



Application of Traditional Ecological Knowledge and Practices of Indigenous Hawaiians to the Revegetation of Kaho'olawe.

Samuel M. Gon III

Abstract

Kaho'olawe Island has been established as a natural and cultural reserve, and an ongoing process of removal of dangerous unexploded ordnance is to be followed by a restoration of the native vegetation of the island, now largely denuded and highly disturbed by alien weeds. As part of the planning process for this effort, a review of Hawaiian traditional ecological knowledge and land management practices was undertaken, offering many premises, precedents, and practices for the effort, all stemming from chants and recorded practices of Hawaiians. It becomes clear that traditional approaches have much to offer the modern restoration effort.

He wahi kapu 'o Kaho'olawe no nā kaiāulu maoli a me ka hana no'eau o ka po'e Hawai'i maoli. Ke lawe aku nei nā mea weliweli kua mai Kaho'olawe i kahi 'ē, ma hope, e ho'ōla hou 'ana ka moku, ma o ke kanu ana o nā meaulu maoli ma nā wahi māneoneo o ka 'āina i laila. I ho'omākaukau no keia hana ho'ōla, ua ho'oma'ama'a mākou i nā oli, nā mo'olelo, a me nā leo kūpuna e pili ana i ka hana kuhikuhi pu'uone a me ko ka po'e kahiko mālama 'āina. Ua 'ike nō mākou: he mea nui ka hana no'eau a me ka 'ike o ka po'e Hawai'i no ka ho'ōla hou o Kaho'olawe i keia mau lā.

Ho'okaka'a lani i loli ka honua
Kau mai ka 'ahu'ula ke ēwe ka piko o ke akua
I luna i Hālulu ka lani
I ka hale mahina poepoe
I ka puka hāiki pilikia
Puka kīkēkē a ke akua
Ka wai hiona a Kanaloa
A ke aka i malu o hu'ahu'akai
'O Lono-i-ka-owali'i
'O Kū-i-'io-moa
'O wau nō ia
'O Pōuliuli, 'O Pōwehiwehi
'O ka pōpolo kū mai a Kāne la e
Hō mai ka 'ike i 'ike nui
'Amama, ua noa

This **pule**, which comes to us from Theodore Kelsey, accompanies rituals when asking for visions of the future. It is prayed that such visions continue to come to those dedicated to the restoration of Kaho'olawe (Figure 1). This pule is presented here that efforts to reconcile the recovery of Hawaiian natural resources with the richness of Hawaiian cultural knowledge continue to grow.

Introduction

The scope of this project was to "describe traditional restoration and environmental management practices of indigenous Hawaiians in mesic or arid areas as revealed through literature, Hawaiian language sources, oral histories, and chants." This report provides some of the fundamental basis for Hawaiian cultural practices in use and recommended for use in the course of the clean-up and restoration of native ecosystems on Kaho'olawe (Figure 2). It interprets the findings of the researchers to fit within a workable management program for potential application in the restoration of Kaho'olawe. It attempts to inte-

Correspondence

Samuel M. Gon III. The Nature Conservancy of Hawaii, 923 Nu'uuanu Avenue, Honolulu, HI 96817, U.S.A. (808) 537-4508; sgon@tnc.org

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Figure 1. The Islands of Maui and Kaho'olawe (lower center).



Figure 2. Mosaic of barren hardpan, alien vegetation, and remnant native vegetation occupies the island of Kaho'olawe.

grate physical practices and techniques with spiritual protocols.

Background

With a rich heritage of empirical knowledge based on working Hawaiian lands for 1500 years, traditional Hawaiian land management practices take strong advantage of seasonal patterns of rain, wind, and other environmental conditions to determine both the timing and nature of their work on the land, toward maximizing productivity of horticultural and other efforts. All aspects of Hawaiian life, including activities in agricultural and natural settings, required ritual protocol that integrates the spiritual and physical condition of the land and its living occupants, including people. While much of this knowledge has been lost, what remains is in part passed on traditionally among a small set of practitioners, or lies in obscurity among a body of historical written sources (many in original Hawaiian). This body of living and recorded sources was reviewed in order to extract information toward the long-term goal of documenting, recreating and adapting to today's needs, a set of dynamic Hawaiian protocols for land restoration on Kaho'olawe.

We realized at the onset that compiling information on practices and protocol stemming from ancient times results in an incomplete set. Acknowledging the gaps exist in recorded protocol, we attempted to fill some of these gaps by exploring the appropriate set of existing protocol, and making modifications. For example, chants appropriate for planting of agricultural fields were modified and applied to plantings of native trees in a semi-natural setting. We also acknowledge that there is a need for creating entirely new protocol that is not derived from any historical record, but which fits the Hawaiian world view, and is appropriate for today's activities while embracing the context of a long indigenous tradition.

Methods

The researchers employed a combination of 1) standard literature reviews, 2) Hawaiian language source reviews, and 3) interviews with **kūpuna** in English and Hawaiian, to explore traditional indigenous land management and restoration practices. An estimated 35 person days was spent engaged in standard literature review, 15 person days in Hawaiian language source reviews, and 5 days in interviews. The three methods are described in more detail below:

Standard literature reviews

Members of the research team searched through the literature in libraries with the best holdings related to Hawaiian culture, including the State Library, University of Hawai'i library system, and the library of the Bernice P. Bishop Museum.

Two members of the team were already very familiar with the list of native plants naturally occurring on and/or appropriate for cultivation on Kaho'olawe. We built on this familiarity to guide the compilation and synthesis of information dealing with the planting, harvesting, or other uses of those plants. However, with few exceptions (e.g., **olonā**), we note that native plants were not cultivated, but harvested from the wild.

At the onset, we generally anticipated that there would be relatively little direct information regarding practices and protocol for restoring native ecosystems, since prior to Western contact, the **wao akua** (the "realm of gods" land zones not inhabited by people) was relatively intact and there was no conception or perceived need to convert lands from one form of use or condition to a "natural" state (i.e., a state other than agricultural fields or inhabited lands). There is a considerable body of information related to practices and protocol related to ensuring life for the land, and protocol related to imposing **kapu** relative to conservation of resources, etc. Our team reviewed these sources.

Although traditions relating to restoration of native vegetation are largely lacking, there is a large body of English literature (including translations of works originally in Hawaiian) dealing with techniques in propagation and horticulture of many plants of Hawaiian ethnobotanical significance, cited in general works (e.g., Abbott 1992, Handy & Handy 1991, and others) These were reviewed for information dealing with general and specific horticultural practices, for potential modification for use in planting activities for restoration.

Hawaiian language source reviews

Some sources of traditional Hawaiian practices have never been translated into English. We employed staff and students fluent and literate in Hawaiian to review such sources in Hawaiian newspaper archives, library collections, recordings of conversations with native speakers (many now deceased, and representing a quality of information not attainable in living sources today), etc. They searched for the same topics and information as described for the standard literature review above. Relatively early in this process, the conclusion was drawn that the bulk of the untranslated material was not relevant to the present compilation. We also noted that the most significant of the articles dealing with land planting practices and protocol had been translated in works such as Handy & Handy (1991), and other compilations and reviews, and that our time would be best spent compiling and summarizing these translated sources in the framework of this report.

Interviews with cultural experts and kūpuna

In the memories and experience of experts and elders lies information that has never been recorded in written form. Sometimes it is this source that provides the most useful and practical information. Fluent staff with experience in conducting interviews or conversations with **kūpuna** searched out individuals with potential knowledge and sought their help in providing information or insight along the lines described in the standard literature review. While we were not able to arrange for interviews in the short time-frame of this review, of the Maui residents targeted for interview by **Kumu** John Lake, one (Inez Ashdown) had previously talked with him about land practices in the leeward portion of West Maui (Ukumehame Valley) and provided useful information at that time, which is incorporated in this report.

