the Hawai‘i State Archives, stated specifically that the land was to be sold or auctioned, if ever there were no direct heirs, and the resulting money was to be given to the Roman Catholic church, the designated residual legatee. Manuel and his wife, the former Domitilda Kuawaa, had only one child, Joseph, who in turn had only one child, Joseph, Jr. When Joseph Paikō, Jr. died childless in 1947, his will, following his grandfather’s wishes, provided that the majority of the estate was to be held in trust for St. Francis Hospital until the fiftieth anniversary of his death. A substantial provision also was made for his widow until her death.

One of the better-remembered personal attitudes of later members of the Paikō family was the ferocity with which they guarded their fishing rights at Kuli‘ou‘ou-Iki. The old Hawaiian laws, following the ways of the former ahupua‘a land divisions, included offshore fishing rights as part of an acquired beach-front property. After annexation of the islands by the United States in 1898, the Organic Act recognized this tradition, but stipulated that holders had to register their fishing rights with the territory’s Attorney General by 1905. The Paikō family registered their rights, which extended from the beach to the reef and thereafter guarded them jealously. Their area was an excellent mullet- and torch-fishing ground. Stories of gunshots heard on good torching nights were not uncommon.

Paikō Beach, fronting the length of Paikō Drive, is a very narrow strip of coarse dirty sand and pebbles. At high tide, the beach disappears almost completely under water. The shallow coral and mud flats just offshore extend out more than a hundred yards toward the reef, making this a poor place for recreational swimming. The beach at Paikō is frequented primarily by net and torch fishermen and by surfers, all of whom must wade through the rocky, muddy shallows to reach the cleaner, deeper areas near the reef.

The tip of Paikō Peninsula sometimes is called “Stubenberg’s Island,” for Arthur F. Stubenberg who owned the land from 1948 to 1973. It is also known to many of the local residents on the Drive as “Sand Point,” a name descriptive of the tidal land the area comprises. Stubenberg’s Island, or Sand Point, impounds a natural lagoon between Paikō Drive and the Kuli‘ou‘ou-Iki shoreline. On March 30, 1974, Paikō Lagoon was officially declared a wildlife sanctuary by the State’s Department of Land and Natural Resources, primarily in an effort to save several endangered species of Hawaiian shoreline birds (Clark 1977:34).

The words of a kupuna interviewed by Stevens-Gleeson and Hammatt in 2008 suggest that, for the last half-century or more, factors such as sedimentation of the reefs and overharvesting have significantly diminished marine resources in Maunalua Bay. The elder, who has resided in the Wailupe area since the 1930s, offers much insight into the nature of changes occurring during the twentieth century:

> Prior to the 1950s, Kahala was mainly agricultural west of Kealaolu, dotted with small chicken farms and piggeries. It produced most of the produce, eggs and flowers for East Oʻahu. I can recall going there to buy eggs and vegetables with my father. We always picked *ogo* and *limu kohu* [edible algae] prior to leaving and exchanged it for what we needed. This barter system prevailed until the farms were displaced by housing prior to statehood . . . One feature that exists today, as a lined drainage channel, is the Kapakahi Stream, which flowed to the ocean through Waiʻalae Country Club. It used to contain *oʻopu* [gobies] and an abundance of frogs. There were abundant mullet on the mud flats at its mouth and *oʻama* [juvenile goatfish] during the summer season. Mixed with *oʻama* fingerlings were large schools of *amaʻama* and *moili*. It was a natural hatchery area much like the mouths of Wailupe, Niu, and Kuliʻouʻou streams used to be. When the *oʻopu* spawned, many Filipino families fished there. When there was fresh water, vast beds of healthy *ogo* flourished offshore, growing into large, softball-sized clusters. Today, little ogo remains, a result of overharvest and/or pollution. The entire reef line from Kahala to Portlock was covered with *limu kohu*. There was so much that it was inconceivable that it would one day die out. One of the best gifts one could take to Hawaiian families in the neighbor islands was *limu kohu*, cleaned and salted, where it was scarce. In today's language, it was "choke!" I am unsure of its demise, but suspect water quality has much to do with it. There is no way it could have been overharvested.
>
> The lagoon area [at Paikō Drive] served as a natural hatchery for mullet and *nehu*. Most of the mullet in Kuapā pond were taken from the mud flats in front of Kuliʻouʻou Park and put into the pond. Hawaiians never mastered breeding *amaʻama* in ponds, so every mullet in the hundreds of acres of Kuapā pond had to be caught as fingerlings on the Kuliʻouʻou flats and thrown into the pond. The *nehu* and *ioa* fed the *akule* fishery off of Portlock. Paikō also enforced its ahupuaʻa konohiki fishing rights until after Statehood. The konohiki began at Niu peninsula and extended ʻEwa up to the small rock wall at Kawaikui Beach Park. That wall still exists today. Directly seaward from that wall a no fishing sign was posted in the ocean half way out to the breakers. It delineated the Paikō konohiki west boundary. The entire konohiki area was teeming with mullet. I recall throw netting there every day after school. I will describe this later, but I recall that there was a Kaʻai for the konohiki, one of the Ewaliko family, a very big guy. I always pictured him as a Hawaiian warrior. While stern, as I got to know him he told me many things about Wailupe. I recall him calling Koko Head "Kohala." When you think about it does look like a humpback whale. He taught me never to pull the *ogo* roots off the back because these were the *ogo* seeds . . . One would leave one-third of the mullet you caught in the cistern when you left Paikō "taxes." Mr. Ewaliko would take the fish every day to the River Street fish market. The spring flows today although at a vastly diminished rate, but you can still feel the cold fresh water flowing into the ocean. I believe this artesian water originates in the Wailupe forest reserve. This in part was the reason why there was so much mullet and *ogo* along the shoreline. Only the small wall remains as a faint memory of Paikō konohiki.

. . . all of Maunalua Bay from Portlock to Paikō was an *akule* konohiki. The *akule* came to feed on balls of *nehu* off Portlock. Today, the *nehu* and *i'ao* are almost gone and with it the *akule*, although one can still catch *halalu* near Kaiser's breakwater today during the summer. When the *akule* came in the water was black with them, and the Rosa family set the *akule* nets to harvest tons of fish. The channel leading in to the bridge was dredged when the Hawai'i Kai marina was built and this deepening has caused the general demise of the entire shoreline west thereof (Stevens-Gleason and Hammatt 2008).

Figure 3.1 Dive Charter Vessel in Deep Water along Portlock Point, Summer 2011

The history of human use of Maunalua Bay underscores the constraining environmental effects of the relatively dry upland regions; the utility of the flat and thus readily habitable lands along the coastline; and the dietary importance of fish ponds, nearshore resources, and foods grown in the lower valleys. Today, most developable land has indeed been built upon, even in the upper portions of the valleys and along the pali or ridgelines. The once productive fishponds are no longer functional; nearshore resources are being negatively affected by a variety of stressors; and constraints on direct acquisition of seafood are often remedied by trips to the grocery store.

The Maunalua Bay region is now densely populated, and the traditional social relationships and economic transactions that once characterized life in the various ahupua'a are now increasingly difficult to identify. Certain modern activities in the uplands - such as frequent and widespread use (and leaky non-use) of motor vehicles, indiscriminate use of pesticides, and careless discard of chemicals and rubbish - now contribute to the physical decline of nearshore and shoreline habitats and resources, thus constraining traditions that are historically rooted in the pursuit and use of local marine resources. Indeed, numerous human stressors now threaten the health of the bay and its related ecosystems (Mālama Maunalua 2009).

3.2 Past Invasive Algae Removal Work around Maunalua Bay

Early Work to Remove Invasive Algae from Maunalua Bay. Prior to formation of Mālama Maunalua and initiation of the large-scale IAR project funded through the ARRA and administered by TNC, a small group of concerned residents began to discuss their observations about the ecological status of Maunalua Bay. Efforts to mobilize a response to growing problems were led in part by a local high school teacher and paddling coach[2] who observed increasing algal growth in the bay. Having previously learned about algae removal during an A‘ohe Limu‘e event in Waikiki, she initiated removal of leather mudweed (*Avrainvillea amadelpha)* in Maunalua Bay with the help of her high school students. Although initial efforts were limited in scale, the sequence of events that followed was essential to development of a larger restoration strategy.

The teacher formed a linkage between her high school program and a National Science Foundation (NSF) Fellowship Program at the University of Hawai‘i (UH), where she was then attending graduate school. The NSF program encourages public school teachers to develop science education partnerships. Thus, a working relationship was formed between the NSF program, the UH College of Education, Kaiser High School, and the UH Botany Department, students of which were researching native sea grasses and invasive species in Maunalua Bay.

Various prospective goals and objectives were discussed during an initial meeting of the partnership. It was decided that a long-term inter-generational effort was needed to improve management of natural resources along the southeast coastline of O‘ahu. Partners agreed that students should possess a practical understanding of the Hawaiian concepts of mālama i ke ‘āina (taking care of the land), and mālama i ke kai (taking care of the sea). Objectives included the development of learning programs wherein students would gain first-hand experience of environmental science, environmental stewardship, and the complex issues that natural resource managers must address on a regular basis. In addition to educational programs, partners agreed to develop means for improving the ecological status of Maunalua Bay.

Several programs were subsequently established to involve students at Kaiser High School in programs for monitoring and restoring the marine environment. Water quality monitoring was undertaken, as were habitat studies, fish counts, and a traditional method for replanting native limu. Some students undertook research in the streams around Maunalua Bay. In short, the programs served to teach students to apply scientific principles in a natural laboratory while advancing important Hawaiian values regarding the natural world. As more students got involved, the focus shifted to the invasive algae problem. At one point, small experiments were designed to estimate the number of person-hours needed to clear a plot of invasive algae and to determine the best times in the lunar cycle to clear algae (Hawai‘i Coral Reef Initiative 2005).

Over time, additional groups and individuals became interested, and additional partnerships were formed. For instance, the Kaiser High School program became associated with the Hui Nalu paddling club and the Polynesian Voyaging Society. Meetings were held to discuss algae

[2] Outrigger canoe paddling is very popular along the southeast coast of O‘ahu. Many solo paddlers regularly depart from the Portlock area, paddle downwind the length of the bay, and ultimately arrive at Kaimana Beach in Waikīkī.

removal and strategies for involving local residents. TNC became involved and worked to raise funds and formulate strategies for a large-scale IAR project.

Mālama Maunalua and the IAR Project. The ARRA-funded IAR project was implemented through the collaborative efforts of many groups and individuals. The history of the project reveals how the leveraging of resources can lead to the establishment of a successful non-profit organization, in this case, Mālama Maunalua. The synergy established between Mālama Maunalua and other organizations in the region was central to the success of the project.

Mālama Maunalua was formally established in 2005. A full-time coordinator was hired to consolidate and extend partnerships with the National Oceanic and Atmospheric Administration (NOAA), the University of Hawai‘i, and TNC. By 2009, Mālama Maunalua volunteers had cleared approximately 100 tons of algae from Maunalua Bay. More than a dozen schools were involved, and approximately 750 to 1,000 students had worked on the project.

TNC helped fund the programs, while also contributing community outreach functions and guidance regarding technical aspects of algae removal. TNC also contributed kayaks, trucks, dumpsites, and techniques for avoiding the spread of algae to uncontaminated areas. University and government scientists helped support the effort by identifying invasive algae hotspots and by monitoring areas that had previously been restored. The various groups worked collaboratively to create the aforementioned Conservation Action Plan for Maunalua Bay.

Mālama Maunalua was viewed as a likely candidate for ARRA funding by NOAA, representatives of which were looking for potential restoration projects with potential for generating positive environmental and social impacts. As one Mālama Maunalua staff member noted, ARRA funding represented an opportunity to scale up the algae removal effort. NOAA ultimately supported the IAR project, TNC assumed the fiduciary responsibilities associated with administration of ARRA funding while also lending its technical expertise and support, and Mālama Maunalua committed its energies to mobilize members of the local community, and a highly proficient environmental restoration firm known as Pono Pacific was retained to undertake the contractual labor associated with removing the algae.

