Final Environmental Conditions Report

Unexploded Ordnance (UXO) Model Cleanup
Kaho'olawe Island, Hawaii

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TABLE OF CONTENTS
FOR THE
ENVIRONMENTAL CONDITIONS REPORT

1.0 GENERAL INTRODUCTION

Photographs of the archaeological, cultural, biological and environmental conditions of the work areas will be taken; before, during, and after all intrusive work being conducted on Kaho'olawe. These photographs will document the condition of the work areas and the effects of the Model UXO Cleanup upon the environment.

1.1 Purpose of Report

The purpose of this Model UXO Cleanup Project is to conduct an unexploded ordnance (UXO) cleanup of a limited area on the island of Kaho'olawe in order to model:

- UXO cleanup procedures and technologies
- Coordination of UXO clearance
- Cleanup and protection of historical, cultural, and religious (HCR) sites
- Environmental protection efforts in areas affected by UXO cleanup

The Memorandum of Understanding (MOU) between the U. S. Navy and the State of Hawaii provides for commencement of cleanup prior to completion of the land use plan, with the agreement of both parties. The areas included in the model cleanup will be those which the Navy and the Kaho'olawe Island Reserve Commission (KIRC) jointly choose. Generally, the areas are those visited by the Protect Kaho'olawe Ohana (PKO) during religious and cultural accesses. A primary purpose of the model is to reduce the risk of bodily harm posed by the potential presence of unexploded ordnance to those accessing the island for cultural and religious purposes. Additional areas may be proposed by either the KIRC or Navy for future inclusion by joint agreement.

The purpose of this report is to document the archaeological, cultural, biological and environmental conditions of the work areas of the Model UXO Cleanup Plan before any intrusive activities occur.

1.2 Philosophy

The philosophy behind the development of this plan is rooted in the National Historic Preservation Act of 1966, Executive Order No. 11593. During 1990, the United States Navy, Protect Kaho'olawe 'Ohana, and the County of Maui joined forces and moved forward to formalize a strategy for the environmental Protection and Cultural and National Resource Management of the Island's water and land areas. The philosophy behind the strategy focus on three main goals, removal of ordnance, preservation of cultural and religious areas combined with managed restoration and development of lands and education centers.

1.3 Authority

Section 110 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires Federal agencies to integrate preservation of significant historic properties into their plans, programs, and missions. To comply with this requirement, the U.S. Navy, in accordance with the Consent Decree

and Order field in United States Court, in Aluli et al. v. Brown et al., dated December 1, 1980; and Memorandum of Agreement for the Kaho'olawe Archaeological district dated July 20, 1981, and 36 CFR Part 66 has begun to document, preserve and integrate significant cultural and religious sites on the island.

Title X of the fiscal year 1994 Department of Defense Appropriations Act, Public Law 103-139, directed the Secretary of the Navy to convey the island of Kaho'olawe to the State of Hawaii and to conduct UXO removal and remediation of the island of Kaho'olawe. Memorandum of Understanding (MOU) between the United States Department of the Navy and the State of Hawaii concerning the island of Kaho'olawe, Hawaii as recorded with the State of Hawaii Bureau of Conveyances on 06 May 1994 as Document No. 94-075038 (MOU) in general describes a cleanup based on land uses identified by the Kaho'olawe Island Reserve Commission (KIRC) on behalf of the State. The MOU provides for commencement of cleanup prior to completion of a State land use plan with the agreement of the State of the Navy. At a public meeting of May 18, 1995, the KIRC. on behalf of the State voted unanimously to approve the Hakioawa Model UXO Cleanup Project as described in the 'Model UXO Clearance Project' proposal dated May 2, 1995. The Navy and KIRC have agreed to proceed with this model effort in a collaborative manner.

2.0 SETTING

Kaho'olawe is the smallest of the eight major islands in the Hawaiian chain, comprising 45 square miles (117 km^2), and representing only 0.7% of the total land area of the eight major Hawaiian Islands combined. It is located seven miles (11.2 km) southwest of Maui island. The highest point on the island is located in the east-central portion of the island about three-quarters of a kilometer west of Pu'u Moaulanui at an elevation of 1,482 feet (452 m) (Figure 1). The south and east coast areas are characterized by sheer cliffs of high as 300 to 800 feet (91 to 244 m) that are cut by a few steep-sided gulches. The west end slopes gradually toward the sea and contains a small number of shallow, intermittent stream beds. The northern coast, trending northeast to southwest, exhibits low cliffs interrupted by 15 major gulches and numerous smaller gullies. More than one-quarter of the island, in the area comprising most of the upper slopes of Lua Makika (east-central) and areas to the south and west, has been eroded down to saprolitic hardpan (Hommon 1983).

2.1 History of the Island

2.1.1 Pre-Contact Period

What is known of as the pre-contact period on Kaho'olawe is gleaned from archaeological data, extrapolations from what is known about the pre-contact period on other Hawaiian islands, and from mo'olelo (traditional Hawaiian oral lore). Most archaeologists presently agree that the Hawaiian Islands were settled approximate A.D. 500 by voyagers from eastern Polynesia. The Polynesian origin of the Hawaiian people is evidenced by their language, culture, social organization and technology. The original settlers brought with them domestic plants and animals, including sweet potatoes, taro, pigs, dogs and chickens. Fishing was of great importance on Kaho'olawe. Dryland agriculture was practiced on a small scale on inland slopes and coastal gulches.