In the course of literature reviews and interviews, we kept our lines of investigation broad, so that we might uncover unanticipated and potentially fruitful information. We flexibly sought information that seemed applicable to the scope of the project.

Results

Introduction to tenets of the Hawaiian relationship to the land and its natural resources

With a rich heritage of empirical knowledge based on working Hawaiian lands for 1500 years, traditional Hawaiian land management practices take strong advantage of seasonal patterns of rain, wind, and other environmental conditions to determine both the timing and nature of their work on the land, toward maximizing productivity of horticultural and other efforts. All aspects of Hawaiian life, including activities in agricultural and natural settings, required ritual protocol that integrates the spiritual and physical condition of the land and its living occupants, including people.

Activities engaged in on Kaho'olawe within the traditional framework should be conducted within the traditional Hawaiian world view, to the extent possible for people greatly exposed to and for the most part raised primarily within a foreign (Western) world view.

Among traditional Hawaiian contextual beliefs were several items unlike those found in modern Western thought:

- relationship between humans and natural objects or living things (e.g., 'aumakua)
- that rights and responsibilities apply to all things in the natural world
- consciousness of the natural world and its elements
- that humans may speak directly to those elements of interest
- that environmental ethics include asking permission for resources

- giving something when taking anything of significance

Other concepts, such as that of spiritual essence (and beings imbued with such essence), are shared with modern Western thought. The consequences of such Hawaiian concepts for the restoration efforts on Kaho'olawe are discussed below.

Concept of spiritual essence (aka)

Hawaiians recognize that spirit is separate from matter. Material objects or beings contain spiritual essence (**aka**), which can be food for gods (**akua**). Thus the food offerings to akua are not for material consumption, but for spiritual consumption. The spirit of a person is 'uhane, which is to say, the soul of a man is an **akua** (i.e., a conscious spiritual entity; see below) (Dudley 1990).

Spiritual essence can be manipulated by humans. In the practice of 'unihipili, the soul ('uhane) of a deceased family member is brought back into his/her bones, kept in the household, and nourished with rituals and offerings until it was strong and could help the family as 'aumakua (family deity).

On Kaho'olawe the approach will be to strengthen (via prayer and offerings) the aka of the **kinō** (body) of **Kanaloa** and of any physical forms on the island, whether people, plants, etc. We will bear in mind that the physical manifestations alone are not the totality of being.

Concept of spiritual beings (akua)

Akua in Hawaiian belief are not "gods" in the sense of creator beings separate from their creations. They may indeed create or generate portions of the known universe, but this does not set them apart as separate from that creation (contrasting with Western theological separation of God from His creation). It has been suggested that **akua** should be considered "conscious spiritual entity," a non-material part of existence.

On Kaho'olawe we acknowledge that the island itself is **kinolau** of the **akua Kanaloa** (one of four major Hawaiian akua); also see notes below regarding **kinolau**.

Concept of a conscious universe

Cognition and volition is not singular and not restricted to humans, nor even to animate objects. Human parts are considered capable of volition ("the hands picked up") and inanimate objects (e.g. rocks, fire, etc.) are capable of feeling, thinking, acting.

In working toward the restoration of Kaho'olawe, we will treat all elements of the world as conscious of our efforts and of our intents, and actively participating in the efforts. Protocol will reflect this tenet. For example, permission will be asked of plants (as **kinolau**) and of the **akua** directly, to pick propagation material.

Concept of spiritual power (mana)

Mana, or degree of spiritual power imbued into an individual or object correlates to the degree of **kapu** exercised in dealing with that **mana**. **Mana** is a variable, with different **akua**, people, or things having different amounts of **mana**. The physical body constrains the expression of **mana**.

To the extent possible, those who can help strengthen the **mana** of the restorers and the restored (the island and its living things) will be called to do so, continually and as needed. Kaho'olawe is already a place imbued with **mana**, as are those who have been most effective in its conveyance and restoration. Prayers to strengthen **mana** (**pule ho'omanamana**) will be part of protocol.

Concept of dualism

Dualism is obvious in Hawaiian cultural practice, pairing land and sea, male and female, right and left, upright and prostrate, light and dark, etc. Many chants include litanies of minor dualisms: inside and out, north and south, sunrise and sunset, in addition to the major dualisms.

Although not a major aspect of restoration protocol, we expect that dualisms (e.g., roles of male and female participants, pairings in chant, or symbolic dualism in offerings and other aspects of protocol will be apparent in those developed for Kaho'olawe).

Gender-based division of labor

Related to dualisms based on gender is division of labor based on gender. Division of labor was based partially on the grounds of the prestige of work: Only men planted the noble **kalo**. Less prestigious crops such as ' **uala**, **ipu**, ' **uhi**, and **kō** were grown by both men and women. Gathering from the forest and the sea was for women because it was "beneath the dignity of men." (Handy et al. 1972). **Kapu** imposed on women involved many food items, and extended beyond consumption of the food to restrict handling or growing of those **kapu** items.

In Maori sweet potato planting, division of labor varied by tribe. Where women were excluded, it was stated to be because of danger of defilement resulting in an affront to **Rongo** (Best 1976). Similarly, in Hawai'i, restrictions were imposed on menstruating women against contact with gourd vines because the vine is **kinolau** of **Loño** (Handy & Handy 1991). Many such restrictions were integrated into the larger set of restrictions and regulatory rules imposed by the **kapu** system. In the time of **Ka'ahumanu**, most common Hawaiians readily gave up the most restrictive elements of the **kapu** system (Handy et al. 1972).

It is unlikely that many (if any) Hawaiians today would want to go back to the full set of dietary restrictions, the separate eating, etc., of the ancient ways, although many of those culturally active today readily comply with specific **kapu** imposed by their practices (e.g., in **hula**, etc.). To the extent that sexual division of labor is appropriate and

acceptable to participants in the Kaho'olawe effort, then it is recommended here, in order to remain consistent with traditional approaches.

Concept of multiple physical manifestation (kinolau)

Kinolau are multiple potential physical manifestations of **akua**. Handy wrote: "probably if we knew in its entirety the ancient Hawaiian teachings about nature and creation, it would be found that every natural phenomenon and form of life was thought to be the embodiment of a particular god or demigod." In Hawai'i alone among Polynesian societies was the concept of **kinolau** taken and developed into a major theological system.

Reestablishment of the full complement of **kinolau** that once were present on Kaho'olawe means ascertaining the fullest possible appropriate complement of living elements that were present. This effort corroborates those that seek to increase the native biological diversity of the island, but is limited by appropriateness (e.g., non-native species would not be among those **kinolau** that were once present). Existing plants and animals on the island will be recognized as **kinolau**, some of great significance to modern Hawaiians (e.g., the **pueo** population on island), and should not be treated "merely" as biological elements, but with appropriate cultural protocol.

The active role of man in nature

Man is more than observer in the growth and fertility of nature. There are examples of observances which limit human action or require him to engage in much effort to benefit nature. These were undertaken as ethical and natural obligations, man doing his part in a communal relationship with the natural world.

Obviously man labored to cultivate crops and feed his fish ponds and fishing grounds. In doing so, he engaged in spiritual practices assisting in the productivity of nature. Frequent prayers to appropriate **akua**, at every step of a process, was the rule. For example, in Kamakau (1964), there were prayers for the farmer involving making the digging stick, preparing an area for planting, actual planting, asking for rain, asking for fruit to develop, asking that the fruit be the correct size and shape, and finally, prayers of thanksgiving at the harvest.

Methods of communicating wishes to nature included 1) addressing the high gods directly (**E Kāne, e Lono, nā akua mahi'ai**), 2) addressing them via their **kinolau** forms (**E Lono-lau-ākea**), 3) addressing natural forms and processes directly (**E ka lā, e ola ia'u**). Review of surviving chants shows that it was much more often an address to gods or their **kinolau**, direct address of nature was relatively rare.