Further, Mālama Maunalua and TNC worked to identify key persons and groups with the capacity to contribute to the project. These included persons in the Paikō community, and agencies and organizations such as: the State of Hawai‘i Division of Aquatic Resources, and the Division of Forestry and Wildlife; NOAA; the University of Hawai‘i; Maunalua Fishpond Heritage Center; Liveable Hawai‘i Kai Hui; and various neighborhood boards. As one Mālama Maunalua staff member commented, “the right factors converged at the right time” to undertake this important project.

4.0 Socioeconomic and Sociocultural Research Results

The intent of the research described in this report was to capture and represent the relevant perspectives, experiences, and socioeconomic status of research participants during and soon after completion of the invasive algae removal process. Phase I research activities involved in-depth but largely unstructured interviews with numerous persons in the public and private sectors; participant observation; site visits; and archival analysis. The resulting information was used to inform and guide subsequent research and analysis. During the second phase of the research, a semi-structured protocol was used to guide a total of 131 interviews with persons directly or indirectly involved in the 2010 IAR project.

4.1 Representation of Experiences with and Perspectives on the IAR Project

The intent of this project was not full representation of the perspectives and experiences of the Maunalua Bay "community." Rather, significant effort was undertaken to ensure that a wide range of stakeholders and numerous persons employed in the IAR project were interviewed, so as to adequately characterize pertinent local perspectives, experiences, and knowledge regarding the central issues at hand. The term "stakeholder" is used here in reference to individuals or groups possessing one or more of the attributes of knowledge, power, legitimacy, or urgency (Mitchell et al. 1997) as these relate to use and management of public trust resources. In this case, such persons included the following:

(1) Individuals directly involved in the IAR project, including members of community organizations, institutions, and the firm contracted to conduct the algae removal effort;

(2) Residents of Kuliʻouʻou ahupuaʻa, and especially persons residing in the Paikō neighborhood;

(3) Persons from around Maunalua Bay area who use the ocean for recreational and food-gathering purposes;

(4) Local kūpuna, members of local kamaʻāina families, and other knowledgeable long-term residents of the area;

(5) Local educators and other key persons in the public sector;

(6) Environmental researchers working around Maunalua Bay;

(7) Community volunteers;

(8) Native Hawaiian cultural practitioners; and

(9) Farmers who use algae in their agricultural operations.

Persons in each of these groups were consulted to discuss a variety of topics and issues pertinent to socioeconomic and sociocultural dimensions of the IAR project. Results of this work are described in the following sections.

4.2 Quantitative Research Results across the Full Sample

Description of the Sample. Interviewees varied from 18 to 72 years of age (Figure 4.1, Table 4.1). Nearly 24 percent were between 18 and 25 years of age, and 38 percent were between 31 and 40. Sixty-six percent were male and 34 percent were female. Ethnic backgrounds varied extensively among respondents. Most described their ethnic heritage as mixed, which is common in Hawai‘i.

Table 4.1 Tabulated Age Distribution

Age Group	Number of Interviewees	Percentage of Interviewees
18-25	20	23.6
26-30	13	15.4
31-40	24	28.4
41-50	10	11.9
51-60	9	10.7
60+	9	10.6

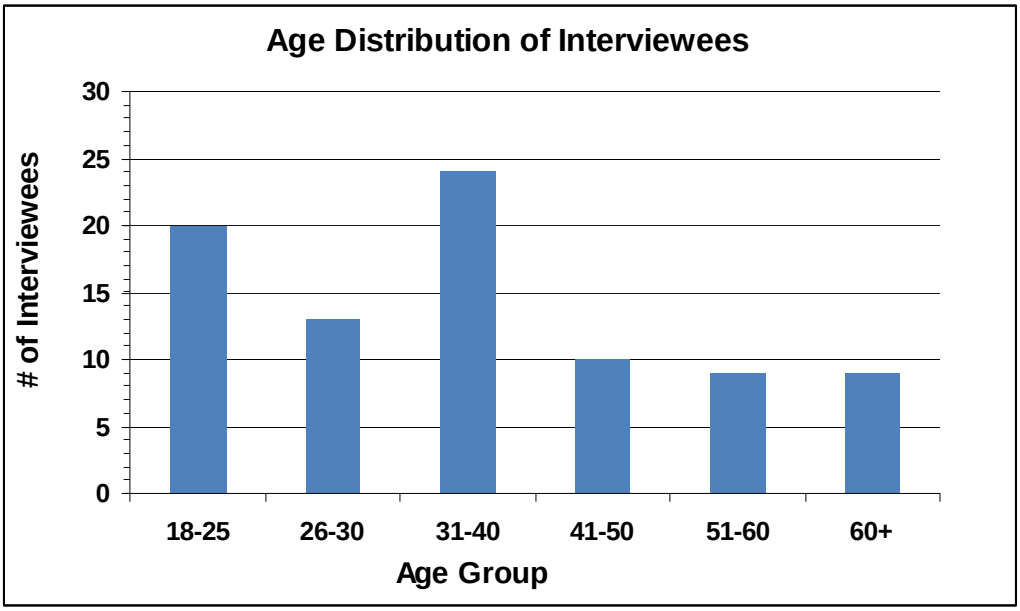

Figure 4.1 Age Distribution Chart

Level of educational attainment also varied considerably across the sample (Table 4.2). Almost 12 percent of interviewees possessed a high-school diploma or the equivalent, whereas more than 48 percent had completed either an associate’s or bachelor’s degree. Nearly 25 percent had completed a graduate degree program.

Table 4.2 Level of Education Attained by Interviewees

Level	Percent Attaining
Some high school	3.5
High school diploma or GED	11.8
Some college	11.8
Associates degree	8.2
Bachelors degree	40.0
Graduate degree	24.7

About 80 percent of interviewees reported that their households include between two and five persons holding jobs. About 15 percent reported living in households with a single source of income, and about five percent reported living in households wherein six or more persons contribute income (Table 4.3). Some 83 percent reported individual earnings under $30,000 per year, while 17 percent reported annual individual income between $30,000 and $50,000 per year (Table 4.4).

Table 4.3 Number of Persons Earning Income in Sampled Households

Household Members Who Earn Income	Percentage of Interviewees (n=67)
1 person	14.9
2 people	43.3
3-5 people	37.3
6+ people	4.5

Table 4.4 Reported Household and Individual Income in Sampled Households

Estimated Household Income ($)	Household Income (% of Interviewees; n=41)	Individual Income (% of Interviewees; n=18)
0 - 29,999	9.8	83.3
30,000 - 49,999	22.0	16.7
50,000 - 74,999	12.2	-
75,000 - 99,999	17.1	-
100,000 - 199,999	34.1	-
200,000+	4.9	-

Over 52 percent of interviewees reported that they had lived in or near Maunalua Bay at some time during their lives. Some 32 percent reported long-term family ties to the region. Notably, 70 percent of the sample had earned or were earning income through the IAR project or through jobs related to tourism or recreation in and around Maunalua Bay.

Overview of Space-Use Patterns. As noted above, a variety of ocean user groups and community constituencies were consulted during the course of this project. All persons interviewed were asked to discuss the various ways they use or interact with the marine environment in and around Maunalua Bay. Most reported using the ocean in a variety of ways, many of which were recreational in nature, and most identified themselves with several stakeholder groups.

Nearly 41 percent of interviewees reported that they primarily use a single part of the bay for recreational or food-gathering purposes, while 60 percent reported that they commonly access a variety of areas. The most commonly used locations were the Paikō/Kuli‘ou‘ou and Hawai‘i Kai/Portlock areas (Table 4.5). Recreational activities are particularly common in both locations. Many interviewees also reported using the Kahala and Kawaiku‘i areas. About nine percent reported using many locations in Maunalua Bay during the course of the year.

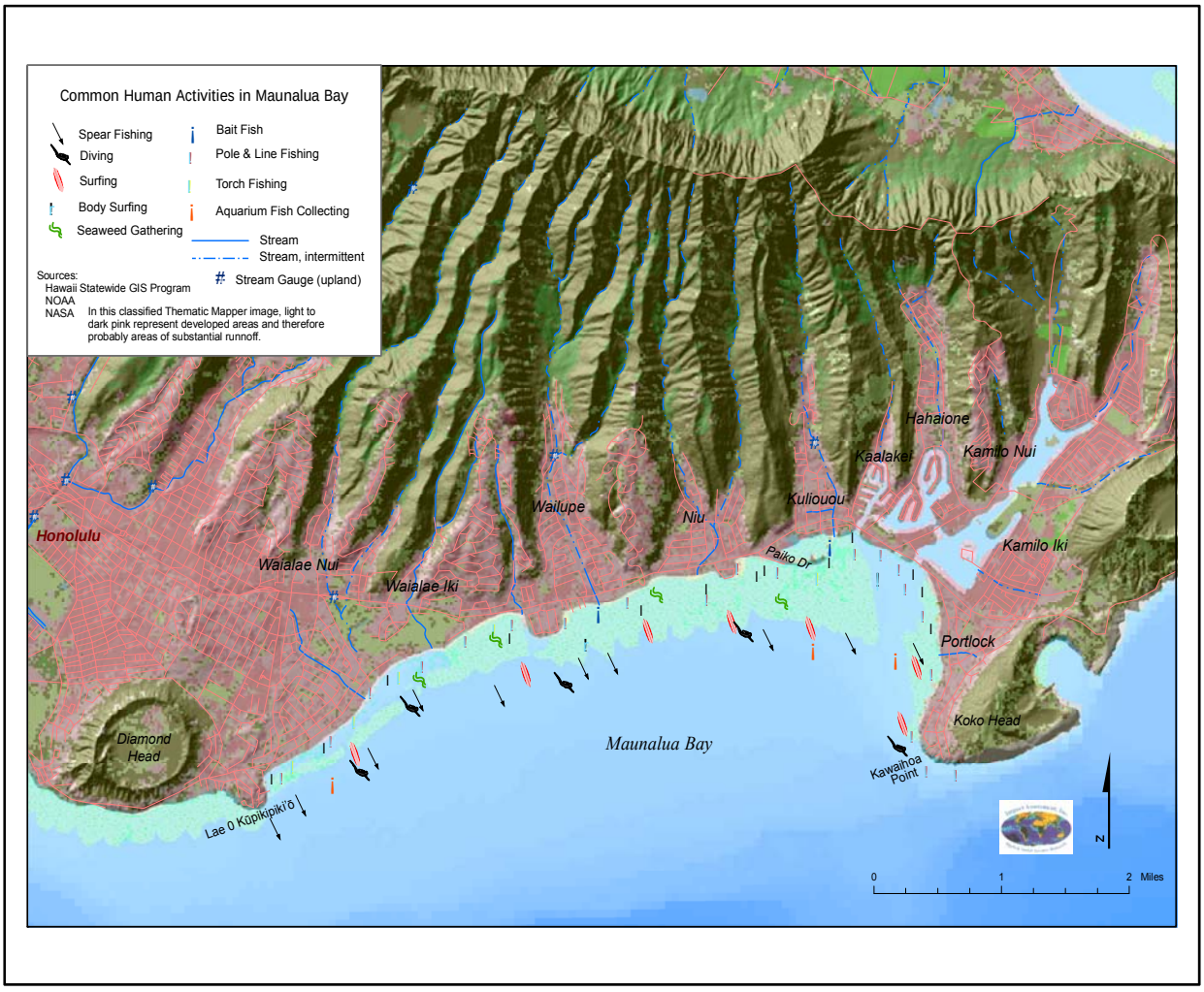

Figure 4.2 Human Activities Commonly Occurring in Maunalua Bay

Table 4.5 Areas of Maunalua Bay Commonly Used by Research Participants

Area of Use	Percent Using Area (n=86)
Waialae	11.3
‘Āina Haina/Wailupe	22.5
Niu	19.7
Paikō/Kuli‘ou‘ou	57.7
Hawai‘i Kai/Portlock	52.1

Overview of Perspectives on Environmental Change. A large percentage of research participants report having first used or associated with Maunalua Bay after the year 2000 (Table 4.6). This is partly an effect of the fact that many of the contracted workers on the IAR project hail from other parts of O‘ahu or other Hawaiian Islands, or have recently moved to Hawai‘i from the continent. Many participants reported a much longer association. Seven research participants have lived in the Maunalua Bay area and/or have used the bay since the 1950s or earlier.