Tied to the economic system was an important socioeconomic land unit called the ahupua'a, described by Kirch (1985:2) as follows:

> ...land use was linked to a tiered system of land divisions. Whole islands or parts of large islands constituted moku, independent chiefdoms, which were divided into a large number of radial land sections, ahupua'a. These generally ran from the forested uplands, across the agricultural lands, and out to the coast and sea, encompassing the resources of both land and ocean...Each ahupua'a was controlled by a lesser chief, who in turn appointed one or more stewards to oversee production, organize work parties, collect tribute, and in other ways represent the chief. Ahupua'a were economically self-sufficient to some degree, although differences in the local resource base (agricultural land, water resources, stone for tools, and so on) resulted in differences in the production patterns of individual land sections.

Kaho'olawe is thought to have been an ahupua'a of Maui and to have been divided into smaller sections called 'ili which were occupied and worked by commoners. The ahupua'a of Kaho'olawe was probably managed by a local chief representing a Maui district chief. Traditional accounts indicate the inhabitants of Kaho'olawe maintained close ties to Maui.

The essence of Hawaiian religion is related to forces in nature. Religion focused on various nature deities and ancestral spirits whose assistance and aid were sought through rituals including offerings and prayers. Temples, or large heiau, usually built on commanding sites were used for community ceremonies. For individuals or small groups, shrines were commonly used for religious purposes. Rituals were accompanied by an offering to enlist the deities' aid in an undertaking. Many shrines were fishing shrines, although household and occupational shrines were also used. Both heiau and shrines are found on Kaho'olawe. Traditional accounts indicate that Kaho'olawe was closely associated with several deities, including Kanaloa, the god of the ocean, the deep sea, and of navigation and carving.

A model of the pre-contact history of Kaho'olawe based on the location and dates of occupation of habitation features has been proposed (Hommon 1980b:[7]55-67). Beginning somewhere around A.D. 1000 the island was settled and small communities were established along the coast. In time, greater use of inland areas for cultivation of dryland crops and adz quarrying occurred and the original dry forest environment changed to an open savannah of grassland and trees as a result of vegetation clearance for firewood and agriculture (Spriggs 1991). Estimating the ancient population of Kaho'olawe is made difficult by the nature of research on the island. The maximum population was probably a few hundred. As many as 100 or more people may once have lived at Hakioawa, the largest settlement on the island. Located at the northeast end of the island and facing Maui, Hakioawa's size and location reflect Kaho'olawe's ties to that island.

2.1.2 Early Post-Contact Period

From 1779 to 1841 Kaho'olawe is described by various informants as having a small population, estimated at below 100, with fishing as the main economic activity (Silva 1983). Kaho'olawe was made a penal colony sometime around 1830 by Miriam Kekauluohi, the premier of Hawai'i under Kamehameha III. Men were sent to Kaho'olawe and women to Lana'i for such crimes as rebellion, theft, divorce, breaking marriage vows, murder, and prostitution (Kamaku 1961:356-357). Accounts suggest that food was scarce and trips to Maui were occasionally made for provisions. An informant of an island chronicler, Thomas Thrum (1902:121), stated that a small bay named Kaulana was the site of the penal colony. In 1853, the law which established Kaho'olawe as a penal colony was repealed.

2.1.3 Ranching Period

2.1.3.1 Early Ranching

From 1858 to 1910 Kaho'olawe was leased from the Hawaiian government from numerous ranching ventures, none of which proved successful. Sheep and cattle were introduced after a survey by the Hawaiian government in 1857 which favorably evaluated the island for stock raising. The number of sheep and wild goats (introduced prior to 1858) soon grew to be a problem despite efforts to control them, and as early as 1875 many parts of the island were denuded through overgrazing.

2.1.3.2 Forest Reserve

From 1910 to 1918 the Hawaiian Territorial government designated Kaho'olawe as a Forest Reserve in order to restore the island through revegetation and removal of all livestock. The program failed and leases again became available.

2.1.3.3 Late Ranching

From 1918 to 1941, Angus MacPhee leased the island (from 1920 in partnership with H.A. Baldwin), and endeavored to build a ranch operation. He made efforts to eradicate the goats and develop a permanent water supply. Ranch headquarters were at Kuhe'eia Bay. This period is described in detail by MacPhee's daughter (Ashdown 1979). In 1939, because of dry conditions and the wishes of the Navy to use a portion of the island for practice purposes, part of Kaho'olawe was subleased to the navy and the cattle were removed from the island. On December 8, 1941, with the commencement of WWII, the U.S. Army took over the entire island under authority of martial law and ranching operations ended.

2.1.4 Military Period

Kaho'olawe continued to be sublet to the Army until 1953 when Executive Order 10436 placed the island under the jurisdiction of the Secretary of the Navy for use by the Armed Services. The entire island was used as a target range from 1941 to 1968. In 1968 the target zone was modified to include

only the central one-third of the island (Figure 1). In 1976 (Marinco 1976:18) there were 17 air-to-surface targets, and 20 surface-to-surface targets. These targets varied in size from 6-foot rock pyramids to mock airfields and target areas covering several acres.