It is not the intent of this paper to provide for the details of the Hawaiian protocol appropriate for Kaho'olawe restoration. Chants appropriate for the various aspects of pro-

toloc are to be found in a broad set of sources, both traditional and contemporary. These can be applied to the restoration effort to help affect integration between the physical and spiritual aspects of the healing of the **kino** of **Kanaloa**.

Physical and spiritual nature of work

Beckwith (1940) noted that work was recognized to consist of a balance of two basic aspects: physical-labor, and spiritual work (worship).

It is important to point out the importance of spiritual work in the ancient context. Much attention and effort was made to make sure that activities conducted in Hawaiian society were conducted in the proper spiritual context. It was just as inappropriate to conduct physical labor on a day dedicated to spiritual labor as it would be to avoid physical labor on a day appropriate for such labor.

Work and training

Hawaiians of old were (and many still are) trained to be observational learners. One learns by watching a skillful person and emulating, rather than asking too many questions. (Pukui et al. 1972b). "**E pa'a ka waha, e hana me ka lima,**" (Keep the mouth closed, work with the hands) is a saying that exemplifies this approach.

Coordinators of Kaho'olawe efforts should be mindful of this approach when working to apply traditional knowledge and approaches. **Kūpuna** might not appreciate too many questions asked, and Hawaiians in training might be more observational than questioning, and appear on the surface less inquisitive and interested than they really are.

Hard labor was admired, laziness undesirable

In public works projects, chiefs who labored were admired. Kamehameha worked hard in fishpond work and in farming (Fornander, 1918-1919; Handy et al. 1972; Ii 1959; Kamakau 1972, 1976). Labor in projects for the community good was engaged in by ali'i and commoners. Chiefs worked with commoners in preparing new **kalo** patches (Kamakau 1976). If **'ōlelo no'eau** are any indication, laziness is undesirable. There are many admonishments against laziness in Puku'i (1983).

Moral conduct was important during work

Maintaining good moral conduct during work seems a broadly-established standard in Polynesia (e.g., there is a passage describing this idea amongst Maori (Best, 1976)). This extends beyond the worker, to his family. In Hawai'i - there are stories regarding the conduct of members of a fisherman's family, who should be on their best behavior when the husband is out fishing.

Those integrating Hawaiian practices on Kaho'olawe will no doubt make it explicit that successful efforts depend on an approach that is morally sound. Individuals will be

asked to keep to their best behavior, and to avoid the practice of any vices while on Kaho'olawe, or engaged in restoration work both on and off island.

The concept of aloha 'āina

A loving relationship with the land is evident from phrases from ancient sources, such as **Hi'iaka's** chant about Puna: "**O Puna 'āina aloha**" It is likewise reflected in the large number of place names that appear in poetical sayings and **'ōlelo no'eau**, celebrating the outstanding qualities and features of those lands.

Acknowledging that "**aloha 'āina**" received its first modern public expression via Hawaiians fighting for the return of the island (and hence the phrase carries its traditional politically activist connotations), it is time for further development of more intimate relationships with **wahi pana** and the living elements of Kaho'olawe to be developed by every participant in the restoration process, confirming Kaho'olawe as "**'āina aloha.**"

It should be reiterated here that the term "**aloha 'āina**" is not a recent one, and in historical accounts refers to patriotism and devotion to one's nation. Only in the last few decades has the term come to mean "love of land," and generally among those who do not speak Hawaiian, or those Hawaiians for which Kaho'olawe is indeed a patriotic cause. Thus, while Kaho'olawe may be **'āina aloha** for many people, their relationship to the land may not be best expressed as "**aloha 'āina,**" unless they intend a political and patriotic connotation.

Hawaiian environmental ethic

Given a conscious participating natural world related to the humans within it, the environment is expected to provide for and protect humans, but in a manner that is reciprocal. The environment serves man as commoners serve a chief. However, just as a chief can be deposed by those he/she rules, the natural world can punish and neglect humans if people do not perform according to their appropriate demands of a reciprocal relationship with the natural world.

Assessment of the equity of the relationship between land and people will be part of the responsibility of those who establish and organize the ongoing cultural protocols for Kaho'olawe. It will be a challenge to affect a balance between a variety of traditional and modern techniques in the ecological restoration of the island, and the framework of traditional protocols.

Concern for the future of resources

Conservation is not a concept foreign to Hawaiian culture. For example there is an admonition to replant when you harvest plants or animals from the wild (Pukui et al. 1972b). There also have been recordings of expressions of the concern for saving resources for future generations (perhaps in reaction to the perceived reduction of

resources). One example involves Kamehameha I, who saw men bringing down young sandalwood. He asked them why they were exploiting the young trees. They replied that he (Kamehameha) was old and that they didn't know who would succeed him. Kamehameha told them to think of the children, and that the young sandalwood belonged to them.

There is a similar story involving bird catchers. Kamehameha told them to take feathers and then let the birds go. The bird catchers didn't understand why they should do so (as the conventional practice was to collect not only the bright yellow feathers, but also other feathers for **ka-hili** and other feather work, and then eat the birds). Kamehameha told them that the birds were for the children. (Pogue 1978; Kamakau 1964).

In another example of Hawaiian conservation consciousness, there is the saying: **Haole kī kolea!** (Plover-shooting **haole!**), said in exasperation of a white person's wasteful ways. The **haole**, in going plover hunting, shoots with his gun, killing some, maiming others. The maimed can fly elsewhere to die or become victims of some other animal. But the Hawaiian goes quietly at night with a net. He takes what he wants and lets the others escape unharmed. (Pukui 1983)

Connection of forest with moisture

There is a traditional saying: **Hahai nō ka ua i ka ulu lā'au** (Rain always follow the forest). Clouds and rain were seen to form readily over forested slopes. Knowing this, Hawaiians hewed only the trees that were needed. (Pukui 1983)

Value of native forest, threatened by feral animals

Statements by John Papa I'i indicate that Hawaiians understood the value of the forest and the deleterious effects of alien animals: "The land was rich, and there were many trees in olden times.... ..there would be commercial wealth in the trees of these mountains if they were fenced off from animals. So it is with the planting places of every poor person. The person who manages these mountains and valleys could become prosperous." (Ii 1959)

Transmission of cultural knowledge

The sources of traditional beliefs and practices were in ancient times traditional knowledge embodied in stories, chants, riddles, and proverbs. Young people were presented with this oral information, as well as allowed to view and emulate practices.

It is apparent from the draft cultural protocols and cultural restoration plans for Kaho'olawe that the tradition of oral transmission and participatory learning will continue on Kaho'olawe. To the extent possible, these methods should continue to play a major role, augmented as necessary by western educational practice (e.g., lectures, written handouts, video, etc.).

Language recommendation

As a living, evolving language, Hawaiian language continues to incorporate terms from specialized fields in science, etc. We recommend specific development of the Hawaiian language with regards to biology and ecology as a way to facilitate integration of modern ecological concepts and restoration practices, so the Hawaiian culture can cope with, and grow into new technology and knowledge.

Summary of land management and planting practices and protocol

Lack of documentation for restoration

There is a large body of literature (reviewed in Handy et al. (1972) and others) that provides some very specific information on planting practices for a variety of food, fiber, etc. crops. There is some mention of the use of certain native species in forests, and assertion that although effect was small relative to modern changes, Hawaiians would have affected the lower forest zone directly via harvesting of woods, medicinal plants, etc., clearing for agricultural lands, and also via introduction of rats and pigs. Significantly, there was found no mention of restoration of agricultural lands to native forest.

Management of semi-wild ecosystems

Although there seems to be no record of native forest restoration in Hawaii, there are examples of managed, manipulated, but semi-wild ecosystems in ancient Hawai'i. Fish ponds are a good example of the alteration of a natural system to become an aquacultural system of different but native composition. The establishment of self-maintaining **mai'a** and **kalo** in the wet lowland valleys. **Olonā** groves, where wild patches were managed for production of **olonā** (Hiroa 1957). On cultivated lands the closest example of a managed forest ecosystem might be the zone in Kona that was dominated by breadfruit (described in Kelly 1983) and **pili** grasslands maintained by burning (Kirch 1982, Kelly 1983, McEldowney 1983).