Interviewees were asked to rate the condition of the marine environment in Maunalua Bay at different points in time: at the time of their first use of or association with the bay, immediately before the start of the IAR project, and at the time of the interview during or immediately after completion of the project. Virtually all reported that the health of the bay was currently threatened, and most reported that they had personally observed changes in the marine environment during their tenure of association or use. Most discussants stated that the marine environment was in better condition at the time of their first use or association than immediately before the IAR project was initiated. Finally, numerous interviewees characterized the Maunalua Bay ecosystem as being healthier at the end of the IAR project than before it was initiated (Table 4.7, Fig. 4.2).

Table 4.6 Reported Dates of Initial Association with Maunalua Bay (n=86)

First Association with Maunalua Bay	Number of Interviewees
1950-1960	7
1961-1970	6
1971-1980	9
1981-1990	9
1991-2000	6
2000-2005	15
2006-2011	31

Table 4.7 Interviewees’ Assessment of the Environmental Status of Maunalua Bay (n=86)

Point in Time	Perceived Condition (% of Interviewees)				
	Severely Degraded	Degraded	Neither Good nor Bad	Healthy	Very Healthy
First association with the bay	13.60	28.80	22.70	22.70	12.10
Immediately before the IAR project	32.90	51.20	15.90	0	0
During or immediately after IAR project	9.40	34.10	34.10	21.20	1.20

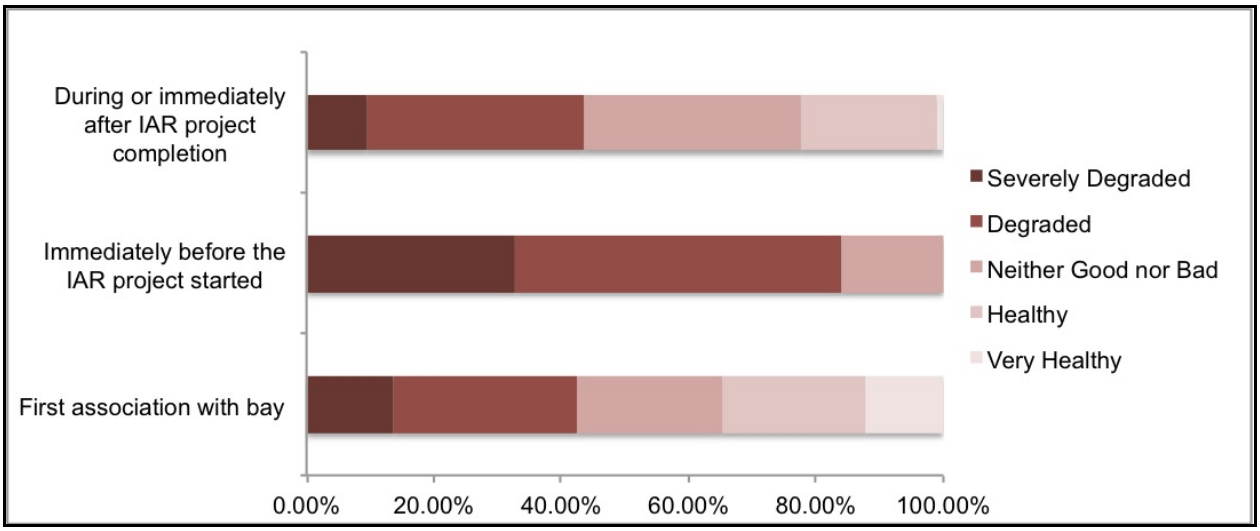

Figure 4.3 Perceived Environmental Status of Maunalua Bay over Time

Research participants were also asked to describe environmental changes they had personally witnessed and to discuss when and why such changes had occurred. Long-time residents generally reported more and more significant changes to the marine environment than did those with a shorter period of association with the bay. Commonly reported changes included the following:

- Decline in local water quality;
- Decline in abundance of native species;
- Decline in species of fish used for consumption;
- Increased sedimentation and changes in the condition of the benthic substrate;
- Increased prevalence of invasive species; and
- Changes in ocean circulation patterns and freshwater input from streams and springs.

Factors most commonly cited to explain such changes included the following:

- Increased coastal development, including development of the Hawai‘i Kai area;
- Increased use of impervious surfaces and the channelization of streams, both of which are perceived to have increased delivery of land-based pollutants, nutrients, and sedimentation;
- Overexploitation of fish resources;
- Dredging of the Hawai‘i Kai marina and other areas, and associated sedimentation and siltation of nearshore areas around the Bay;
- Increases in human population on O‘ahu generally and East O‘ahu especially ; and
- Increase in the number of new residents and absentee land-owners.

Perspectives on the Social Benefits of the IAR Project. All persons interviewed were aware of the IAR project and more than 80 percent had participated in an event related to removal of algae in Maunalua Bay. Over 52 percent were direct participants in the 2010 IAR project, and 74 percent reported that the project had increased the level of local involvement in efforts to improve the ecological status of Maunalua Bay (Table 4.8).

Over 51 percent of interviewees indicated that they experienced direct economic benefits from the IAR project, primarily through ARRA funded employment. Nearly 14 percent reported that they had experienced indirect economic benefits from the IAR project.

Most research participants were initially exposed to the 2010 IAR project through word-of-mouth (Table 4.8). This corresponds with the finding that 97 percent had talked with other community members about the restoration effort. The media played a relatively less significant role in informing interviewees about the project (Table 4.9).

Table 4.8 Involvement in and Sources of Exposure to the 2010 IAR Project in Maunalua Bay

Type of Involvement with the IAR project	Percentage
Have participated in the IAR project (n=87)	80.5
Have participated in IAR project related activities (n=88)	52.3
Have talked with other community members about the IAR project (n=88)	96.6
The IAR project has gotten you or others you know more involved in Maunalua Bay (n=85)	74.1

Table 4.9 Reported Means of Initial Exposure to the 2010 IAR Project (n=88)

Means of Exposure	Percent of Interviewees
Community Event	3.4
Organization Representative	8.0
Internet	1.1
Television	4.5
Newspaper	8.0
Word-of-Mouth	58.0
First-Hand Experience	17.0

Interviewees reported a variety of benefits from the IAR project. For instance, there was general consensus that the work generated greater public awareness about environmental problems in the area, including those associated with overuse of marine resources (Table 4.10: A-C). Further, over 94 percent of interviewees indicated that the project had stimulated greater understanding of local history, and more than 89 percent indicated enhanced ecological understanding (Table 4.10: D; G). More than 82 percent asserted that the project had resulted in a feeling of heightened personal ownership of the bay and its resources, and over 84 percent believed that the project resulted in an enhanced sense of community-level stewardship (Table 4.10: E-F).

Most research participants believe that fish stocks and native limu would benefit as a result of the project; moreover, it was generally agreed that the bay now *looked* cleaner (Table 4.10: L). Further, almost 80 percent of interviewees reported the perspective that the IAR project was benefiting local businesses, and more than 95 percent agreed that the project had generated interest in future habitat restoration and conservation projects in the region (Table 4.10: M-N).

Figure 4.4 Under Sail in Freshening Trade Winds: Maunalua Bay, Summer 2011

Table 4.10 Reported Benefits of the IAR Project (n=87)

Response variable: "The IAR project has resulted in…"	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Don't Know
A. More local discussion about Maunalua Bay	46.0	46.0	2.3	0.0	0.0	5.7
B. Improved community awareness about the condition of Maunalua Bay	44.8	49.4	2.3	0.0	0.0	3.4
C. Greater understanding of use activities around Maunalua Bay	32.9	49.4	14.1	2.4	0.0	1.2
D. Greater understanding of the history and heritage of the Maunalua area	50.0	44.2	3.5	2.3	0.0	0.0
E. Heightened sense of personal ownership of the bay and its resources	37.2	45.3	11.6	1.2	2.3	2.3
F. Stronger perception of need to take care of the Bay	27.6	57.5	6.9	0.0	0.0	8.0
G. More learning about native ecosystems in Maunalua Bay	41.2	48.2	5.9	2.4	1.2	1.2
H. Improvement in local fisheries	29.9	43.7	5.7	1.1	1.1	18.4
I. Improvement in native algae populations	43.7	49.4	1.1	0.0	0.0	5.7
J. Negative impacts to the marine environment	0.0	0.0	4.6	37.9	49.4	8.0
K. Negative impacts on the Maunalua Bay human community	0.0	1.1	3.4	40.2	50.6	4.6
L. A cleaner-*looking* bay	50.0	44.2	3.5	1.2	0.0	1.2
M. Local economic improvements	29.9	50.6	9.2	1.1	0.0	9.2
N. Enhanced interest in future habitat restoration and conservation projects in area	47.7	48.8	2.3	1.2	0.0	0.0

4.3 The IAR Contractor

Attributes of the Subsample. The environmental restoration firm known as Pono Pacific functioned as the IAR contractor. The first IAR crew members were hired in January 2010. Training and orientation included information about the ecology of Maunalua Bay and the nature of the invasive algae problem. Some long-time residents of the area participated in the orientation, and shared with crew members their personal recollections and perspectives on social and environmental changes in the region. In later interviews, crew members often described these stories as having imparted a sense of importance to their work.

The contractor hired approximately 75 crew members during the course of the project. At any given time, approximately 35 to 40 individuals participated on a part-time or full-time basis. Six full-time employees are now working on other projects for the firm. One new staff-support position was filled for IAR project needs; this individual is now involved in the firm's other projects on O'ahu and Hawai'i Island. The firm subcontracts its human resource functions to another company, and thus the IAR project has generated secondary benefits for the subcontractor.

An estimated total of $900,000 was expended on direct labor costs associated with the IAR project. It should be noted that this income was generated during a major economic recession, when O'ahu-based employment opportunities were quite limited. Thus, key elements of the official statement of purpose for the ARRA[3] were met through the Maunalua Bay IAR project. These elements include: (1) the creation of jobs to promote economic recovery; (2) the provision of assistance to those most impacted by the recession; and (3) investment in environmental protection work that has the potential to provide long-term economic benefits.

Further, the IAR project enabled the contractor to advance its expertise and capacity to undertake additional projects in the region. Notably, the firm received approximately 500 applications during the first week of the 2010 IAR project.

General Description of the IAR Work. The IAR project required that employees wade through water less than about three feet in depth and manually pull or pick the invasive mudweed from the soft sediment substrate. Workers removed non-alien infauna and other species from the mudweed and returned these to the ocean. The alga was then placed into net bags. Once filled, the bags were placed on kayaks and floated to the beach, whereupon they were transferred onto a wagon and emptied into a dump truck for transportation to a composting site. Community volunteers developed this basic method years before the ARRA-funded project was initiated.

[3] As stated in Public Law 111–5, February 17, 2009.

Figure 4.5 Community Volunteers Remove Algae from the Paikō Site in 2010

The work was typically undertaken by three groups of eight workers, led by a crew leader who rotated each group through the various tasks. Typically, one group engaged in the removal process, while a second transported in the morning and picked in the afternoon, and a third picked in the morning and transported in the afternoon. This approach was developed to reduce injuries, fatigue, and worker monotony. Workers were permitted to switch tasks at will.

While in the ocean, crew members typically worked together in the same area or cell (Figures 4.5a, 4.5b). Cells were strategically plotted to facilitate efficient removal of the invasive algae, a task complicated by the difficulty of seeing the ocean bottom in often muddy conditions. The removal process was systematically improved through innovations developed by the workers themselves.