On October 22, 1990, under Presidential Memorandum by President George Bush, the Secretary of Defense was directed to discontinue use of Kaho'olawe as a weapons range and to establish a joint DOD-State of Hawaii commission to examine the future status of Kaho'olawe. This commission, known as the Kaho'olawe Island Conveyance Commission recommended in their final report to Congress on March 31, 1993 to return the island to the State of Hawaii, and for the United States to bear the cost and liability for the clearance and removal of UXO from the island. Under Title X of the 1994 Defense Appropriations Act, the Island of Kaho'olawe was designated to be conveyed to the State of Hawaii and the sum of $400 million dollars set aside to provide for the environmental restoration of the island. On May 7, 1994, title to the island was conveyed to the State at ceremonies conducted at Paluea Beach, Maui. Title was conveyed by the Honorable William Cassidy, Assistant Secretary of the Navy (C&R).

2.1.5 Climatic Change and Environmental Transformation

Kaho'olawe's history can be further illuminated in terms of the dramatic environmental transformation that has occurred over time. As initially postulated by Hommon (1980a) and refined by Rosendahl (1987) and Spriggs (1991), pre-contact settlement and use of Kaho'olawe probably transformed the environment from dry forest to primarily grasslands/shrub vegetation with substantially less forest cover.

Nineteenth century accounts indicate that the introduction of herbivores, at the time of western contact, resulted in rapid denuding of the island's vegetation. The environmental degradation reached a threshold in the middle/late 19th century resulting in catastrophic wind and water erosion which altered the face of the island. By the early 1900s ranch wells which had been potable became salty as the denuded island could no longer recharge the ground water basal lens. Feral goat and sheep populations grew (except for some eradication efforts during the Forest Reserve period and the MacPhee ranching period) until 1985 when the Navy instituted an aggressive eradication program. During the 1980s, programs of revegetation, soil conservation and tree planting were initiated by the Navy, the State, and the Protect Kaho'olawe 'Ohana to begin environmental restoration of the island.

2.1.6 A Native Hawaiian Perspective on Kaho'olawe's History

The following text was included at the request of the Protect Kaho'olawe 'Ohana. Its inclusion does not indicate Navy verification or confirmation of its contents. Navy archaeologists have been unable to find either oral or written support for some of the following assertions.

[The following section is abridged from McGregor 1993]

> According to Native Hawaiians the concept of *wahi pana*, or sacred place, is vital to the understanding of Kaho'olawe's history. The basis of this concept is the Hawaiian belief that,

'Other various forces of nature were Gods who formed the earth and imbued it with a dynamic life force and energy' (McGregor 1993:1). Hawaiian chants, creation myths, and oral tradition all indicate the significance of Kaho'olawe as a *wahi pana.*

Prior to western contact Kaho'olawe had other names such as *Kanaloa* (the name of the Hawaiian god of the ocean and guardian of navigation), *Kahiki Moe* (the place where the sun sets or goes to sleep, with *Kahiki* also being a metaphor for the original Polynesian homeland) and *Kohemalamamala O Kanaloa* ('Shining Birth Canal of Kanaloa,' referring to the importance of the island as a directional aid for the launching of the long voyages of Hawaii *ali'i,* or chiefs, between Hawai'i and Tahiti). These and other names reflect the importance of the island both as *wahi pana* and *pu'uhonua,* that is, a spiritual sanctuary and as a directional aid for voyagers.

Lae O Kealaikahiki ('Point of the Pathway to Tahiti'), the name for the westernmost point of land, was used as a landmark for navigators as they left Hawai'i. Also near this area is a rock referred to as *Pohaku Kuhi Ke'a I Kahiki* ('The Rock That Points the Way to Tahiti'), which was another key traditional navigation marker. At Moa'ulaiki there are the remains of a platform used for navigational school and of a housesite for the *kahuna,* or specialist, who instructed the students. The presence of a large number of *ko'a,* fishing shrine, on Kaho'olawe reflects the fact that fishing resources are varied and plentiful. These *ko'a* served as land markers for ocean fishing grounds and thus constitute yet another type of navigational aid. One of the most important cultural resources on Kaho'olawe is a *ko'a* at Hakioawa on the island's eastern cost, which according to legend was constructed by 'Ai'ai, son of Ku'ula, the patron god of fisherman.

By A.D. 1400 the interior of Kaho'olawe began to be used for agriculture, and this was the time, also for the initial development of the Pu'u Moiwi adze quarry, the second largest quarry in the Hawaiian Islands. By the middle of the 17th century a large settlement developed at Hakioawa, which grew to become the island's political and religious center. The island's largest known *heiau* is located at Hakioawa, and was probably constructed during this period. From the early post-contact period, despite the abolishment of chiefly and state rituals by Kamehameha II, traditional Hawaiian religious practices and spiritual beliefs continued on Kaho'olawe and its use as *wahi pana* persisted, up to the U.S. military take over of the island in 1941. After 1941, in spite of the military restriction for access to Kaho'olawe, several Native Hawaiian families managed to occasionally visit the island. In 1976 the Protect Kaho'olawe 'Ohana focused public awareness on the problem of access to the island. Since that time the 'Ohana has regularly visited the island for religious and cultural purposes and, as stated in the 1993 Kaho'olawe Island Conveyance Commission report, Kaho'olawe '...continues to be a *wahi pana* and serves as a *pu'uhonua* as it has for generations of Native Hawaiians and others who have visited its shores, lived upon its lands, and fished in its surrounding water.'