Use of natural relationships and processes, especially those of nutrient enrichment of semi-natural settings is seen in the practice of putting fishes put into **kalo** fields, which provided nitrogenous fertilizer for the growing **kalo** plants (Kamakau 1976).

Translocation and supplementation of species

Translocation of species will be important on Kaho'olawe since Kaho'olawe has lost many of its original complement of plant and animal species. Documentation of traditional translocations include the original Polynesian introductions of plants such as **kalo**, **'ulu**, and **'ōhi'a 'ai** from the Eastern Polynesian homeland to Hawai'i (Wagner, et al. 1990). Dealing with marine ecosystems, it is noted that **limu** (algae) species were brought from Maui and Moloka'i, and planted at Queen Lili'uokalani's residence in Waikīkī (Abbott 1984). **Huluhuluwaena** in Kāneohe Bay

was supposedly transported there by a chief from Hawai'i (Fortner 1978). Augmentation of species (which differs from translocations only in that the species in question is already present at the site) to enhance a site was a traditional Hawaiian practice. In one obvious example, desirable fish fry were actively stocked in fish ponds, augmenting natural recruitment of fry.

On Kaho'olawe, it is reasonable and traditional to bring in a variety of appropriate plants and animals for the express purpose of restoring and enhancing ecosystems.

Ecological zonations recognized

Zonation on the side of a mountain with regards to natural vegetation and agricultural zones was well recognized (Agricultural zonation in described in Kona and Lapakahi studies, as well as in Handy et al. 1972). Finding the optimal agricultural zonation of cultigens must have taken a lot of experimentation over generations. Finding the optimal establishment zones for native species on Kaho'olawe has to proceed similarly, since we know very little of the original vegetation of the topside of the island. We only have reference ecosystems as models from adjacent islands. We know much more about what the coastal vegetation might have looked like through places that have never had ungulates such as 'Ale'ale and the islet of Pu'u koa'e.

With cultigens, it was recognized that different cultivars were better adapted to given environments. This contributed to a proliferation of cultivars in **kalo** (e.g., Whitney et al. 1937), as well as in **mai'a**, **'uala**, **'awa**, etc. Diversity in itself was probably also valued (Kepelino 1932). This pre-existing understanding can be extended to growing native species and experimenting with their proper distributions on Kaho'olawe.

Protocol of the planters (Mahi'ai)

Handy et al describes many details of the protocols of those who worked the land to provide sustenance and other resources. Some examples include the "Cult of Lono" in relation to **'uala** and **ipu** cultivation (and pig-raising), that of **Kāne** in relation to **kalo**, **kī** and **'ohe**, **Kanaloa** with **mai'a**, **Kū** with **niu** and **'ulu**, and as patron of fishing (via **Kū'ula**). There is discussion of **Kāne** and **Kanaloa**, and their joint association with springs of freshwater, and with **Lono** and rainfall.

To the extent that parts of Kaho'olawe will ultimately come under cultivation of food and other crops (e.g., **'uala** and **ipu**), we expect that protocol of the **mahi'ai** will be developed in areas of cultivation. We recommend setting aside at least some significant areas for cultivation of such crops, versus establishment of native vegetation.

Plants cultivated by a man are highly personal (e.g., Handy, et al. 1972). The firstborn of **Papa** and **Wākea** became **Hāloa** the **kalo** and sibling to man. "A man standing in the

midst of a taro plantation has a sense, not of a mass of vegetation as in a hay or grain field, but of individuals, for each plant stands out in its own right."

The plants placed into cultivation for Kaho'olawe, or planted in the ground on the island should be treated as individuals with a relationship to their planter, who should be involved to the extent possible in their ongoing care. Protocol and appropriate short chants encouraging the planted individuals should be developed and taught to the **mahi'ai**.

Seasonal planting/growing patterns

Understanding the natural cycles of weather and climate in Hawai'i, and in particular, on Maui and Kaho'olawe can greatly enhance the success of restoration efforts. Timing plantings with the coming of **Ho'oilō**, the Hawaiian wet season, is one obvious example. However, the sources consulted reveal very specific patterns on annual, lunar, and other cycles that helped the planter schedule his efforts.

Of the body of recorded knowledge regarding seasonality and growing patterns, we should look to those based on dryland (e.g., **'uala**) cultivation for guidance, rather than those related to wetland (e.g., **kalo**) cultivation.

Weather wisdom a major element

Intimate understanding of the signs in the heavens, currents, winds and sea, clouds, mists and atmospheric conditions. The quality of mind and sensory perception of those with perpetual rapport with nature from birth means that all natural features are alive with meaning impressed upon the conscious and unconscious mind.

It is unfortunate that for the most part there are no individuals who have had the opportunity in modern times to establish such a rapport. A long-term goal might be to re-establish via training such sensitivities in future Hawaiian individuals on Kaho'olawe (and indeed elsewhere). While modern meteorological tools and methods provide a powerful augmentation, there is much in the subtleties of the winds, clouds, and rains on Kaho'olawe that modern tools are not designed to detect or wield to the benefit of the restoration effort. Trained human observers of the portents of the weather may serve us better in some situations.

Attention to the seasons

The two-season year of the Hawaiian planter and the attention given to climate and other patterns within the main seasons determined the activities of planting and harvesting. **Kau wela**, "summer" the dry and hot months from roughly May (when the **Makali'i** set at sunrise), and **Ho'oilō**, "winter" the cooler, rainy months, beginning in roughly October, when the **Makali'i** rise at sunset. Handy et al. (1972) launch into a month-by-month description of the environmental conditions and corresponding activities of ancient Hawaiians (e.g., **'ikuwā** was the time for in-

door work, for the seas were too rough for fishing, and rain drove the agriculturalist indoors, thus for women weaving mats and baskets was the work, and for men, thatching, repairs of buildings, and fashioning of tools, weapons, and gourd containers).

There are seasonal patterns on Kaho'olawe that should not be ignored by those responsible for its restoration. While there may be no good detailed sources with regard to the seasonal climate patterns on the island, there is nothing to stop good empirical observation of those patterns, which can be incorporated into the restoration effort. Successful practices and lessons can be passed on via documentation of those practices developed by the modern planters of the island.

Significance of lunar timing for planting

Kepelino (1932) described each day of the lunar month, starting with **Hilo** (the first night after the new moon) and proceeding through each day. Most of the days are described as being good for planting, with certain days particularly good for certain kinds of crops. For example, the days of **Kāne** and **Lono** are both described as good for planting **'uala**. For some of the days identified as good for cultivation, the reasoning seems related to the name of the day. The day called **Hua**, for example, is described as good for cultivation because the word "hua" can mean "fruitful." In contrast, a few days are specifically identified as bad for cultivation, such as **'Olekūkahi**, **'Olekūlua**, **'Olekūkolu**, and **Lā'aukūkahi**.

Although perhaps it is not mandatory to follow the lunar planting prohibitions, it may nonetheless be advisable, as protocol is developed for plantings and cultivation on Kaho'olawe, to make note of the auspicious cultivating days of the Hawaiian lunar month as part of the context for protocol.

Protocol specific to key plant taxa

In Hawaiian horticultural practices, different species and varieties of cultivated plants received highly specific protocol related to planting, tending, harvesting, and post-harvest preparation.

Native trees

While there is no record of Hawaiians planting native trees for the purpose of reforestation or restoration of native vegetation, protocol has been recorded that indicates that native trees such as **koa**, **'ōhi'a**, and **lama** were not casually handled. Depending on the purpose of handling, protocol specific to major appropriate gods would be practiced (e.g., to **Kū** for **'ōhi'a**, to **Lea** for canoe trees, to **Laka** for **lama** dedicated to the **kuahu** (altar) of the **hālau** (hula school)).