Figures 4.6a & 4.6b Crew Members Negotiate the Shallow Reef Flats at the Paikō Field Site

Algae removal work is physically demanding. Workers are constantly exposed to the changing elements. Temperatures can vary considerably between the water and air, especially during the winter months and during periods of strong trade winds. Picking requires continual bending or squatting. Moreover, full algae bags are heavy. Low tide conditions increase the difficulty of transporting bags to the shore. Given the challenging nature of the work, the contractor provides workers with gloves, sunscreen, rash guards, and reduced-price boots. The firm also extends full-time work benefits for employees working four-day work weeks.

Demographic Characteristics of Crew Members. At the time of the in-depth interview stage of the project, the IAR contractor was employing 22 full-time and 18 part-time workers. Of the 40 employees interviewed, eight were female and 32 were male. Interviews were conducted at the Paikō field site. The age of workers ranged from 18 to 65 years, with 65 percent age 30 or younger (Table 4.11).

Interviewees were primarily of mixed ethnic backgrounds, with extensive and often mixed local representation of Hawaiian and other Pacific Islanders, Japanese, Chinese, Filipino, Portuguese, and haole,[4] among others. Most workers had completed some college education or were currently enrolled in a university. Less than one-third of respondents had ever lived in the Maunalua Bay region or had familial ties to the Maunalua Bay area (Table 4.12).

Figure 4.7 IAR Crew Members in Protective Gear

[4] The term haole is used non-pejoratively here, with reference to persons of Euro-American ancestry.

Table 4.11 Age Distribution of IAR Contract Workers (n=41)

Age of Crew Members	Number of Interviewees	Percent of Interviewees
18-20	6	15
21-25	13	33
26-30	7	18
31-40	9	23
41-50	3	8
50+	2	5

Table 4.12 Workers' Association with Maunalua Bay by Time Period (n=30)

Year of Earliest Association with Maunalua Bay	Number of Interviewees	Percentage
1960-1970	2	5
1971-1980	2	5
1981-1990	3	8
1991-2000	2	5
2001-2005	5	13
2006-2009	12	30
2010	14	35

Approximately 70 percent of the IAR contract crew reported participating in one or more recreational activities in Maunalua Bay. These include: fishing, diving, surfing, swimming, paddling, snorkeling, and jet-skiing. Approximately 50 percent of respondents reported familiarity with more than one area of the bay.

Characterization and Discussion of Project Benefits. The information obtained from interviews and related ethnographic research enabled characterization of the various benefits accruing to IAR crew members as a result of their involvement in the project. This information may be valuable for planners seeking to site and encourage involvement in conservation and restoration projects in the future. Benefits were both economic and sociocultural in nature.

Economic Benefits. As noted above, some 75 persons were contracted during the life of the project, resulting in average input of $12,000 per household during 2010. This figure varied extensively for each worker, depending on duration of employment, hours worked, and nature of duty. The majority of crew members who worked on the project on a consistent basis reported that their individual annual income during the IAR project was between $30,000 and $49,999.

Four supervisory positions were funded. Roughly 68 percent of all workers were either unemployed or held only part-time positions prior to being involved in the project (Table 4.13), and some 59 percent reported that their income increased either moderately or substantially when compared to positions held just prior to work on their new position (Table 4.14). Crew members almost invariably lauded the receipt of medical benefits while working on the IAR project.

Table 4.13 Employment Status of Interviewees Prior to Participation in the IAR Project (n=40)

Prior Employment Status	Number of Interviewees	Percentage
Unemployed	20	50.0
Part-Time	7	17.5
Full-Time	12	30.0
Retired	1	2.5

Table 4.14 Changes in Income Status among IAR Project Workers (n=43)

Change in Income Post-Hire	Number of Interviewees	Percentage
Increased substantially	7	17.9
Increased moderately	16	41.0
Stayed the same	6	15.4
Decreased moderately	6	15.4
Decreased substantially	4	10.3

Given the economic climate at the time of hire and the nature of the work, virtually all IAR workers described satisfaction with the job and the utility of their wages for covering housing, food, and other costs and for enabling social activities and/or travel. Many were pleased to be able to contribute to the costs endured by other workers in their households. There was a commonly expressed sentiment that the employment was highly beneficial in terms of maintaining individual and collective financial stability.

Table 4.15 Reported Household or Individual Income during Course of Project (n=43)

Income Level ($)	Among Workers in Households (%)	Among Single Workers (%)
0 - 29,999	18.2	16.7
30,000 - 49,999	27.3	83.3
50,000 - 74,999	18.2	-
75,000 - 99,999	18.2	-
100,000 - 199,999	13.6	-
200,000+	4.5	-

Table 4.16 Household Size among IAR Contract Workers (n=43)

Household Size	Percent of Workers
Single	12.8
2 people	33.3
3-5 people	46.2
6+ people	7.7

More than 92 percent of participants reported their belief that that the IAR experience would help them find employment in the future. Some respondents noted that their work on the project had shifted their thinking about the future, and that conservation work or conservation-related academic pursuits were now a strong possibility. These perspectives indicate that some employees were not solely interested in employment, but were using the experience in an exploratory fashion or to develop skills for potential future careers.

Respondents almost universally spoke positively about the nature of the IAR work environment. Typical comments included the following: "[this work is] 200 percent more fun;" "I get paid less, but it's the kind of work I wanted to get into;" "my life is more balanced … instead of [being] a workaholic, I balance work and play"; and, "it's so much better than being in an office." As discussed below, respondents also often reported a sense of personal gratification and fulfillment through working to improve the status of the natural environment. Many participants emphasized the value of this and other non-monetary aspects of the work.

Social Benefits. IAR contract crew members indicated that the work resulted in various social and physical benefits. For instance, a vast majority of respondents agreed or strongly agreed that the strenuous nature of the work was making them healthier and physically fit (Table 4.17), and more than 97 percent agreed or strongly agreed that the job resulted in a feeling of accomplishment and personal gratification. Such benefits were often discussed with great emphasis.

Table 4.17 Social Benefits Reported by IAR Crew Members (n=43)

Response Variable	% Strongly Agree	% Agree	% Neutral	% Disagree	% Strongly Disagree
Healthier and more physically fit	38	43	15	3	3
Sense of accomplishment	48	50	3	0	0
Personal gratification	46	51	3	0	0
Household economic benefits	18	50	13	18	3
Good work environment	43	58	0	0	0

Crew members invariably developed strong social ties during their work on the IAR project. One area resident observed that the IAR team became a sort of community on the water. Positive psychosocial aspects of the job were related in part to the nature of the workplace and an emphasis on team-building. The work itself was conducive to social interaction and crew members often "talked story" while working.

The algae removal goals of the project were clear and it was clear that kokua (cooperation) was needed to achieve those goals. Working together to meet the goal reportedly led to a strong sense of camaraderie and group identity.

In response to queries about additional benefits associated with the IAR project, interviewees mentioned: (a) development of new skills and knowledge; (b) spiritual fulfillment; and (c) a sense of satisfaction in giving back to society by restoring the marine environment in Maunalua Bay. Positive feelings were often expressed in such statements as "I am…giving back to the ocean [which] I use daily [as a surfer and fisherman]." Mention of such benefits makes clear that the workers believed the IAR project will yield significant ecological benefits. Many reported their belief that the work would inspire others to become involved in conservation work in the islands.

Respondents often noted that the sense of accomplishment achieved through the IAR project was reinforced by persons in the adjacent neighborhoods. Positive interactions were especially noted in regard to residents of Paikō Drive, who often provided workers with refreshments and occasionally honored the crew's efforts by hosting small painas (parties). In short, IAI crew

members stated that positively impacting the local marine environment and thus the residents of Maunalua Bay was highly gratifying.

At a more general level, numerous IAR contract workers suggested that their work was enabling strong connections between the restoration effort and the larger Maunalua Bay community. Over 80 percent of the workers reported their belief that the IAR project was leading to increased public discussion about the ecological status of the bay, and 70 percent reported that the project was enhancing a sense of overall community stewardship of the marine environment.

IAR workers also noted that the scale of the invasive algae problem and the success of the IAR effort led to acceptance and ultimately cooperation among a variety of disparate groups. For instance, although the IAR project initially was not well-received by certain residents of adjacent neighborhoods, it was ultimately welcomed throughout the area. This end result was achieved in part through collaborative work to explain the nature and purpose of the project to the public, and to minimize or mitigate any untoward impacts of the workers' presence in the area.

Cultural Benefits. The IAR project drew upon and was related to a variety of Native Hawaiian concepts and practices. These were seen as significant aspects of the project by many IAR contract workers (Table 4.18). In fact, many workers often used Hawaiian concepts and terms in their description of the benefits of the project.

Table 4.18 Native Hawaiian Concepts and Terms Used by Interviewees to Describe the IAR Project*

Hawaiian Term	Conceptual Definition*
Mālama	The importance of caring for the land; restoring the land and sea to revitalize individuals and communities
Holoʻokoʻa	Recognizing connections between land and sea, and maintaining holistic balance in the land-sea ecosystem
Ahupuaʻa	The need to manage resources and the environment in a way that takes into account aspects of specific places and the ecological knowledge that has evolved in such places
Manaʻo	Sharing of traditional knowledge and wisdom between generations; intergenerational perspectives and experiences, translated to keiki (children) from kūpuna (elders)
Kuleana	The importance of responsibility for self, for others, and for the land and sea

* Terms and concepts described by respondents were supplemented with definitions from Pukui and Elbert's Hawaiian dictionary (University of Hawaiʻi Press, 1986)

Some interviewees made a conceptual linkage between restoration of the bay and revitalization of Hawaiian cultural practices. Others associated their IAR work with the indigenous concept of mālama, as taught by their elders, and hope to improve the condition of Maunalua Bay for subsequent generations. Nearly all respondents mentioned a desire to learn more about the history of Hawaiʻi, the Hawaiian language, and Hawaiian culture in general. One respondent noted that he worked on kalo loʻi plots (taro plots) and studied the Hawaiian language, but that his IAR work was most effective in reconnecting him with his ancestors and traditional values of mālama i ke kai. Many IAR workers grew up in Hawaiʻi and thus share a natural understanding of the ocean. Some also practice maritime traditions developed in other parts of Oceania and the Asian rim countries.

For certain IAR workers who possess an understanding of Hawaiian culture, there was an implied trade-off between the health of the bay and that of the crew. That is, while the IAR project was perceived to be improving the ecological status of the Bay, the strenuous nature of the work was seen as potentially disruptive to one's balance and capacity to keep up the work with maximum efficiency. This can be explained in terms of the exchange of *mana* or spiritual energy/supernatural power (Pūkui and Elbert 1986), wherein the workers were putting a lot of energy into their work, which makes the bay healthier, but in so doing were also losing individual *mana*. Faced with a loss of their own energy, some workers refueled by resting as needed, or by briefly engaging in recreational activities.

Other important cultural dimensions of the IAR project involved the Hawaiian concepts of holism and the ahupua'a. The removal of invasive algae and subsequent use of the biomass for farming (discussed in greater detail in Section 4.6) exemplifies the traditional concept of holistic relationships (holo'oko'a) between land and sea. Some IAR contract workers were aware of efforts by Mālama Maunalua and its partners to reduce land-based pollution and restore local watersheds, and nearly all recognized connections between the proliferation of problems in the ocean and detrimental human activities on land.

4.4 Community Elders and Long-Time Residents

Attributes of the Subsample. Seventeen kūpuna or kama'āina (long-time or lifelong residents of the islands) were interviewed during this study. The majority of interviewees were residents of various ahupua'a in the Maunalua Bay area, such as Niu Valley, Kuli'ou'ou, Hawai'i Kai, and Kamilo Iki. Many interviewees reported a long history of residence in the area. Some were traditional land owners and resource managers. Other had worked or recreated in the bay for many years and thus possessed in-depth knowledge of the area.