2.2 Climate

Kaho'olawe, because of its position in the lee of Mount Haleakala, Maui, only receives an average rainfall of about 10 to 25 inches per year, with most rainfall occurring between November and April,

when southern (Kona) storms prevail. There is no reliable source of potable water on Kaho'olawe, although rainfall catchment areas exist (Takasaki:1991). Streamflow is intermittent and occurs following rains. The estimated annual temperatures range varies less than 5¡C (9¡F) from about 21-26¡C (70-79¡F) at sea level with a 2.5¡C (4.4¡F) lower average temperature at the higher elevations of Lua Makika (Hommon 1980b:[7]7).

2.3 Geological and Soil

2.3.1 Geology

Kaho'olawe is a single shield volcano with a three-mile diameter caldera located on the eastern edge of the island. Volcanic actions along a rift zone extending from west-southwest and east and north have capped the caldera and built the shield. Along the western portion of the rift zone Pu'u Moiwi remains as an old cinder cone and Lua Kealialalo is the result of a collapsed crater. The north rift zone is indicated by a bulge in the northern portion of the island and contains Lua Kealialuna, a cinder cone, and Lua Makika, the eroded crater of a lava shield covering an area of 10 square miles. The east rift zone is marked by 40 dikes in the sea cliff and has little topographic expression (EIS 1979:2-1).

2.3.2 Soil

Kaho'olawe's soils are derived from Hawaiian basalt and are typical of the soils found on other Hawaiian islands. Soil erosion, by wind and water, is the major environmental destabilization process affecting Kaho'olawe. It has been estimated that in recent times more than 1,880,000 tons of soil are being lost each year as a result of erosion (DLNR 1990). It has been found that the hydraulic properties of the soil on Kaho'olawe vary greatly, even within small areas. As expected, land cover seems to be highly significant in determining the rate of water movement into the soil, with vegetated soils allowing water infiltration at much higher rates. The first known mention of erosional problems appeared in *Hawaiian Gazette* in 1881, which attributed the problem to grazing by goats and sheep, primarily on the island's plateau. Shortly after the turn of the century, this inland plateau had eroded to hardpan, a condition that has remained fairly stable since the 1930s. The environmental impacts from this erosion include both loss of soil and the resulting degradation of plant and animal habitats on the island and the surrounding waters.

The major coastal areas impacted by erosion lie between Lae Paki and Wa'aiki Point, with Ahupu Bay having the highest percentage of silt in the offshore sediments and the least amount of coral growth. It is estimated that much of the island's top layer of soil has eroded. This stripping averages about five feet, but has been as much as eight feet (Stearns, 1940). Much of the eastern end of Kaho'olawe is eroded to a point where only hardpan remains.

3.0 CULTURAL RESOURCES

The necessity to identify, record and protect the cultural treasure of this unique island remains in the forefront of this proposal. Consideration is given to the importance of this island in its role in the

revitalization of the Hawaiian culture and its planned future in the Hawaiian Sovereignty Movement.

On March 18, 1981, the entire island of Kaho'olawe was placed on the National Register of Historic Places because of its archaeological, cultural, and historic significance. It is the only entire island currently on the Register. Kaho'olawe's numerous unique and significant items include the well preserved remains of settlements, religious and burial sites, Petroglyph, numerous fishing shrines, and the states second largest ancient Hawaiian stone tool quarry site.

Many of Kaho'olawe's archaeological and historic resources are unique. No other island has a comparable array of intact fishing shrines. Further, because the island has not undergone the kind of development found on its neighboring island, most of the remains of ancient Hawaiian settlements are intact and discernible. Finally, Kaho'olawe has passed through a number of distinct historical periods, beginning in the late 18th century. There are distinct remains and remnants from these periods still on the island, including: a possible mission school, the records for which extend back to 1828; a penal colony operated at Kaulana Bay from 1826 to 1853; sheep ranching which had structures located at Honokoa, Ahupu, and Kuheia Bays beginning as early as 1858 and continuing through 1909; cattle ranching which began in earnest in 1918 and continued until 1941; military activities which began in the late 1920's and continue to 1990.

Kaho'olawe is also of great significance to native Hawaiians and others who, in addition to acknowledging its importance in yielding data regarding Hawaiian cultural heritage, consider it of significance as a symbol of cultural survival and regeneration. It is considered by some to be a *wahi pana* - a sacred place- to be used for education, awareness, and experience in Hawaiian cultural, as a place to carry on traditional customs and practices, and as a *pu'uhonua* - a place of refuge and spiritual regeneration. Kaho'olawe is also viewed as a place to practice and advocate *Aloha 'Aina*, which is described by the Protect Kaho'olawe 'Ohana ('Ohana) (n.d.) as follows:

> Aloha 'Aina is a traditional concept that lays the foundation for Hawaiian religion, culture and lifestyle. Aloha means love, and 'aina means land. The two words together express several levels of meaning. At the deepest level the presence of our ancestors and gods of the land are acknowledged, respected and cherished, through ceremonies both public and private. This intimacy with the 'aina is also expressed in the interdependent subsistence relationship between man and his island. Man is nurtured with taro from the land and fish from the sea, and in turn cultivates and nourishes the island. This relationship is finally symbolized by pride in our homeland - patriotism for this land Hawaii.