For Kaho'olawe, developing practice and protocol for native trees should involve a combination of protocols adopted from those that exist for specific taxa (e.g., those

mentioned above), as well as those more generically appropriate for native trees.

Native shrubs/herbs/grasses

No sources deal with protocol specific to the planting of shrub and grass species, despite the importance of at least one native dryland grass (**pili**, *Heteropogon contortus*, used in thatching). We could not find specific protocol even for the picking of **pili** for thatching, although almost certainly such protocol existed. Similarly, many native shrubs were used for such purposes as **lei**, medicines, dyes, fiber, etc., but with the exception of **olonā**, which is the only endemic plant that was widely cultivated, the others were either harvested from preexisting wild populations, or planted opportunistically at house-sites.

Even if no specific record of such protocol has survived to the present, it would be appropriate to consider developing and practicing protocol relative to native shrubs and grasses, especially to those species of ethnobotanical significance.

Practice and protocol specific to key positions and activities

Choosing a site for restoration

Aside from the practical aspects of choice of a site for planting (good soil, appropriate moisture sources, etc.), we found no clear specific documentation for choice of a site for restoration or planting. However, one aspect of site choice did emerge, which sets a precedent for reliance of such decisions on land experts.

Traditional use of land experts

Kepelino (1932) described various stations in Hawaiian society (e.g., **mō'i**, **kuhinanui**, **kahuna**, **koa**, etc.) One in particular, the **kuhikuhipu'uone** (land experts) "understood the nature of the land, the things that grew on it, the character of the soil, whether productive or non-productive, the presence or absence of water, and so forth "

Thus the process of maintaining special advisors on the nature of the land and its character is appropriate for Kaho'olawe's restoration. It was a highly respected post among the high chief's retinue.

Preparing the ground

In preparing a site for planting, we found several items that warrant description, including some that are designed for use in very arid sites that would otherwise challenge the planter. These methods are described separately below.

Irrigation

There is a great deal of documentation of the well-known system of wetland kalo irrigation, but other systems for drier regions were also in use. Irrigation in the Waimea-

Lalamilo field complex was intermittent and supplementary - the diverting of runoff onto fields was used as surface water flow occurred (Kirch 1985). Such supplementary irrigation was used to produce a second crop of **'uala** in the course of a year (Handy & Handy 1991). Diverting flood waters of an intermittent stream in Kona has also been documented as a means of augmenting existing soil moisture. (Kirch 1985)

Soil retention

Terracing to retain soil and control irrigation is cited and described in many traditional and anthropological sources. Such terracing will be consistent with contour erosion control measures in the course of ordnance clean-up on Kaho'olawe.

Soil augmentation

On lava flows on the island of Hawai'i, soil was brought in to allow for cultivation. In Ke'anae on Maui, soil is said to have been brought in to create arable land (Handy & Handy 1991). Creation of and transportation of composted soil is talked about in article from the Kū'oko'a of March 24, 1922. (Handy & Handy 1991). Use of rotten **kukui** trees for making fertile soil for dry-land **kalo** was described by Handy & Handy (1991) and from Fornander (1919-1920). Another method of soil augmentation used composted **kukui** leaves (Handy & Handy 1991). Use of ferns and grass cuttings for fertilizer has also been described (Handy & Handy 1991). In Hāmākua, Hawai'i, the field was called **pākukui**, because the **kukui** tree was used to create and augment the soil. A **kukui** tree was cut down and the branches and leaves trimmed off; the pieces are allowed to decompose and become soil.

Making soil, and transporting soil to where there is none is very relevant to the soil-denuded portions of Kaho'olawe. We see that a variety of plant material and transported soils can be used to create and enrich soil conditions. **Kiawe** chipping and mulching is one obvious possibility, entirely consistent with traditional methods.

Mulching and Fertilizing

Fertilization of wetland **kalo** was accomplished by incorporation of vegetation into the mud (Handy & Handy 1991). There is no record of use of manure as fertilizer in traditional Hawaiian agriculture. We haven't yet seen a Hawaiian explanation of this, but it's probably the same reason that Maoris didn't use it. The European practice was abhorred by them; it was seen as being filthy and contaminating (Best 1976). Fields were covered with cut grass as moisture-retaining mulch in Kohala (Handy & Handy 1991). Mulch was used to retain soil moisture. It was moved aside when it rained, and moved back when rain ceased.

Burning of vegetation was used to clear land and fertilize it (via the ashes) in both **kalo** agriculture (Handy & Handy 1991), and for **'uala** (Handy & Handy 1991). Burning *Pandanus* branches was practiced to make soil fertile: (Handy & Handy 1991). Burning mulch was a way to fertilize soil (Handy & Handy 1991).

While mulching on Kaho'olawe seems appropriate practice, use of fire to fertilize the land should be conducted with great care (if at all), so we don't risk destroying the vegetation we are trying to restore. It may not be possible, except at small scale, to move mulching to take advantage of passing showers. The scale of the action is probably too great to apply effectively to the island.

The *kuaiwi* agricultural system of rock mulching

Morris Major (Bishop Museum's anthropology department) has done a great deal of research on the **kuaiwi** planting system, the best remaining examples of which are at the Amy Greenwell Botanical Gardens. **Kuaiwi** are long, low stone mounds, 1-3 feet high, 6-15 feet across, that run **mauka** to **makai** for several hundred yards to more than a mile in length (the longest known remnant of a single **kuaiwi** is above Kealakekua Bay, extending for more than one mile from 600' to 1,500' in elevation).

According to the journals of many early explorers and amateur botanists the **kuaiwi** were part of an integrated agricultural system in which **kī**, **kō**, gourds, **mai'a**, and in some cases even **'ulu** grew in the **kuaiwi**, and **kalo**, **'uala**, **wauke** and **'uhi** grew in the fields between **kuaiwi**. In addition to the Polynesian introductions planted in the **kuaiwi**, early records indicate the presence of ferns (which still proliferate along the **kuaiwi**) and "weeds," possibly native grasses and herbs growing in the **kuaiwi**.

Morris believes that the **kuaiwi** system was in use until about 1840 from at least Kealakekua to Kona. He attributes the decline of the **kuaiwi** to a sharp decline in the Hawaiian population, and the introduction of plantation style agriculture. This system is applicable to planting in a dry setting for several reasons:

- moisture - the **kuaiwi** are described as being very effective at catching morning dew (plants grow well in the **kuaiwi** even during Kona's dry season), and preventing evaporation after rainfall.
- mulch - the **kuaiwi** were constructed using "waste" rocks ranging in size from a pebble to the size of a fist, probably cleared from surrounding fields. In addition to this rock mulch, decaying vegetation from the plants and ferns growing in the **kuaiwi** would contribute nutrients and add to the topsoil beneath the **kuaiwi**. Studies done by Morris and

his counterparts found that in the areas between **kuaiwi** the topsoil ranged in depth from 6-10 inches, while underneath the **kuaiwi** the topsoil is almost 24 inches deep.

- model of the natural land features - the physical form of the **kuaiwi** reflects the **mauka-makai** flows of 'a'ā lava. One suggestion is that the early Hawaiians observed how well plants grew in older 'a'ā flows and how the rocky 'a'ā prevented evaporation and was effective at trapping soil.
- Maui example - **kuaiwi**-style agriculture may have been used in portions of lower Kaupō, Maui, judging from remnants of **kuaiwi**-like linear structures with the correct **ma uka - ma kai** orientation. Thus the practice might be adapted to Kaho'olawe not as a "Kona" practice with questionable connections to Kaho'olawe, but as a Maui practice with high likelihood of having been applied on Kaho'olawe.