Many of the discussants worked for community-based organizations such as Livable Hawai'i Kai Hui and Maunalua Fishpond Heritage Center, or agencies such as Office of Hawaiian Affairs and the State of Hawai'i Division of Forestry and Wildlife. Most characterized themselves as persons who value activities such as diving, fishing, paddling, and farming in the region. Although the Maunalua Bay area has become urbanized over the years, the traditional history of the region lives on in the stories and shared knowledge of such elders and long-time residents.

Perspectives on the Past. Interviewees were asked to describe their recollections of Maunalua Bay and the nature of any environmental changes that have occurred there. All interviewees characterized the Maunalua area as historically rural with numerous local farms and dairies. In years past, only one road led into the area, and dirt roads led into the valleys. Fishponds stretched along the coast, each fully functioning with various species. This area was traditionally known for its abundance of marine resources (Yuen 2010).

Interviewees described an abundance of mullet. One informant reported that the schools of fish looked like "clouds." Another noted that "there were so many of them that you could have walked on their backs." Fish species reportedly were diverse, and included akule, mullet, moi, uhu, moana, and kūmū, among others. White crab, Samoan crab, lobster, 'ōpae lōlō, and he'e

were abundant, as was limu, including ʻeleʻele, ogo, and manauea. Maunalua Bay was a place where people could readily fish and collect their food, and recreate in the ocean and streams. Respondents also recalled times when land owners retained and enforced traditional rights over coastal fisheries. One respondent recalled how konohiki rights were eventually transferred to a group of landowners when the single landowner (previously the konohiki) parceled the land into plots. This group established a fishing hui and various rules to manage the fisheries in the Paikō area.

Freshwater formerly flowed directly into the bay at many locations, including Kalauhaʻihaʻi, or Lucas Spring. Many of these local springs have either disappeared or now flow at a greatly reduced rate. One discussant mentioned how freshwater wells were used to irrigate certain horticultural areas. The same interviewee told stories about how she would ride her horse to Hanauma Bay. The horse would drink from freshwater springs bubbling up through the reef flats. Several interviewees mentioned seeing wild horses and goats roaming in the mountains.

Perspectives on the Benefits of the IAR Project. Long-time residents of Maunalua Bay described several benefits resulting from the IAR project. Many viewed the project as generating increased sharing of knowledge between generations. Interviewees also described restoration of the bay as having the potential to return to conditions remembered from youth. One person asserted that fish species that used to be common in the bay are starting to return.

This subsample of interviewees tended to envision the IAR project as involving a traditional mode of stewardship that addressed the relationship between land and sea. Many conceptually linked the project to broader cultural revitalization work in the region, such as the restoration of cultural landmarks, including Pahua heiau (an agricultural heiau or place of worship located on the makai side of Kamilo Nui Valley), and the reintroduction of native plant species at Paikō Lagoon (Franklin 2010a, b). One interviewee stated that "Pahua heiau can again become a striking symbol for an agriculturally revived Maunalua."

Interviewees also discussed the benefits of increased education and awareness about the history of Maunalua Bay, along with the perpetuation of traditional environmental knowledge. Although some interviewees remain skeptical about the potential long-term success of environmental restoration in the 21st century, all expressed a measure of hope for the future.

The historical perspectives of long-time residents provide a valuable source of information regarding social-ecological change in this region. Most discussed the Kaiser development, which transformed much of the land surrounding Maunalua Bay from a rural agricultural area into an urbanized residential community. The remaining agricultural lands were pushed back into the valleys, with Kamilo Nui being the last active farming valley in the region.

Social changes were also described, including a decrease in the number of local families and an increase in absentee home owners. Some elders stated that the community has become increasingly transient in nature, and that neighbors often do not know each other anymore.

In sum, the IAR project was described in terms of its benefits to both the natural environment and the people of Maunalua Bay. Some elderly residents believe that the ocean substrate and the

quality of water in the nearshore zone are gradually being restored, and that limu and sea grass are returning. Others are waiting to see what the future will bring.

Figure 4.8 Piko Fishing Hui Tag, Ca. Early 1950s
(Photo courtesy of the Gleason Family)

Figure 4.9 View of Koko Head from Puʻu Ikena Park

4.5 Avid Fishing in Maunalua Bay

This section summarizes information gathered from in-depth interviews conducted with seasoned fishermen who use the Maunalua Bay area.[5] Such fishermen were identified based on recommendations made by persons highly familiar with fishing and with particularly avid fishermen in the area. Four of the 15 fishermen interviewed reported selling part of their catch on occasion. All but two kept fish for household consumption, and 11 of 15 reported giving away part of their catch to friends and family. Among fishermen who sold part of their catch, the primary buyers were local seafood markets and restaurants. The intent here was to generate a basic description of nearshore fishing activity among particularly avid fishermen, and to report their perspectives regarding the ecological status of Maunalua Bay and the IAR project.

Attributes of the Subsample. Fishermen interviewed for purposes of this project ranged in age from 24 to 71 years, with a mean age of 47 years. All were male, with the exception of a husband and wife team, who were interviewed together. The majority of interviewees were originally from Hawai‘i, and those who were not born in Hawai‘i had lived in the islands for most of their adult lives. A little more than half of the respondents lived in the Maunalua area at the time of the interview, and others lived either nearby, or had previously lived in the area for a significant amount of time.

Table 4.19 Years of Experience Fishing Locally (n=14)

Number of Years Fishing in Area	Tally
<10	3
10-20	0
21-30	3
31-40	1
41-50	5
50+	2

Fishing Activities and Ocean Use Patterns. Interviewees reported fishing a variety of habitats, from the shoreline out to the pelagic zone. Five fishermen reported fishing a single habitat type, and five reported accessing four or more habitats. The fore-reef and reef slopes reportedly were the most commonly accessed areas, and the most intensively fished (Table 4.20).

Table 4.20 Intensity of Use of Specific Habitats by Fishermen (n=16)

Habitat Type	Number of Respondents Reporting Use	Intensity of Use Index*
From Shore (shoreline/intertidal)	8	0.54
Inside the Reef (reef flats)	7	0.27
Reef Edge (fore-reef/reef slope)	10	1.00
Deep Reef (reef slope, bottomfish habitat)	8	0.36
Offshore (pelagic)	6	0.14
Other	1	0.00

* The index was calculated as the percentage of total time per habitat multiplied by the number of respondents reporting use; a score of 1 indicates most commonly used, a score of 0 indicates least commonly used.

[5] IAI also assisted Mālama Maunalua in the development of a representative survey of fishing and fishermen in Maunalua Bay. Results are forthcoming.

Most fishermen used multiple areas of the bay, with the most extensive use reported for the Portlock and Paikō areas (Table 4.21). Six fishermen reported using only one or two areas, and seven fishermen reported regularly accessing four or more areas. This suggests that about half of the respondents are relatively mobile, while the remainder tend to fish in the same location.

Table 4.21 Areas Typically Used by Sample of Avid Fishermen (n=15)

Area Used	Fishermen Reporting Use of Area
Portlock	9
Paikō/Kuli‘ou‘ou	9
Niu	5
‘Āina Haina	7
Wailupe	5
Kahala	6
Waialae/Black Point	7

The fishermen reported usage of a wide range of gear types, including rod-and-reel, nets, traps, and spears (Table 4.22). The most widely used gear was either the three-prong Hawaiian sling or speargun. Rod-and-reel fishing along the shoreline was also prevalent, as were pelagic trolling and fishing with bottomfish rigs.

Fishermen reported that average catches today had decreased substantially from when they had first started fishing in Maunalua Bay. A 46-percent decline in reef fish catch was reported, and a 56-percent decline in intertidal species was reported (Table 4.24). Declines were reported to be more extensive for some species, such as papio and ulua. Additionally, species that were previously accessible in shallow habitats were now often said to be seen in deeper areas. Size decreases were also reported, particularly for he‘e, papio, ulua, and uhu. Although these reports may indeed bear some empirical accuracy, the small number of fishermen interviewed constrains analysis.

Table 4.22 Gear Types Used by Subsample of Avid Fishermen (n=15)

Gear Type	Number of Fishermen using Gear
Three-Prong or Spear-Gun	16
Fly Rod	2
Spinning	7
Gill Net & Surround Nets	5
Crab Net	2
Throw Net	1
Trolling, Bottom Fishing, or Hand Line	6
Trap	1

Table 4.23 Comparison of Average Monthly Catch, Past and Present (n=12)

Habitat Type	Average Catch: Present (lbs)	Average Catch: First Started (lbs)	Percent Change
Pelagic	136	156	-13
Reef	7.7	14.3	-46
Intertidal/Estuarine/Fishpond	2.0	4.5	-56

Perspectives on the Past, and Benefits of the IAR Project. When asked to assess the ecological condition of Maunalua Bay through time, most fishermen reported the perspective that the health of the bay and its resources had declined over time. Among those who began fishing in the area prior to the 1970s, the stated extent of decline was more pronounced than among those who started fishing during subsequent decades (Table 4.25).

Table 4.24 Comparison of Perspectives on Environmental Conditions among Avid Fishermen

	1950s	1960s	1970s	1980s	1990s	2000s	Today
Experienced Fishermen	4.5	4.2	3.3	3.2	2.5	2.5	2.2
New Fishermen	-	-	-	-	3.0	3.0	3.0
All Fishermen	4.5	4.2	3.3	2.9	2.4	2.4	2.3

Note: Experienced fishermen (n=6) included those who had fished the bay prior to the 1970s and new fishermen included those whose first association with the bay was 1990 or later (n=5) (All fishermen, n=15).

With regard to the effects of the IAR project, fishermen in the Paikō lagoon area asserted that the ocean in the vicinity of the algae removal site was considerably more translucent than before the project was initiated. The most seasoned fishermen suggested the area looked as it did decades ago. Fishermen who frequent areas some distance from the algae removal site were naturally less assertive about the effects of the project.

A brief cognitive exercise was conducted to elicit fishermen's perspectives on ecological change. Participants rated the condition of Maunalua Bay over past decades using a five-point scale, where five represents a very healthy state and one represents a much degraded state. Results are provided in Table 4.26 below.

Table 4.25 Fishermen's Ranked Perspectives on Ecological Change in Maunalua Bay

Fisherman	1950s	1960s	1970s	1980s	1990s	2000s	Today
1	****	****	*	*	*	*	*
2	*****	****	**	**	**	***	***
3		****	****	***	**	**	*
4			***	***	***	***	***
5			*****	****	***	**	*
6			*****	*****	****	****	****
7				*	*	*	*
8				***	**	*	*
9				***	**	**	**
10				***	***	***	**
11					***	***	***
12						*	***
13						*****	*****
14							**
15							**
Perspectives of Degradation	**Total Score**						
	←Less Degraded					**More Degraded→**	
	4.50 (n=2)	4.17 (n=3)	3.33 (n=6)	2.90 (n=10)	2.36 (n=11)	2.38 (n=13)	2.27 (n=15)

All fishermen interviewed were familiar with the IAR project. Five out of twelve interviewees reported noticing differences in the status of certain areas following the start of the IAR project. Generally speaking, the project is thought to have improved shoreline habitat and water quality around the removal site. Four fishermen believed that the project had resulted in better habitat for reef fish, and two fishermen reported that they had personally observed an increase in abundance of certain reef fish species, which was attributed to the project. One fisherman believed the project would likely negatively affect o‘io and weke feeding areas.

While only one fisherman was directly involved in the IAR project, over 75 percent of the subsample believed the project was successful in getting more people involved in taking care of Maunalua Bay. Three fishermen participated in a project-related community event, and three others said they hoped to participate in future events. All but two fishermen had talked with others in the community about the IAR project.

Other Salient Issues. About half of the fishermen belonged to a community organization and had recently participated in a local fishing tournament. More than 80 percent had attended a meeting about marine fisheries. Taken together, these indicate a significant level of interest in fishing and management of fishery resources in the region.