3.1 Prehistoric Resources

Archaeological investigations on Kaho'olawe have shown that a variety of site types and features exist on the island. Archaeological sites and features are defined as follows:

> SITE: A location with remains of human activity such as artifacts, food remains, stone debris, and/or architectural structures.

FEATURE: A discrete area within a site such a stone platform, scatter of artifacts and food remains, or an isolated fire pit.

On Kaho'olawe many archaeological sites are multi-purposed, that is, they contain several features, each of which may have a different use. Therefore, archaeological features are regarded as the basic unit for recording and analysis, and each site has been recorded noting each feature and designating them individually.

Most of the features recorded on the island are classified as 'habitation features' which are areas of general residential activities such as food preparation, and manufacture of tools and graft items. They fall into two categories - those with visible structure and those without structure.

- Habitation Structures - Habitation structures include stone platforms, terraces, enclosures, open-sided enclosures, paving, etc. All structures are of mortarless masonry construction. The building stones are usually locally available basalt, although coral and beach-rock conglomerate were sometimes used. Most habitation structures probably served as foundations for perishable structures of pole and thatch.

- Habitation Features Without Structures - These include activity areas, midden scatters and deposits, rock shelters, habitation caves, and fire places. Activity areas contain such thing as concentrations of artifacts, stone alignments, erosionally lagged clusters of fire-cracked rocks, etc. They are usually found on the surface in flat or gently sloping areas. A midden (refuse) scatter is an area with artifacts and /or midden distributed on the surface with no evidence of significant sub-surface deposits. Unlike activity areas, midden scatters are not concentrated and have ill-defined boundaries. Midden deposits are subsurface cultural remains and usually cannot be seen except along erosional faces. Rock shelters and habitation caves are protected areas that contain archaeological materials. A fire pit place is a concentration of charcoal usually surrounded by a rock alignment.

- Religious features - Among Kaho'olawe archaeological features believed to have functioned in a religious context are *ko'a* or fishing shrines, inland shrines, and *heiau*.

  Ko'a - These are enclosures and terraces associated with concentrations of unworked coral, either irregular chunks or branch coral or water-worn coral cobbles. Most Kaho'olawe *ko'a* are within 100 meters of the shore. Usually present at most *ko'a* is at least one water-worn stone, some 30 centimeters to 1 meter in length which was originally in an upright position. Each *ko'a* around the island marks a separate fishing ground.

  Inland Shrines - On Kaho'olawe fifteen structure located outside the coastal zone were found to contain quantities of unworked branch coral. On the assumption that the presence of such coral was a symbol of sanctity wherever it occurred, these structures

are referred to as 'inland shrines.'

Heiau- Three structures in the Hakioawa district on the northeast shore have been tentatively identified as *heiau*. In general throughout the Hawaiian Islands, these sites are usually large, complex stone structures that consist of at least one platform and/or at least one enclosure. Upon these stone foundations a variety of superstructures were contracted of perishable materials within and around which ceremonies took place.

- Economic features - Thirty-two archaeological features on Kaho'olawe are classified as lithic quarries and workshops. Fourteen of these features are termed basalt adze quarries and workshops, consisting of large flakes and adze preforms, as well as outcrops and boulders of the basalt source material. The remaining economic features contain basaltic glass flakes and cores and evidently functioned as workshops for the production of cutting tools of basaltic glass.

- Miscellaneous features - Petroglyph depicting human figures, animals, and geometric forms were found in 24 features. More than 515 individual Petroglyph have been found on boulders and bedrock faces near the coast and at one feature in the inland zone. Other features are termed 'mounds' and include a variety of cairns and piles of stones. Burial and burial caves are also found on Kaho'olawe.

3.2 Historic Resources

Fifty-six historic features have been identified on Kaho'olawe. Most of the historic features are located in the Coastal Zone and are associated with the island's ranching period. The area within the greatest concentration of historic features is the old ranching headquarters at Kuheia Bay. This site (175) was mapped in 1983 and the features located include enclosures, house sites, concrete and cobble fireplace remains, structures for water catchment and storage, roads and platforms. Another small site (178) near the mouth of Kaulana Gulch may contain the remains of occupation by inmates of the penal colony.

3.3 Traditional Cultural Resources

The significance of Kaho'olawe as a *wahi pana* (sacred place) and *pu'uhonua* (place of refuge) and cultural learning center is discussed above. The island thus represents an embodiment of traditional cultural values, and specific goals have been set forth by native Hawaiian groups regarding identification and preservation of the cultural resources which are manifestations of these cultural values. These goals include planning a historic, cultural and living sanctuary; finding, recording and restoring Kaho'olawe's historic sites, educating the public about the abundance of historic information and restoring Kaho'olawe's historic sites and establishing a natural marine and land reserve.

3.4 Potential Cultural Resources

Although Kaho'olawe has been intensively surveyed for archaeological resources, area of potential

archaeological site discovery exist on the island. These areas are located in portions of the island, especially the Inland Zone, that have large grassy areas. If these grassy areas are located on old soils (not newly deposited erosional soil), they could contain subsurface archaeological deposits or cultural resources not easily visible in the heavy grass. It is important for Kaho'olawe users to be aware of these areas in order to avoid damage or destruction of presently unidentified archaeological resources.