Planting

Planting rituals and schedules

Specific actions/rituals were done for specific crops. (Covered in detail in Handy & Handy (1991)). For example, for **mai'a** one was supposed to act as if the banana sucker being planted is heavy (see below, from Kepelino 1932). The appropriate time of day for banana planting is when the sun is at the zenith and just about to descend, which is the time when the shadow is directly underneath one. If the banana is planted then, it will bear in a short time. If planted in the morning it takes a long time for the banana to grow before it bears any fruit. (Fornander 1916-1920) in preparing the sucker for planting, one would grasp the plant, lift it up, and exclaim in a boasting voice (**oli 'aiha'a**):

Ka mai'a nui e!
Ka mai'a nui e!
He 'umi eke ke hue
'A 'ole hiki ka 'ahui ke amo,
'Elua kanaka hiki ke amo,
Hiki inoino
 The great banana!
 The great banana!
 It will yield ten hands
 The bunch can not be carried
 It will take two men to carry it
 With difficulty.

For Kaho'olawe there will be cause to conform to ritual for cultivated plants such as banana, but the lack of similar rituals for native plants suggests that specific protocol will have to be created for such species, perhaps by adopting and adjusting protocol for cultivated taxa.

Propagation

Hawaiians used several methods of traditional propagation, including cuttings (**'awa**), seeds (**ipu**), offshoots (**mai'a**), layering, and tubers (**'uhi**). Specific methods for each propagation technique suggest that a long-standing set of empirical practices were handed down among planters. For example, planting **'uala** in drier, rocky places was called "**maka'ili**." There was very little soil proper, the greater portion of the field being gravel with rocks all around. There were large holes made, resembling banana holes. Upon sprouting of the **'uala** vines gravel and stones are piled up around them, and by the time the hole was covered thick with the growing leaves the tubers were large, somewhat tasteless, but edible (Fornander 1867).

For Kaho'olawe and native plant propagation, the recommendation is to take full advantage of existing propagation techniques and explore newer techniques. To do so would sit comfortably within the broad range of techniques traditionally described.

Enhancing growth or production

Traditional hand pollination

Meyen (1834) noted that in Honolulu a Hawaiian woman was pollinating flowers of **pua kala** in order to enhance seed production:

"We noticed an Indian [Hawaiian] woman standing in the midst of some of these plants, taking hold of flowers and using them for something; we went up to her and saw to our astonishment that she was cleverly spreading the pollen of a blossom upon its stigma. On our asking why she was doing it, she answered that it would make more seed grains come forth, which are used for eating there like we use our poppies"

The word for pollen in Hawaiian is **'ehu**, and Handy et al. (1972) suggest that the above account is evidence that Hawaiians understood the relationship of pollination to fertilization and seed set. Puku'i indicated she believed that what Meyen observed was an old Hawaiian practice.

In the restoration of Kaho'olawe it will be entirely appropriate and traditionally correct to engage in pollination practices in order to increase seed yield. Research on appropriate protocol and oli for this practice should be developed.

Weeding and Pest Control

Methods for weed and pest control in available sources was rarely specific, but mention was made of removal of plant weeds by burning (Handy & Handy 1991), by

manual removal, or with the aid of a shell (Handy & Handy 1991).

Rat control was important to Hawaiians, who recognized that rats could destroy crops or other important plants. The story of Pikoī the rat shooter (using a small bow and arrow) is an example (Pukui 1995). He is brought in to kill a rat that was eating up a garden of **'uala** (Pukui 1995). However, it remains unknown if rat control ever was attempted this way in common practice.

As to insect pests, there are traditional rituals used to curb the damage caused by caterpillars (usually native species of sphingid moths) on **'uala** (Handy & Pukui 1972). Hand-picking of the caterpillars off the plants and burning them is described as common practice among Maoris (Best 1976). One story from Ka'ū, Hawai'i describes a certain Hawaiian who did that, but the consequence was that he was killed by caterpillars, since Ka'ū was the home of **Kumuhea**, a deity for whom caterpillars were **kinolau** (Handy & Pukui 1972). Although Ka'ū Hawaiians were entreated to treat caterpillars with care (Handy & Pukui 1972), perhaps the story indicates that some Hawaiians practiced manual removal and burning of agricultural pests.

Predator control was practiced in fish ponds. Certainly the walls of the fishpond kept predators out (as well as desirable fish in), as only small fish could enter the **mākāhā** (fishpond sluice gate).

Disease control measures

Hawaiians appear to have been aware of the basic epidemiology of plant disease. Blighted **ipu** vines were burned to prevent further spread. Even for families related to **Lono** (and who thus held gourds as **kapu**) control of disease was practiced, not by burning, but by burying their infected vines (Handy & Handy 1991).

Harvesting

Restrictions on over-harvesting included general rules. For wild-collected plants the rule was: Take some, but leave some: don't take all. For those plants that could be propagated readily, the rule was to replant when you harvest wild items (Pukui et al. 1972). For **koa** trees - and medicinal materials - there are recorded rituals specific to harvesting activities.

On Kaho'olawe, harvesting conventions are not likely to be important for some time, however, such conventions will apply to those sites off-island providing for seeds or other propagules (cuttings, etc.). The conventions against over-harvesting, and adherence to appropriate protocol for harvesting are both recommended.

Other Practices and protocol appropriate for restoration

Protocol for growth/healing

There are a number of descriptions of protocol related to growth (**ho'oulu**) and healing (**ho'ōla**)

Imposing and lifting kapu

Imposing **kapu** on any of the plants and animals of Kaho'olawe in the course of restoration is entirely appropriate, allowing for restrictions on harvesting of any living things until it is appropriate to do so. To do so for the purpose of conservation and allowance of growth means that the **kapu** is imposed in the name of those deities to whom the request for assistance is given. We recommend that protocol for the imposition and lifting of **kapu** should be specifically developed for Kaho'olawe, using elements established in protocol dedicated to evocation of growth and healing.

Protocol appropriate for coordination of effort

Dealing with conflict and communication

Recognizing that complex societal rules and large community projects can lead to conflict, Hawaiian traditional practice includes protocol designed to set matters right (**ho'oponopono**). The process of **ho'oponopono** is described in Pukui et al. (1972). It involves both social and spiritual processes to remove hurt feelings, misunderstandings, and incorrect assumptions about the motives, thoughts, and actions of parties in conflict.

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On Kaho'olawe water, soil, and foliage is sparse. However, our ancestors offered practices appropriate in areas lacking streams and not having an abundant water supply.

From Hawai'i to Ni'ihau the soil and its character are not the same; they differ in one place from that of another. The nature of the lands is of two kinds, dry and wet; of soil and of rock, good and bad; and mountainous, abounding streams, valleys, hills and ridges. In Kohala, the grass was burned until the ground was cleared, then the ground was broken up with a spade and when the soil became softened it was thrown up, leaving a hole about one foot deep. The dirt was then broken fine and the **kalo** tops planted.

When the **kalo** tops take root, then the dirt is cleared away, again thrown up and the old leaves of the plant, two or three perhaps, are taken off, so that the **kalo** plant might flourish. This work is called “weeding” (olaulau). The **kalo** tops have several names:

Omu'omu'o	the bud stalk
Pu'u	seed kalo
Oha	the sprig or suckers
A'ae	the remaining shoot after the crop is pulled

The dry planting methods for **kalo** varies by place and condition. In dry, but forested regions such as in the **wao ma'ukele**, or **wao kanahele**, the mode of planting was called **ohiki**, in which the **kalo** tops were closely planted together; the leaves of the trees constituted the soil and mulching. In such places **kalo** was called **aka-ka**. In places grown over by fern or grass, **ohiki** (see above) was also the method of planting; but the **kalo** tops were planted in pairs and in triplets.

Ukumehame, a recollection of Kaho'olawe

Ukumehame, (literally, payment in mehame wood), is the first valley as the road comes off the **pali** heading towards Lahaina, Maui. It is a unique land area, where the mouth of the valley is just about a mile from the **kahakai**, coastal area. A large stretch of **ko** runs up to the **'aina pu'u**, or hilly places. The topmost peak of the Ukumehame is called Hōkū'ula, (the red star, Hawaiian name for the star Aldebaran) and below it, the hill in the valley center is Hōkū Wa'iki (the name for the smaller stars in the constellation of Taurus). From Haki'oawa bay, on Kaho'olawe, this valley is quite visible. (Ashdown 1970).