When queried about the principal problems affecting fishing in Maunalua Bay, the interviewees offered a variety of responses. The most commonly stated responses related to: (1) diminished water quality, attributed to land-based pollution and runoff; (2) inadequate regulation of certain fishing practices and lack of adequate fisheries enforcement; and (3) overly extensive commercialized recreational activities, such as jet-ski rentals.

The fishermen universally asserted that more people need to get involved in taking care of Maunalua Bay. All respondents also supported better enforcement of existing rules and regulations. Notably, the majority of this subsample supported the idea of a marine protected area as a way to improve ecological conditions in Maunalua Bay. Although the rules of such a reserve were not specified, interviewees appeared willing to stop fishing in *certain areas*, at least until conditions improved. At the same time, there was almost universal agreement among the fishermen that fishing should be allowed to continue in Maunalua Bay.

4.6 Recreational Ocean Users

Attributes of the Subsample. People recreate in Maunalua Bay in a variety of ways. Popular activities include paddling, surfing, sailing, diving, boating, and angling, among others. A total of 12 avid surfers, paddlers, shoreline anglers, and divers were interviewed. Anglers reported the longest association with the Bay, regardless of age. The surfers, by contrast, generally indicated a shorter history of association with the Bay. Most respondents could be described as local; few had been in Hawai‘i for less than 10 years. All respondents revealed a deep interest in the ecological status of the Bay.

Perspectives on the Benefits of the IAR Project. Recreational ocean users invariably asserted that the IAR project was generating noticeable improvement in local water quality. Visibility was said to have improved and surfers, in particular, described the value of being able to see the bottom – the reefs upon which the swells break, and sandy channels that afford good access to the reefs. Certain surfers feared some negative impact, since enhanced access could result in more crowding at certain surf breaks. Paddlers asserted that their access points were generally too far from the IAR site as to have an effect on their activities.

All interviewees reported enjoying the beach adjacent to the IAR areas, now said to be cleaner than prior to the project. Some related their opinion that the area was now more "family-friendly." In sum, recreational users were positive about the IAR project and its initial effects on their activities.

Other Salient Issues. Recreational users voiced a number of concerns. Salient concerns noted by this group included: (1) siltation and runoff-related pollution; (2) decline in favored fisheries species; (3) invasive algae; (4) lack of ocean education; and, (5) noise and pollution associated with jet skis. Many respondents described construction as a major water quality concern, as it is thought to result in extensive siltation. The group generally believed that the IAR project was beneficial because it helped to inform the community about ecological problems and the potential benefits of organized response to such problems.

Figure 4.10 Keiki Recreating in Maunalua Bay, Summer 2011

4.7 Mahi‘ai

Mahi‘ai (farmers) have a long history of activity in the Maunalua area. Historically, the uplands were used for agriculture and ranching. Kamilo Nui Valley was traditionally known as Ke Kula o Kamauwai, or “famous sweet potato planting place” (Franklin 2010a, b). Starting in the late 1950s, the uplands began to be used for residential purposes. Over time, local farming and ranching operations began to diminish in number, with Kamilo Nui ahupua‘a the only remaining area where agriculture remained a significant industry (Franklin 2010a) (Figure 4.7). Today, Kamilo Nui Valley is owned by the Bishop Estate Trust. Farmers continue to lease land in the valley.

Figure 4.11 View of Kamilo Nui Valley with Koko Head Crater in the Distance

Attributes of the Subsample. Individuals from four Maunalua-area farms were interviewed during the course of the project: all used algae recovered from Maunalua Bay as a compost and fertilizer agent. Farmers in this area of O‘ahu are said to constitute a tight-knit community, with a long local history of familial knowledge in subsistence horticulture and commercial agriculture. The interviewees were second-generation farmers, able to describe long-term changes in the environment and gauge the benefits of receiving algae from the IAR project.

The farmers stressed the importance of passing knowledge on to the next generation. They hope that increased community involvement and interest will expose younger generations to the history and practical value of contemporary farming in an area that is now largely urbanized. One farmer noted that the Maunalua Bay community is at a critical point in its development and that outreach and education are needed to perpetuate the concept of mālama ‘āina. Franklin (2010a) reports the words of one resident who agreed that people should “grow food, not more houses, in Maunalua, [leaving] a meaningful legacy for our children.”

Perspectives on the Benefits of the IAR Project. Farmers have benefitted from the project in numerous ways (Figures 4.11a & 4.11b), and each of the interviewees described a direct economic benefit to their business. One farmer estimated that over the previous five months, the algae saved ten percent of costs for soil media. This reportedly equated to hundreds of dollars per month. Another farmer asserted that the algae spurred rapid plant growth, facilitating more rapid marketing of his products.

While each farmer has developed different methods of using the algae, the consensus is that the use of algae as fertilizer has saved considerable sums of money while increasing levels of productivity. One interviewee reported that because the algae is highly absorbent, it may be a useful means for reducing the amount of nutrients that reach the ocean and lead to problems, such as anoxia and eutrophication.

Figures 4.12a & 4.12b Maunalua Area Farmer Describes Composting of Invasive Algae

Moreover, all of the farmers believe that the algae provide good nutrition to the produce. This finding is supported by preliminary research conducted by scientists at the University of Hawai‘i College of Tropical Agriculture and Human Resources, who have been investigating the benefits of composting the material (Radovich and Hue 2010). Preliminary findings suggest that nutrient uptake varies, but that composted algae invariably provide valuable nutrients to many commercially marketed plant species.

Researchers and residents are also working with Mālama Maunalua to investigate the most efficient way to decompose the invasive algae (Yuen 2010; Flemister 2011). Representatives of the group report their hope that composted algae can eventually be sold to raise funds to further ecological restoration efforts in Maunalua Bay.

Further, farmers discussed the benefits of using algae from the IAR project to help achieve their goals of becoming more sustainable and less reliant on off-island sources of fertilizer. Farmers described the algae as having come full-circle, arising partly due to the eutrophic affects of pollution, but now contributing needed nutrients to the soil and agricultural products and providing an absorbent buffer to further runoff.

Figure 4.13 Farmer Tending Crops at the Base of Koko Head

Figure 4.14 Unloading Algae for Composting

Farmers and area residents involved in the compositing effort are maintaining traditional connections between land and sea. According to one observer, "growing food on the land while helping to restore a habitat for native species in the sea - that's taking the traditional concept of ahupua'a and making it work in a brand-new way" (Yuen 2010).

Various school groups and community members have become involved in the local composting effort. As a result, numerous residents are becoming aware of local cultural and agricultural history, which is a corollary benefit of the IAR project (Franklin 2010b).

Interviewees further noted that composting relates to broader efforts to preserve land and restore cultural sites on the island. Indeed, the benefits of the IAR project extend beyond Maunalua Bay. Kōkua Kalihi Valley, a non-profit organization that manages a farm in Kalihi Valley above Honolulu, was the first farm to receive algae from the bay. Since the farm is a non-profit entity, operators can readily experiment with various crops and growing techniques, and share their experiences with other farmers. In short, the IAR project is connecting local farmers to the ocean.

4.8 Educators

Attributes of the Subsample. Research staff also interviewed a group of educators involved in various environmental programs around Maunalua Bay and elsewhere on Oʻahu. The teachers were associated with: Waiʻalae Public Charter Elementary School, Niu Valley Middle School, Hahaʻione Elementary School, Kapiolani Community College, Kaiser High School, Punahou School, and Kailua High School.

The subsample of teachers described a variety of environmental problems in Maunalua Bay. These include: excessive development, dredging, non-point source pollution, runoff, sedimentation, excessive recreational activities, and overfishing. Some of the educators believe that newly arriving residents often do not know or care about local environmental issues, and that the status of the marine environment would ultimately be further degraded as a result.

All of the educators interviewed during the course of the study stated that there has been increased public interest in curricula that address environmental issues and local stewardship of the island's natural resources. Concurrently, there has been increased attention to hands-on and place-based educational programs, wherein teachers focus on issues in their own communities and present opportunities for students to gain first-hand knowledge of environmental science. Some of the educators have been involved in the development of inquiry-based learning, which allows individual students to create their own educational and research projects.

Perspectives on Local Environmental Programs. Respondents in this subsample uniformly believed that Maunalua Bay provides a good location for students to learn about the marine environment, and each of the interviewees had developed curricula involving environmental learning. Some programs were being initiated at the time of the interview; one program was in its eighth year. In one case, an entire grade was involved in a service project in Maunalua Bay, with 240 students participating.

Students involved in these programs typically reside in the Maunalua Bay area or use the bay for recreational activities. The programs thus often enhance pre-existing connections between the students and the natural environment. Most programs have resulted from partnerships between the schools and either Mālama Maunalua or TNC. Some have included an IAR-related

component. Other organizations involved in educational programs include the Maunalua Fishpond Heritage Center and the Department of Land and Natural Resources' Division of Forestry and Wildlife.

A variety of programs have been established in recent years. For example, one program enables students to interact with local kūpuna. Others have instructed students on the difference between invasive algae removal methods, methods of composting algae, and the effects of sedimentation and land-based pollution.

Interview data strongly suggest that educators and students obtain a variety of benefits from their programs in Maunalua Bay. These benefits manifest through mutual learning experiences regarding: local ecology; understanding of anthropogenic threats to the bay; environmental restoration and conservation practices; traditional concepts regarding stewardship; transfer of knowledge between generations; and increased community awareness of ecological problems and solutions.

Aside from pulling algae, other practical activities being undertaken by students include planting native terrestrial plants around Paikō lagoon and working with farmers in the uplands. Educators typically coordinate with Mālama Maunalua to set up excursions to various locations and to facilitate interaction between students, elders, and volunteers. Numerous educators described the value of exposing students to traditional and local ecological knowledge. Interviewees assert that place-based programs allow students to become more aware and more thoroughly connected to their communities and to the natural world. This was said to foster a sense of stewardship.

Educators also believed that hands-on learning facilitated the personal growth of the students and served to develop leadership skills. One educator asked, "how are you going elevate kids to level of leadership if you don't elevate them." Programs in Maunalua Bay were perceived to be exposing students to potential career options, including careers in science and environmental management.

Finally, the teachers generally believe that the IAR project has improved conditions in Maunalua Bay. All of the teachers believe that portions of the Bay *look* cleaner. One educator reported that she has personally observed native species returning to areas where invasive algae have been removed.

4.9 Researchers

Attributes of the Subsample. Eleven research scientists were interviewed during the course of the study. Affiliations included the University of Hawai'i, Hawai'i Pacific University, and various state and federal agencies. Researchers had been working in the area for various lengths of time, some as long as 30 years. Moreover, many university researchers have encouraged their students to undertake research in the Maunalua Bay area. All of the researchers are connected to the Maunalua Bay community in some way. Most interact with community organizations such as Mālama Maunalua. The researchers see themselves as neutral parties who can provide the

objective analysis needed for effective management of natural resources, such as those in Maunalua Bay.

Research Activities around Maunalua Bay. Researchers have investigated many environmental issues in the Maunalua region. Most work has been focused on biophysical aspects of the area's terrestrial and marine ecosystems. Two professors have been examining algal communities in the region for decades. One has worked on similar projects elsewhere in the Hawaiian Islands and has played an advisory role in the restoration of Maunalua Bay. The other has also focused on eel grass ecology, especially in the Paikō area.

A number of researchers have been studying the impact of invasive algae. This research has been instrumental in guiding IAR work and initial restoration of nearshore marine habitats. One project involves experimental research of competition between native and invasive species. Another involves analysis of the spatial distribution of invasive algae and monitoring the re-growth of invasive species. Another experiment was undertaken in a controlled laboratory setting to examine the potential role of urchins in controlling invasive algae species.

Oceanographic studies have also been performed in the Bay in recent years. For instance, U.S. Geological Survey (USGS) scientists have been examining circulation patterns and sediment transport and related effects on coral spawning patterns. Wolanski et al. (2009) have been researching the environmental impact of urbanization since 2006. This work has linked physical circulation studies with assessment of water quality and the status of coral reef ecosystems.