4.0 BIOTIC RESOURCES

Kaho'olawe's biotic environment is an extremely fragile resource that could be severely impacted by the remediation process. Prior to disturbing vegetation a pre-approval for cutting, cropping or for digging must be obtained for each area selected for UXO removal. Due care must be take to protect and minimize intrusion to the unique and endangered marine wildlife that utilizes the beaches and near shore water while conducting UXO sweeping, removal and disposal.

Over 95% of the island's vegetation falls into two types: the Hardpan Desert Vegetation and the *Prosopis* (Kiawe) scrub-forest (Lamoureux 1970). These are described by Ahlo and Hommon (1980:7) as follows:

> Hardpan Desert Vegetation is characterized by widely spaced Australian Salt bushes (*Atriplex semibaccata*) and tree tobacco (*Nicotiana glauca*). Pillars of uneroded soil (hummocks) are commonly crowned with grasses and herbs but comprise only a small portion of the total area within the hardpan desert. Generally the hardpan desert is extremely barren.
>
> The second major vegetation zone on the island is the Prosopis scrub-forest. Kiawe (*Prosopis pallida*) forms the dominant vegetation within this zone. The Prosopis scrub-forest surrounds the hardpan desert vegetation zone. In many gulches Kiawe forms a closed canopy forest with trees ranging from 4 to 10 meters in height. On more exposed locations the trees are more sparsely distributed, smaller and may be shaped by the prevailing winds. Other less common plants in this zone are *Leucaena leucoccephala* (koa-haole), *Acacia farnensiana* (klu), a few clusters of the indigenous *Erythrina sandwicensis* (wili wili), and *Lantana camara*. The remainder of the island is composed of various grass and shrub species of limited distribution.

A botanical survey on Kaho'olawe by Corn, et al. (1980) identified 146 plant species. Of these, 102 are listed as exotic, i.e., introduced following European contact, 42 as native to the Hawaiian Islands or introduced prior to European contact in 1778, and two as unknown. Also of interest is a stand of native cotton, *ma'o* (*Gossipy sandvicense*) located within the coastal dry shrubland on the west end of the island (Office of State Planning 1993: Figure 5).

In addition to over 17 species of birds which reside on or frequent Kaho'olawe, four mammal species are common on the island: *Rattus rattus* (black rat), *Rattus exulans* (Polynesian rat), *Mus musculus* (house mouse), *Felis catus* (domestic cat: feral). *Capra hircus* (goat) was once common but under an intensive Navy goat eradication program, the goat population has been eliminated. Dogs, pigs and chickens the three Hawaiian domestic species, were probably present on the island prior to Western

contact (Ahlo and Hommon:1980). Remains of *nene*, dark-rumped Petrel, Bulwer's Petrel, White-tailed Tropicbird and the Hawaiian owl (*Pueo*) were also identified in archaeological deposits (Rosendahl 1987:V-75). Cows, sheep, mules, horses and dogs were all present on the island at various times after contact, although none remain on the island today. Ungulate browsing contributed significantly to environmental degradation on the island during the last 150 years.

4.1 Native Flora

[As noted in *Kaho'olawe Island: Restoring a Cultural Treasure:*]

> Kaho'olawe's earliest vegetation seems to have been characterized by a lowland dry shrub land community, probably with a few widely scattered larger shrubs or small tress. Late in prehistory, or, perhaps, early in the historic period after 1778, the shrub land was replaced largely by a grassland community as a result of anthropogenic (human) burning. This condition has quickly transformed Kaho'olawe into its present-day appearance, characterized by a greatly reduced grasslands community and a largely barren wasteland on the inland plate resulting from ungulate grazing.

More than 80 percent of the land on Kaho'olawe is characterized by hardpan, barren soil, and/or alien vegetation. The small remaining area of the island, mostly in the western coastal areas, contain most of the native vegetation.

Thirteen rare plants and a new genus were recorded in a 1992 flora and fauna survey of Kaho'olawe conducted by The Nature Conservancy of Hawai'i. these are as follows:

Scientific Name	**Hawaiian Name**
Kanaloa Kahoolawensis	Palupalu o Kanaloa
Ophioglossum concinnum	Pololei
Liphochaeta byanii	Nehe
Lepidium bidentatum var. o-waihiense	'Anaunau, naunau, kunana
Capparis sandwichiana	Pua pilo, maiapilo
Chamaesyce skottsbergii var.vaccinioides	'Akoko, koko, kokomalei
Fabaceae sp. nov.	
Sesbania tomentosa	'Ohai
Vigna o-wahuensis	
Hibiscus brackenridgeii ssp. brackenridgeii	Ma'o hau hele
Portulaca molokiniensis	'Ihi
Portulaca villosa	'Ihi
Gouania hillebrandii	
Neraudia sericea	Ma'aloa, ma'oloa, 'oloa

There are five distinctive native terrestrial communities that have been identified on Kaho'olawe by the Hawai'i Heritage Program of The Nature conservancy of Hawai'i. These are the 'Aki'aki Coastal

Dry Grassland, the Hawaiian Mixed Shrub Coastal Dry Cliff, the 'Ilima Coastal Dry Shrubland, the Ma'o Coastal Dry Shrubland, and the Pili Lowland Dry Grassland which are described in the following paragraphs.