John Lake (1997) observed: “On the northern flanking wall of the valley [Ukumehame] is seen the outstretched wings of an **lo** (a hawk), etched as if carved by **kalai ki'i** (carver). What is unique about Ukumehame is that the water source is far up in the valley, and not readily accessible. There is a small “**auwai**” system that flows against the mountainside, where fresh **'opae** could be caught. However, by the late 1940's, Pioneer mill expanded their sugar fields and two **pūnāwai** were dug just at the crest of the hill to catch the little water flow. It is here that I experienced dry land cultivation of **'uala**, **mai'a**, papaya and dry land **kalo**. The land was cultivated by my grand-uncle Keoni Kini, uncle to my paternal grandmother. In a family chant, it embellishes the beauty of the valley and the natural environment, but illustrates the nature of

“stamping” the ground after stripping the dry leaves, and turning the soil,

Kupa 'ai 'o Kini i ka mala nui
He uala, ke kalo, me ka 'awe
Noho ana 'ia me ka heihei
Ke 'ike 'o Lāna'i i ka 'ilikai
 Kini tills his great garden
 Of **'uala, kalo** and the wild **kalo**
 Mounding and stamping,
 He looks out to see Lana'i in the sea
 Source: family chant collection, John K. Lake

Literature Cited

Abbott, I.A. 1984. *Limu: An Ethnobotanical Study of some Hawaiian Seaweeds*. Pacific Tropical Botanical Garden, Lawai, Kauai.

Abbott, I.A. 1992. *La'au Hawai'i: Traditional Hawaiian Uses of Plants*. Bishop Museum Press, Honolulu.

Apple, R.A. 1971. *The Hawaiian Thatched House*. Island Heritage, Honolulu.

Ashdown, I.M. 1970. *Ke Alalao o Maui Authentic History and Legends of the Valley Isle Told by Maui County's Historian Emeritus*. 80 pp. Published by Kama'aina Historians, Inc., Wailuku, Maui, HI.

Barrere, D. 1975. *Kamehameha in Kona Two Documentary Studies*. Bishop Museum Press, Honolulu.

Beckwith, M.W. 1940. *Hawaiian Mythology*. Yale University Press, New Haven.

Best, E. 1942. *Forest Lore of the Maori. The Polynesian Society* in collaboration with Dominion Museum, Wellington, New Zealand.

Best, E. 1976. *Maori Agriculture*. A.R. Shearer, Government Printer, New Zealand.

Center for Oral History. 1991. *'Ualapu'e, Moloka'i: Oral Histories from the East End*, Volume II. Social Science Research Institute, University of Hawai'i at Mānoa; and Department of Business, Economic Development and Tourism, State of Hawai'i, Honolulu.

Dudley, M.K. 1990. *A Hawaiian Nation I: Man, Gods, and Nature*. Na Kane O Ka Malo Press, Honolulu.

Emerson, J.S. 1918. *Selections from a Kahuna's Book of Prayers*. Hawaiian Historical Society Annual Report.

Emory, K.P. 1969. *The Island of Lana'i: A Survey of Native Culture*. Bernice P. Bishop Museum Bulletin 12. Bishop Museum Press, Honolulu.

- Fornander, A. 1916 - 1920. *Fornander Collection of Hawaiian Antiquities and Folk-lore* Volumes IV-VI. Bishop Museum Press, Honolulu.
- Fortner, H.J. 1978. *The Limu Eater*. University of Hawaii Sea Grant College Program, Honolulu.
- Gutmanis, J. 1983. *Na Pule Kahiko: Ancient Hawaiian Prayers*. Editions Limited, Honolulu.
- Handy, E.S.C., E.G. Handy & M.K. Pukui. 1972. *Native Planters in Old Hawaii: Their Life, Lore, and Environment*. Bishop Museum Press, Honolulu.
- Handy, E.S.C., & M.K. Pukui. 1972. *The Polynesian Family System in Ka'ū, Hawaii*. Rutland Charles E. Tuttle Company, Incorporated, Honolulu.
- Handy, E. S. C. & E. G. Handy. 1991. *Native Planters in Old Hawaii: Their Life, Lore, and Environment*. Bishop Museum Press, Honolulu.
- Hiroa, T.R. 1957. *Arts and Crafts of Hawaii*. Bernice P. Bishop Museum, Special Publication 45. Honolulu.
- Ii, J. 1959. *Fragments of Hawaiian History*. Bishop Museum Press, Honolulu.
- Kamakau, S.M. 1964. *The People of Old: Ka Po'e Kahiko*. Bishop Museum Press, Honolulu.
- Kamakau, S.M. 1976. *The Works of the People of Old Na Hana a ka Po'e Kahiko*. Bishop Museum Press, Honolulu.
- Kelly, M. 1983. *Nā Māla o Kona: Gardens of Kona. A History of Land Use in Kona, Hawaii*. Department of Anthropology/ Bernice Pauahi Bishop Museum, Honolulu.
- Kepelino, K. with M.W. Beckwith. (Eds.) 1932. *Kepelino's Traditions of Hawaii*. Bernice Pauahi Bishop Museum Bulletin 95, Honolulu.
- Kirch, P.V. 1985. *Feathered Gods and Fish hooks: An Introduction to Hawaiian Archaeology and Prehistory*. University of Hawaii Press, Honolulu.
- Lake, J.K., 1997 [personal communication, recording family farming practices in Ukumehame, Maui.]
- Malo, David. 1951. *Hawaiian Antiquities*. Bishop Museum Press, Honolulu.
- Meyen, F.J.F. 1834. *Reise um die Erde. 1830-1832*. [English translation of Chapter 12, Volume 2, by W.D. Alexander]. Manuscript in Bernice Pauahi Bishop Museum Library, Honolulu.
- Mitchell, D.D.K. 1982. *Resource Units in Hawaiian Culture*. The Kamehameha Schools Press, Honolulu.
- Pogue, J.F. 1978. *Moolelo of Ancient Hawaii*. Translated by Charles W. Kenn. Topgallant Publishing Co., LTD., Honolulu.
- Pukui, M.K. with L.C.S. Green. 1995. *Folk tales of Hawaii: He Mau Ka'ao Hawaii*. Bishop Museum Press, Honolulu.
- Pukui, M.K., C.A. Lee & E.W. Haertg. 1972. *Nānā i ke Kumu*. Queen Liliuokalani Children's Center, Honolulu.
- Pukui, M.K., C.A. Lee & E.W. Haertg. 1972. *Nānā i ke Kumu 2*. Hui Hanai auxiliary of the Queen Liliuokalani Children's Center, Honolulu.
- Pukui, M.K. 1983. *Olelo No'eau*. Bishop Museum Press, Honolulu.
- Titcomb, M. (with the collaboration of D.B. Fellows, M.K. Pukui & D.M. Devaney). 1979. *Native Use of Marine Invertebrates in Old Hawaii*. The University of Hawaii, Press, Honolulu.
- Tuggle, H.D. & P.B. Griffin. 1973. *Asian and Pacific Archaeology Series: Lapakahi, Hawaii*. No. 5. Social Science Research Institute, Honolulu.
- Valeri, V. 1985. *Kingship and Sacrifice Ritual and Society in Ancient Hawaii*. The University of Chicago Press, Chicago.
- Wagner, W.L., D.R. Herbst, & S.H. Sohmer. 1990. *Manual of the Flowering Plants of Hawaii* Volume I. Bishop Museum Press, Honolulu.
- Whitney, L.D., F.A.I. Bowers, & M. Takahashi. 1937. *Taro Varieties in Hawaii*. Hawaii Agricultural Experiment Station of the University of Hawaii, Bulletin 85.
- Wyban, C.A. 1992. *Tide and Current*. University of Hawaii Press, Honolulu.