Certain research has included a community participation component. For instance, the Makai Watch program was implemented to monitor the health of the area's coral reef ecosystems. The program, administrated by Mālama Maunalua in partnership with the State of Hawai‘i, has involved lay persons in fish population studies, water quality monitoring, and investigation of patterns of growth of invasive algae.

Finally, a university professor has helped design and implement a bonefish (‘ō‘io) tagging study. This project involves habitat mapping, diet analysis, and assessment of abundance. It is often the case that researchers work closely with local organizations to help translate the results into information of utility to the general public.

Perspectives on Environmental Change. The perspectives of the research subsample regarding environmental change in Maunalua Bay were naturally more scientific in nature than those of other research participants. All of the researchers readily discussed their perspectives on the degradation of terrestrial and marine ecosystems in the Maunalua Bay area and elsewhere in the islands. As was the case for other subsamples, researchers with the longest tenure in the area provided the most detailed description about environmental change and the factors associated with such change.

Several of the most experienced researchers discussed a large storm that affected southeast O‘ahu in 1978. The event resulted in heavy siltation of Maunalua Bay, and affected local water quality and various habitats for several years. One researcher reported that not long after the storm, she began to notice the establishment of invasive mudweed. In addition to *Aravinvillea*

amadelphia (leather mudweed), other invasive algae were seen, including *Acanthophora spicifera* and *Gracilaria salicornia* (gorilla ogo). Nearshore coral populations were also said to have declined during this period.

Researchers also attribute decline in the status of the marine environment around Maunalua Bay to increased coastal development and diminished input of freshwater. Development was often mentioned as being associated with increases in impermeable surfaces and subsequent problems with run-off and siltation. Channelization of streams was also commonly mentioned as a significant problem. According to interviewees, sedimentation has caused the bay to become more shallow and warmer, while also decreasing habitat rugosity and altering species composition.

Dredging of the Hawai‘i Kai Marina was commonly described as generating detrimental ecological impacts. Researchers described how dredging tends to re-suspend sediment and smother coral communities. Overfishing was also discussed, and many of the researchers believe herbivores and other reef fish populations are threatened due to unsustainable harvesting. Some researchers believe that overfishing is enabled by the many public access points in the Maunalua Bay area and that these also facilitate entry of boat-based pollutants into the natural environment.

Perspectives on the Benefits of the IAR Project and Associated Research. The researchers generally stated that the IAR project has thus far generated positive impacts. Most asserted that water quality in the vicinity of the algae removal area has improved or will improve in the near future.

One researcher likened the IAR project to a large science experiment: with 23 acres of algae removed, it is unclear what will happen to the exposed substrate. He asserted that this makes systematic monitoring work essential to long term restoration objectives.

Some researchers asserted that the project has led to growth of seagrass beds and a return of grazing sea turtles. Others reported having observed other native species returning to hard and soft substrate areas, some of which have not been seen in recent years.

Researchers contacted during this study often linked the IAR project to their own work in the area, and they described basic benefits in this regard. These include: (1) increased collaboration among researchers, agencies, and members of the public who were involved in or associated with the project; (2) new educational opportunities that could potentially involve participatory research; (3) heightened public awareness of a variety of environmental problems and solutions; and, (4) improved scientific understanding of marine ecosystems in the region.

Some of the researchers emphasized benefits associated with participatory research, including the fostering of a community stewardship ethic. One offered the perspective that such research can motivate scientists to address topics of particular interest to persons who use the marine environment on a regular basis and that exchange of information between researchers and the public is often effectively facilitated by non-profit organizations such as Mālama Maunalua.

Figure 4.15 Paikō Area Prior to and Following the IAR project
(Photo Courtesy of The Nature Conservancy)

Potentially detrimental and beneficial social changes were discussed by some of the scientists. For instance, the IAR project appears to have made the algae removal areas easier to traverse on foot, which could exert a negative effect on the substrate. On the other hand, it is believed that environmental awareness has been significantly enhanced and that user groups may now tend to be more careful during interaction with coral reef systems in the region.

In sum, there is a long history of scientific research in and around Maunalua Bay. Some research projects were instrumental in acquiring ARRA funding and directly informed the IAR effort. Researchers contacted during the study generally believe that the IAR project is one of the first large-scale restoration success stories in Hawai‘i, and many envisioned the work as a good model for future collaborative restoration projects elsewhere in the archipelago.

4.10 Mālama Maunalua and Affiliated Organizations

The IAR project has generated a variety of benefits for non-governmental organizations (NGOs) in the region. Representatives of Mālama Maunalua were interviewed to better understand and characterize the effects of the IAR project on the capacity of such organizations. Interviews focused on topics related to hiring and/or retention of staff, acquisition of new expertise, and development of new partnerships.

Mālama Maunalua. ARRA funding allowed Mālama Maunalua to form three permanent positions within the organization. One project manager and one outreach staff member were hired on a full-time basis, and an additional person who had been contributing extensive time on a volunteer basis was hired as a half-time employee. ARRA funding also provided 30 percent and 20 percent of funding for two existing staff members. The new hires have focused on improving the outreach and educational capacity of Mālama Maunalua.

ARRA funds also helped support IAR project contractors. Tasks undertaken by these contractors included: (1) web site development; (2) media editing; (3) geographic information systems development; and (4) public relations. Interviewees characterized the new positions as providing the organization with the capacity to undertake and effectively manage a variety of critical tasks.

The funding has also allowed the organization to acquire 501(c)(3) status as a non-profit organization and to establish a Board of Directors. Mālama Maunalua's offical status as a non-profit organization, along with the experience it has garnered managing a large grant, are perceived as necessary prerequisites to applying for and administering additional grants in the future. In addition, the collaborative development of the Conservation Action Plan in partnership with TNC has helped meet the organizational objective of building functional community partnerships.

ARRA funds also enabled Mālama Maunalua to purchase or lease new equipment and expand its office facilities. New equipment includes: a copy machine, computers for IAR staff, a truck for hauling algae for composting, and the equipment needed to host large volunteer groups participating in community IAR events. Mālama Maunalua has also been able to expand its office space from approximately 400 square feet to 1,300 square feet, with additional room for storage.

According to staff, the funding has "bolstered [Mālama Maunalua's] outreach toolbox." Outreach and education are conducted through various events and presentations, and via a continually updated website. Moreover, ARRA funding has specifically allowed Mālama Maunalua to advance its capacity to manage large events, effectively transmit critical information to its constituents, and train and support new volunteers.

The number and extent of community events hosted by Mālama Maunalua have increased significantly following receipt of ARRA funds (Figure 4.15). Community IAR or huki events have become more frequent and have involved higher rates of attendance.

Media coverage of the IAR project has reportedly improved the public visibility of Mālama Maunalua. Interviewees report that the volunteer pool has expanded to include participants of all ages. As one staff member notes, the IAR project has become a "multigenerational effort" that may serve to perpetuate public interest in restoration efforts in the years to come. In order to accommodate an increasing number of volunteers, staff members have developed an online request form which enables organization of groups and assignment of work on specific dates.

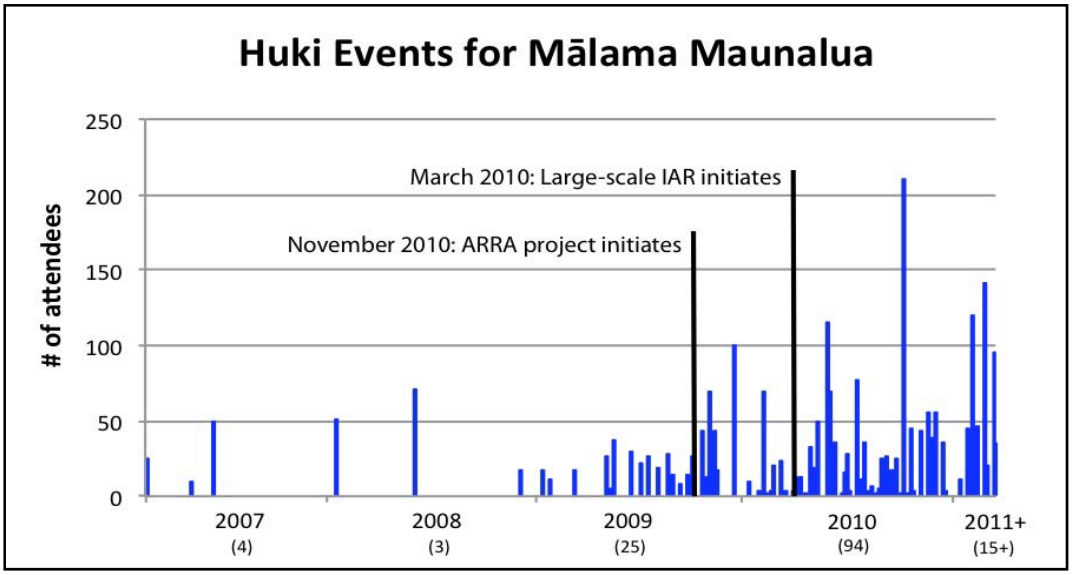

Figure 4.16 Timeline of Community Huki Events Hosted by Mālama Maunalua
(Data courtesy of Mālama Maunalua)

Moreover, ARRA funding has enabled Mālama Maunalua to develop maintain and/or develop new partnerships with area schools, clubs, businesses, government agencies, and other NGOs. Some of the most consistent partners include the following:

- The Nature Conservancy;
- Aloha ʻĀina O Kamilo Nui/Chrysanthemums of Hawaiʻi;
- City and County of Honolulu – Department of Environmental Services and Parks and Recreation;
- Duke's Hawai'i;
- State of Hawaiʻi Department of Land and Natural Resources;
- Hui Nalu Canoe Club, Kaiser High School;
- Kale's Natural Foods Hawaiʻi Kai;
- Livable Hawaiʻi Kai Hiu;
- Local Action Strategy Committee to Address Land Based Pollutant Threats to Coral Reefs;
- Maunalua Fish Pond Heritage Center;
- NOAA;
- Paikō Lagoon Wildlife Sanctuary, Polynesian Voyaging Society;
- University of Hawaiʻi Kewalo Research Laboratory;
- University of Hawaiʻi Sea Grant College Program;
- Waiʻalae Charter School;
- Sustainable Resource Group Int'l Inc.;
- US Army Corps of Engineers; and
- Whole Foods Market.

In 2009, Mālama Maunalua hired a contractor to conduct telephone polls at the beginning and ending of the grant period. The questionnaires measured community awareness regarding the invasive algae threat, the IAR project, and the organization itself. Findings indicate that 59 percent of O‘ahu residents were then aware of the threat of invasive algae to Hawai‘i’s coral reef ecosystems (Ward Research Inc. 2009). Naturally, awareness of the algae problem was relatively higher in the impacted areas, with 71 percent of residents in East Honolulu indicating awareness of the problem. In a post-IAR project follow-up survey conducted in May 2011, survey results showed that overall awareness of the threat had increased (Ward Research Inc. 2011).

The survey results suggest that the ARRA award has raised the profile of the organization and its mission. Staff members report that the organization has gained creditability for being ahead of schedule and under budget, and it hopes to leverage its successes to acquire additional public and private-source funding. This may enable the organization to continue its current work and to address additional threats such as land-based pollution.

The conclusion of the large-scale volunteer and contracted IAR efforts poses some challenges for Mālama Maunalua. As discussed earlier, the ARRA-funded IAR project has raised the profile of the organization and its efforts to remove alien algae. As a result, there is a wait list for volunteers wishing to participate. Staff members fear that if volunteers and community groups cannot be accommodated, they will erroneously think that the invasive algae problem has been eliminated in its entirety. One staff member believes the current challenge is to direct community interest and “harness the energy” that has resulted from the large-scale picking efforts into other programs that can also generate a visibly positive impact. Another staff member notes that the appeal of the IAR work has rested on its ocean-centric focus– fully appropriate in the context of island culture.