For the most part, the 'aki'aki grasslands on Kaho'olawe are simple covers of 'aki'aki (*Sporobolus virginicus*) on loose dunes. These grasslands typically merge with 'ilima (*Sida fallax*) and ma'o (*Gossipy tomentosum*) shrublands or kiawe (*Prosopis pallida*) forests. A few 'aki'aki grasslands occur on the western lowlands of Kaho'olawe between Honokanaia and Lae Paki. This coastal strand community is found in many places throughout the Hawaiian island chain and is not considered rare. The plants of this community are salt-tolerant and include the beach morning glory (*Ipomea pescaprae ssp. brasiliensis*), nohu (*Tribulus cistoides*), and 'ohelo kai (*Lycium sandwicense*).

A particularly unique example of the Hawaiian Mixed Shrub Coastal Dry Cliff community is found on Kaho'olawe's wave-cut stack, 'Ale'ale, located along the southern shore. This 'Ale'ale community is dominated by the rare 'ihi (*Portulaca molokiniensis*), but in some sections, kawelu bunchgrass (*Eragrostis atropioides*) and kolomana (*Senna gaudichaudii*) shrubs were more abundant. Also found were 'akoko (*Chamaesyce celastroides var. amplectens*), *Mariscus phleoides*, 'uhaloa (*Waltheria indica*), ko'oko'olau (*Bidens mauiensis*), nehe (*Lipochaeta lavarum*), the grass *Panicum fauriei var. latius*, 'ilima, the dryland fern *Doryopteris decipiens*, another rare species of 'ihi (*P. villosa*), the rare pua pilo (*Capparis sandwichiana*), and a newly discovered genus given the name 'Ka Palupalu o Kanaloa' (*Kanaloa kahoolawensis*). Several other islands in Hawai'i have this coastal shrub community.

On Kaho'olawe, patches of the 'Ilima Coastal Dry Shrubland community consist of strands of 'ilima, ma'o, *Abutilon incanum*, 'uhaloa, pili grass (*Heteropogon contortus*), kiawe, and Natal redtop (*Rhynchelytrum repens*). These shrublands are commonly found adjacent to Ma'o Coastal Dry Shrublands, 'Aki'aki Coastal Dry Grasslands, Pili Lowland Dry Grasslands, and alien kiawe forests. This community is found in lowland areas on several islands and is, therefore, not considered rare.

Kaho'olawe is one of the better, if not the best, ma'o community in the state. Ma'o or Hawaiian cotton shrubland is considered rare and extremely unstable and is only found on the islands of Moloka'i, Lana'i, and Kaho'olawe. These communities are located in very dry areas with shallow weathered clay soil. Besides the ma'o, other plants of this community are the 'ilima, *Abutilon incanum*, 'uhaloa, nehe, pili grass, and panic grasses (*Panicum spp.*). On Kaho'olawe, remnants of this shrubland can be found on the west coast and lowlands such as Honokanaia.

On Kaho'olawe, the Pili Lowland Dry Grasslands are located on both the northwest and southwest slopes between sea level and the 600 foot elevation. Kiawe and/or wiliwili trees are occasionally found in the grasslands, and depending upon elevation, plants such as 'a'ali'i (*Dodonaea viscosa*), 'ilima, ma'o, pa'u o Hi'iaka (*Jacquemontia ovalifolia ssp. sandwicensis*), and 'uhaloa may be interspersed. One rare vine, *Vigna o-wahuensis*, was found in pili grasslands on Kaho'olawe in the latest Hawai'i Heritage Program survey.

Other alien plants that can be found in this community include sweet acacia (*Acacia farnesiana*), *Lantana camara*, pualele (*Emilia fosgergii*), buffel and other grasses. Overall, most of the known rare plant populations of Kaho'olawe are located on the southern and eastern seacliffs; the most significant location being 'Ale'ale.

The introduced alien species of flora present a challenge in the restoration of the island's natural resources as they are more aggressive and faster growing than native plants. The kiawe, especially, with its deep tap roots, consumes ground water needed for the native plant species.

4.2 Native Fauna

A unique assemblage of native animals exists in Hawai'i. Most of these animals are endemic, occurring nowhere else in the world. Because of Hawai'i's isolated mid-Pacific location and relatively small size, the assemblage of native animal taxa is a result of only a few colonization.

In the Hawaiian archipelago, geology and climate have acted together to create many different habitats. Early arriving species (such as forest birds, insects, and land snails) were able to take advantage of and adapt to these unique habitats. The resulting existing endemic species consist of one land mammal, one marine mammal, 49 birds, hundreds of land snails, and thousands of insects and other terrestrial invertebrates.

Since humans have arrived, they have modified habitat and introduced numerous non-native species that have been very successful in out-competing the native species. The result has been that many of the original animal species have gone extinct, and many of the remaining endemic populations are now considered rare and in danger of extinction.

Little is known about the prehuman native Hawaiian fauna of Kaho'olawe Island because of the rapid rate at which ecological changes and extinction took place, and many of the changes occurred before any detailed biological explorations were undertaken.

Nevertheless, the rocky cliffs, beaches, and surrounding waters of Kaho'olawe continue to provide habitat for native Hawaiian animals including seabirds, sea turtles, and marine mammals. Native Hawaiian aquatic invertebrates occupy the high salinity anchialine pool at Sailor's Hat. The forested areas of Kaho'olawe, although greatly altered, probably contain small isolated populations of native Hawaiian land snails and other native Hawaiian invertebrates. One native Hawaiian land bird, the pueo, (*Asio flammeus sanwichensis*), still survives on the island. Hawai'i's only native terrestrial mammal, the rare Hawaiian hoary bat (*Lasiuru cinereus semotus*), has also been recently recorded from Kaho'olawe.