Glossary of Hawaiian Words Used

'a'ā	Rough lava characterized by clinker and boulders	Kanaloa	One of the four major Hawaiian akua (q.v.), brother of Kāne (q.v.); associated with the ocean, 'awa (q.v.), certain agricultural crops, etc.
a'ae	Small kalo shoots remaining post-harvest	Kāne	One of the four major Hawaiian akua (q.v.), brother of Kanaloa (q.v.); associated with freshwater springs, 'awa (q.v.), healing, sunlight, etc.
'āina pu'u	Hilly land	kapu	Prohibitions imposed for spiritual or practical reasons
aka	Spiritual essence	kau wela	Season roughly corresponding to "summer" characterized by warmer temperatures (March-September)
akaka	Kalo growing in semi-wild forest zones	kī	Ti, <i>Cordyline fruticosa</i> , ancient introduction; grown for a variety of uses from thatching to healing, fiber to spiritual cleansing.
akua	Spiritual being (major or minor) [god]	kiawe	Mesquite, <i>Prosopis pallida</i> , recent introduction.
'aumakua	Ancestral spirit	kino	Body, physical form
auwai	Irrigation canal	kinolau	Multiple potential physical manifestations of an akua / 'aumakua
'awa	Kava, <i>Piper methysticum</i> , ancient introduction; grown for a relaxant drink extracted from its roots	kō	Sugar cane, <i>Saccharum officinarum</i> , ancient introduction.
hālau	Traditional school	koa	<i>Acacia koa</i> , endemic tree symbolic of strength and exalted prowess; a warrior
Hāloa	First kalo plant, elder sibling of man, born of Papa and Wākea (q.v.) and therefore given exalted elder status above human beings.	Kū	One of the four major akua (q.v.), associated with warfare, aggression, leadership, governance, persistence, upright things (hence trees and forest).
haole	Foreigner (originally not necessarily from outside of Hawai'i)	Kū'ula	Major subset of Kū gods evoked by fishermen.
Hilo	1st day in the lunar calendar	kuahu	Altar dedicated to akua or 'aumakua
ho'oilo	Season roughly corresponding to "winter" characterized by increased rain and cooler temperatures (October-February).	kuaiwi	Linear rock mounds used in drier regions to enhance plant growth
ho'ōla	To heal, bring life.	kuhikuhipu'uone	Kahuna (q.v.) specializing in land-use decisions
ho'omanamana	To increase mana	kuhinanui	Prime executive officer of the ruling Hawaiian king.
ho'oponopono	To set right human conflicts via expert mediation and communication of perceived wrong and necessary atonement	kukui	Candlenut tree, <i>Aleurites moluccana</i> , ancient introduction; uses including oil (and therefore light), medicine, dyes, ornamentation, etc.
ho'oulu	To cause growth, including intellectual or spiritual growth	kumu	Source, teacher, foundation
Hōkū'ula	Red star [Aldebaran]	Kumuheia	An akua or 'aumakua of the Ka'ū district of the Island of Hawai'i, one of whose kinolau (q.v.) is a caterpillar.
Hōkūwa'iki	Cluster of stars in constellation Taurus	kūpuna	Grandparent, elder, considered a source of wisdom and experience.
Hua	13th day in the lunar calendar; the moon is waxing, egg-shaped	Lā'au-kū-kahi	18th day of the Hawaiian lunar month
hula	Dance	Laka	Goddess associated with hula and forest (source of ornamentation for hula)
'ikuwā	Month marked by winter storms, raging seas, and the voices of the gods in the elements	lama	<i>Diospyros</i> spp., endemic tree, typically growing in lowland mesic and dry settings
ipu	Bottle gourd, <i>Lagenaria siceraria</i> , ancient introduction; dried fruit was an important receptacle and symbol of the major akua , Lono (q.v.)		
Ka'ahumanu	Favorite wife and kuhinanui (q.v.) of Kamehameha I		
kahakai	Seashore		
kahili	Feather standard symbolic of chiefly or high status		
kahuna	Priest, trained expert		
kalai ki'i	Carver of images		
kalo	Taro, <i>Colocasia esculenta</i> , ancient introduction; primary starch food in Hawai'i.		

Lea	Goddess of voyaging canoes, associated with forest source of canoe logs.	Papa	Earth-Mother in the Hawaiian creation tradition, gave birth to the islands as well as the ancestors of people.
limu	Seaweed (various species); also primitive land plants as mosses, liverworts, lichens, etc.	pili	<i>Hetropogon contortus</i> , indigenous grass, used as a primary thatching for traditional homes
Lono	One of four major Hawaiian akua (q.v.), associated with Ho'oilō , harvest, peace, fertility, winter rains, healing, games, etc.	pu'u	Seed kalo (also hill, bump)
ma kai	Toward the sea	pua kala	Hawaiian poppy, <i>Argemone glauca</i> , endemic
ma uka	Toward the uplands	pueo	Hawaiian owl, <i>Asio flammeus sandwichensis</i> ; considered an important kinolau of 'aumakua for many Hawaiian families
mahi'ai	Farmer	pule	Prayer
maka'ili	Rocky patches for growing 'uala (q.v.) or dry kalo (q.v.)	pūnā wai	Freshwater spring
mākāhā	Sluice gate for large aquacultural sea side ponds	'uala	Sweet potato, <i>Ipomoea batatas</i> , ancient introduction; an important food source in Hawai'i, but not as desired as kalo (q.v.); typically a crop of arable lands too dry for kalo agriculture.
Makali'i	Constellation Pleiades	'uhane	Spirit, ghost, soul.
mana	Spiritual power	'uhi	Yam, <i>Dioscorea alata</i> , ancient introduction; a food source in Hawai'i, but considered undesirable and used only in famine
mehame	<i>Antidesma</i> spp., endemic tree, whose wood was valued for a variety of uses	'ulu	Breadfruit, <i>Artocarpus altilis</i> , ancient introduction; a food source in Hawai'i, but not as important as kalo (q.v.)
mō'i	Ruler; high chief	'unihipili	Spirit of a dead person, sometimes associated with their bones, and sent on errands by praying over the bones.
niu	Coconut, <i>Cocos nucifera</i> , ancient introduction	wahi pana	Places famous in story or legend
'ohā	Sucker shoot from the mature corm of kalo (q.v.)	Wākea	Sky-Father in the Hawaiian creation tradition
'ohe	Bamboo, various species, ancient and recent introductions	wao akua	Realm of the gods (typically high elevation zones)
'ōhi'a	An endemic Hawaiian tree (<i>Metrosideros polymorpha</i>) symbolic of the major Hawaiian akua Kū (q.v.), with hard, durable, red-brown wood.	wao kanahēle	Forested region (general term)
'ōhi'a 'ai	<i>Syzygium malaccensis</i> , a fruit tree grown throughout Polynesia and introduced by Polynesians to Hawai'i.	wao ma'ukele	Wet forest region
ohiki	Planting of clusters of kalo in forested areas	wauke	Paper mulberry, <i>Broussonetia papyrifera</i> , ancient introduction.
olaulau	Removal of a few old leaves of newly planted kalo , to encourage new growth		
'Ole-kū -kahi	7th & 21st nights of the lunar calendar		
'Ole-kū -kolu	9th & 23rd nights of the lunar calendar		
'Ole-kū -lua	8th & 22nd nights of the lunar calendar		
'ōlelo no'eau	Wise or poetical saying		
oli	Chant		
oli 'aiha'a	Emphatic, bombastic chant style accompanying a bent style of dance		
olonā	<i>Touchardia latifolia</i> , endemic nettle, with extremely strong fibers, used for rope, fishing line, and many other cord age functions.		
'ōmu'omu'o	Kalo bud stalk		
pākukui	Use of kukui leaves to create compost soil on rocky land		
pali	Cliff		