Notably, projects designed to address other threats to the marine environment reportedly generate less appeal to the public, since the results tend to be less immediate. Members of the organization’s Board of Directors assert that one of the largest obstacles to long-term restoration of Maunalua Bay is that education and outreach activities remain limited in scope.

The content of the outreach message is also an important consideration. Members of Mālama Maunalua often use Hawaiian terms and concepts and envision restoration largely in terms of cultural revitalization. Reportedly, one unintended consequence of this perspective is a kind of exclusion, wherein malahini haoles (persons new to the islands) do not understand the key concepts underlying the localized approach to restoration. This problem may be alleviated as newly-arriving residents become more familiar with local traditions and customs in Hawai‘i.

The IAR project exemplifies TNC’s commitment to conservation and restoration work in the Pacific. The project represents another success for TNC in its practical support of community-based environmental management, applied research, and collaborative problem-solving. The results of the IAR project will be presented in scientific journals, popular media, and at community meetings. Mālama Maunalua representatives hope the information will be useful to other communities in Hawai‘i and the larger Pacific, where invasive algae is a growing ecological and economic problem.

Figures 4.17 and 4.18 Azure Sea and Sky: Maunalua Bay, Summer 2011

5.0 Summary Conclusions

Environmental restoration projects provide significant benefits to human societies. Such projects increasingly involve a multi-disciplinary approach which addresses critical relationships between humans and the physical environment (Loomis et al. 2009). This report has described a variety of social, economic, and ecological benefits associated with the invasive algae removal project at Maunalua Bay on the island of O‘ahu.

Many persons participating in this study framed the IAR project in terms of its capacity to enhance what are often termed ecosystem services. Ecosystem services are defined here as the human benefits provided by the natural environment (Daily et al. 1997; Millennium Ecosystem Assessment and World Resources Institute 2005). These services can be envisioned in four ways: (1) through *provisioning*, as in the production of seafood; (2) by *regulating*, as in the limiting of drought through rainfall; (3) by *supporting*, as in the sustaining of human populations through photosynthetic production of edible plants; and (4) by *enabling*, as in the facilitation of cultural and recreational activities (Figure 5.1).

Marine ecosystem services have been described to specifically include: (1) global materials cycling; (2) transformation, detoxification, and sequestration of pollutants; (3) support of ocean-based recreation industries; (4) coastal land development and valuation; and (5) provision of cultural and scientific values (Peterson and Lubchenco 1997). These ecosystem services directly support various dimensions of human society, including access to basic materials, human health, social capital, and security, among others (Table 5.1).

With regard to the Maunalua Bay and IAR project, the most commonly mentioned ecosystem services supported by the restoration effort were social and cultural in nature. These involve a range of aesthetic, recreational, educational, and spiritual benefits. Such benefits were often described in relation not only to individuals, but also to a larger community of persons who use the ocean for purposes of recreation, subsistence, and commerce. Research participants often highlighted the importance of the IAR project in terms of its capacity to enable inter-generational transfer of knowledge, the practice of age-old traditions, and collective stewardship of land and sea.

Notably, few examples in the literature demonstrate clear linkages between cultural ecosystem services and ecological restoration projects. The findings of this project are therefore highly significant in that they underscore the sociocultural importance of restoring the marine environment and the many benefits of the restoration process itself. This does not diminish the purely economic benefits of the project, but rather expands understanding of the realities of human interaction with the marine environment, which very often involve values that are not pecuniary in nature.

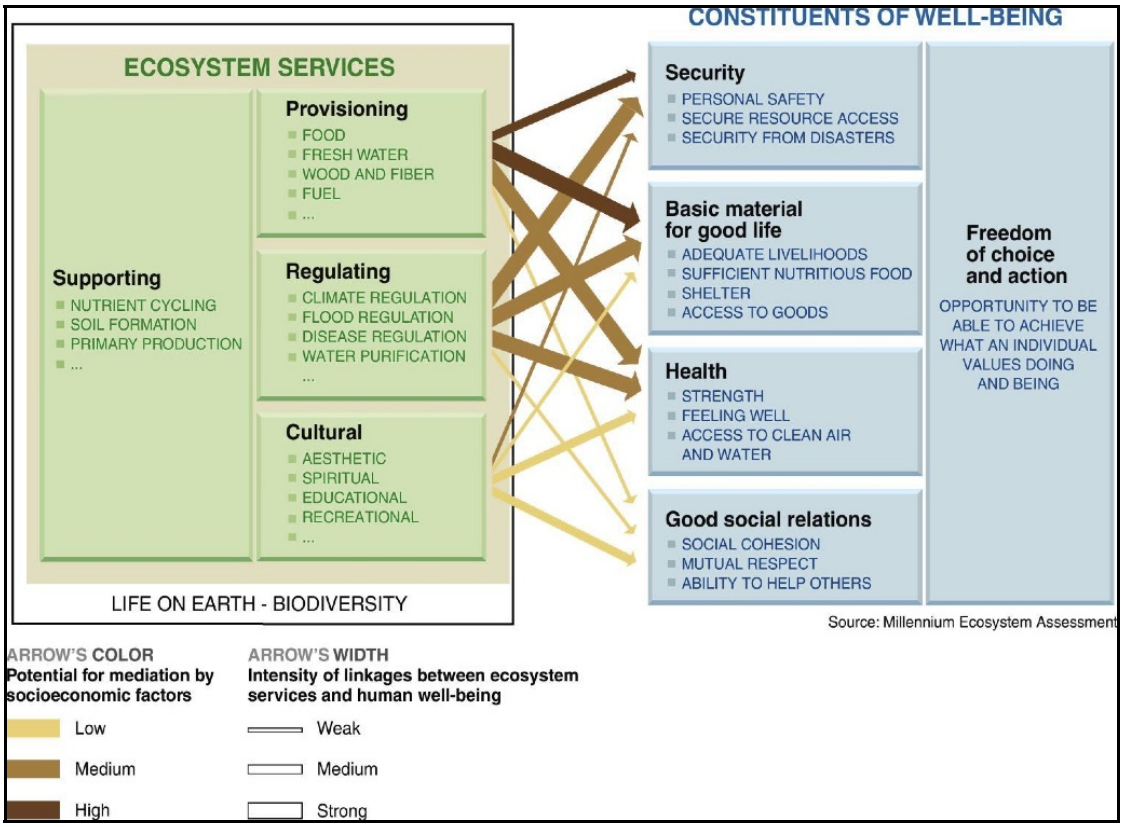

Figure 5.1 Linkages between Ecosystem Services and Human Well-Being
Source: Millennium Ecosystem Assessment and World Resources Institute (2005:15)

Table 5.1 Five Principal Dimensions of Human Well-Being*

Dimension of Human Well-Being	Description
1. Access to Basic Materials	Ecosystem goods and services relied on by societies, including food, fresh water, timber and fiber, fuel, medicines, biological and other natural products
2. Freedom and Choice	The full range of options that individuals and groups have in decisions for lifestyle and livelihood, as affected by environmental quality, resource availability, and resource condition
3. Human Health	Ecosystem regulation of infectious diseases, including disease vectors, nutrient and waste management processes, pathogen processing, and detoxification
4. Social Relations and Social Capital	Cultural, spiritual, and amenity services provided by ecosystems
5. Security	Ecosystem provisioning of livelihoods for economies and dominant modes of production by societies

Source: Kittinger et al. (2010). * As defined by the Millennium Ecosystem Assessment (2005)

5.1 Summary of Social and Cultural Benefits of the IAR Project

The sociocultural benefits of the IAR project are wide-ranging. Perhaps most significantly, the project increased environmental awareness and local capacity for stewardship of the marine environment. This has been achieved through the process of removing invasive algae itself and through the many associated educational programs, research projects, agricultural benefits, community events, outreach programs, recreational activities, and opportunities for furthering communication of knowledge between generations.

The place-based, hands-on nature of educational programs in Maunalua Bay has been a major element in the local and regional diffusion of environmental awareness and stewardship. Scientific research, curricula development, training programs, and community events are important corollary benefits of the IAR project, facilitated through development of relationships between many individuals and organizations. The IAR project has stimulated the development of collaborative relationships that may persist and benefit the Maunalua Bay region for many years.

TNC envisioned positive long-term social relationships as an important project objective even during its early planning phases. Indeed, both TNC and Mālama Maunalua sought to: ensure that residents were properly informed about the project and provided with contact information should they desire additional information. The organizations also undertook a large-scale survey in advance of the project to examine public perspectives on the nature of the invasive algae threat and to analyze prospective solutions appropriate to communities in the Hawaiian Islands. The project was clearly successful in ways that supersede its intended environmental benefits. For instance, the number of volunteers participating in Mālama Maunalua's programs essentially doubled between 2008 and 2010, indicating not only community approval, but also appeal.

5.2 Summary of Economic Benefits

The IAR project provided for at least 82 enduring positions, 30 percent of which were full-time, 33 percent part-time, and 37 percent full- and part-time contractual arrangements. Thus, over the entire duration of the project, it is conservatively estimated that at least 105 positions were directly supported by ARRA funding. More than 13 non-profit and for-profit organizations have benefitted from the project.

Table 5.2 Estimated Numbers of Jobs Associated with the IAR Project

Organization/Institution	Full-Time	Part-Time	Contractual	Total
Pono Pacific	22	22	*	
Mālama Maunalua	2	3	~12*	
The Nature Conservancy	1	2	~7+*	
Subtotal	25	27	~11+*	**82**
Percent	30	33	37	100

It should also be noted that the grant significantly increased the functional capacity of the three principal organizations involved in the IAR project. Moreover, the grant and project enabled the leveraging of additional funds to continue further restoration work in Maunalua Bay.

The IAR project benefitted the household economies of numerous project participants (Table 4.19). Using estimates of reported household size, we conservatively estimate that more than 250 persons received income earned through work on the IAR project (Table 5.3).

Table 5.3 Estimated Numbers of Households and Individuals Benefitting from the IAR Project

Size of Household	Number of Households	Percent Frequency	Total Number of Individuals
1 person	10	12.8	10
2 people	27	33.3	54
3-5 people	37	46.2	148
6+ people	7	7.7	42
Total	**81**	**Total**	**254**

5.3 Conclusion

Archival research and interview data collected during this study indicate that ecological conditions in Maunalua Bay have worsened in recent decades. Older informants, especially those who have observed the marine environment on a regular basis over the course of time, tended to describe gradual loss of certain species, diminished abundance of others, and an overall decline in water quality and the status of various habitats. Younger interviewees tended to report less dramatic changes, likely because the marine environment had already been significantly impacted when such persons first began consistently using or observing the area.

On a promising note, the majority of IAR workers interviewed during this study reported improving conditions around the algae removal sites. Such improvements reportedly included: an increase in the abundance of certain native fish and limu species, better local water quality, and sandier bottom conditions. Certain long-term residents of the Paikō Drive neighborhood agreed with these observations.

The 2010 IAR project in Maunalua Bay has been highly successful in a variety of ways. The social and economic benefits have been profound, and all indications are that local ecological conditions are improving. As this assessment has made clear, humans and the marine environment are intrinsic elements of a single system. Thus, in the event that restoration efforts continue, adjacent human populations will inevitably benefit.

By focusing on human dimensions of the project, the research and report have made clear that the mere undertaking of the IAR work generated far-reaching benefits to local society. When restoration work of this nature is well-planned and collaborative in nature, the likelihood of success is greatly enhanced. When persons and communities with a vested interest in the status of the marine environment are directly involved, heightened awareness of environmental problems and long-term solutions to such problems are assured.

Despite a variety of dramatic social and biophysical changes over time, the nearshore coral reef ecosystems between Lae o Kūpikipiki‘ō and Kawaihoa Point continue to be valued for their capacity to provide opportunities for recreation, education, food-gathering, and traditional cultural practices. The 2010 IAR project in Maunalua Bay clearly exemplifies the kind of collaborative effort that is needed to ensure that such opportunities remain available across the Hawaiian Islands for many generations to come.

Figure 5.2 Beneficiaries of Current and Future Restoration Work in Maunalua Bay

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