It is noteworthy that bones of both nene (*Nesochen sanvicensis*) and the band-rumped storm petrel (*Oceanodroma castro*) have been discovered on Kaho'olawe, although neither species has been reported alive from the island. The endemic nene is Hawai'i's state bird. The species is listed as endangered by the U.S. Fish and Wildlife Service (1991) and by the Hawai'i Department of Land and Natural Resources (1990). The indigenous band-rumped storm-petrel is listed as endangered by the

Hawai'i Department of Land and Natural Resources (1990). With proper management of Kaho'olawe's natural resources, these birds may eventually recolonize Kaho'olawe Island.

Important areas for native fauna on Kaho'olawe are at Honokanaia, Kuheia, lae o Kuikui, and Hakioawa. In these areas, the threatened honu (green sea turtle, *Chelonia mydas*), the endangered 'ilio hono I ka uaua (Hawaiian monk seal, *Monachu schauinslandi*), and the endangered 'ope'ape'a in the uplands. On the southern shoreline, at Pu'u Koa'e and 'Ale'ale, seabirds such as red-tailed tropic birds (*Phaethon rubricuada rothschildi*) and brown boobies (*Sula leucogaster plotus*) nest. The offshore areas around Kaho'olawe are also important habitats for endangered humpback whales (*Megaptera novaengliae*) and indigenous Spinner dolphins (*Stenella longirostris*).

In addition, three distinctive native aquatic communities have been identified on Kaho'olawe, these are the Hawaiian Ephemeral Pool, the Hawaiian Intermittent Stream, and the High-Salinity Lava Anchialine Pool as described in the following paragraphs.

Ephemeral (temporary) fresh-water pools are formed on the island in the basins of intermittent streams after periods of heavy rainfall. Examination of one such pool revealed tadpole shrimps, seed shrimps, phytoplankton, and filamentous algae. The terrain of the island, its many gulches and depressions or lua, can support many ephemeral pools and related organisms.

All streams on Kaho'olawe can be considered intermittent since their water source is not large or consistent enough to support stream flow throughout the year. Intermittent streams often support many species of aquatic insects, snails, and other invertebrates when water is available.

Kaho'olawe's anchialine pool ecosystem at Sailor's Hat is considered unique. It sustains the 'opae'ula shrimp (*halocaridina rubra*), amphipods, snails, and red polychaete tube worms. It is unknown what other species may be found in this pool which is 160 feet in diameter and approximately 50 feet deep. This pool was created by military testing when they set off explosives in the area to simulate a nuclear blast. The large hole that the testing carved into the rocky shoreline allowed ocean water to seep in and over time, the anchialine pool community developed. There are no known naturally-occurring anchialine pools on Kaho'olawe.

Most introduced species of fauna, particularly feral cats, have had a negative impact on the island and present a challenge to the restoration of the natural resources of the island. Eradication of the goats has contributed to the regreening of parts of the island. The termination of ordnance delivery training on the island has led to an increase in the bird population. The lack of standing ponds of water is a deterrent to increasing the native bird population.

REFERENCES

Ahlo, H. M. Jr. and R. J. Hommon

A Management Plan for the Historic Properties of Kaho'olawe (Draft). Prepared for Pacific Division Naval Facilities Engineering Command, Pearl Harbor, Hawai'i. 1980.

Corn, C. A., W. Char, G. Clarke and L. Cuddihy

Kaho'olawe Botanical Survey. Division of Forestry, Department of Land and Natural Resources. 1980.

Hommon, R. J.

Kaho'olawe: Final Report of the Archaeological Survey. Prepared for U. S. Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor. 1980a.

National Register of Historic Places Multiple Resource Nomination Form for the Historic Resources of Kaho'olawe. State Historic Preservation Office, State of Hawaii. Prepared for U. S. Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor. Honolulu, Hawaii. 1980b.

Kaho'olawe Archaeological Excavations. 1981. Prepared by Science Management, Inc. for the U. S. Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor. Honolulu, Hawaii. 1983.

Kamakau, S.

Ruling Chiefs of Hawaii. Kamehameha Schools Press. Honolulu, Hawaii. 1961.

Kirch, P. V.

Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory University of Hawaii Press. Honolulu, Hawaii. 1985.

Marinco, Ltd.

Study on the Feasibility ad Cost of Clearing Kaho'olawe Island of Unexploded Ordnance. Prepared for the Naval Sea Systems Command, Department of the Navy, Washington, D. C. by Marinco, Ltd., Falls Church, Virginia. 1976.

Ritte, W. and R. Sawyer

Na Mana'o Aloha o Kaho'olawe. Aloha 'AINA O Na Kupuna, Inc. Honolulu, Hawaii. 1978.

Rosendahl, P. H., A. E. Haun, J. B. Halbig, M. Kaschko, and M. S. Allen

Kaho'olawe Excavations, 1982-3. Data Recovery Project, Island of Kaho'olawe. 2 vols. Prepared for U. S. Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor. Hilo, Hawaii: PHRI. 1987.

Silva, C.

Kaho'olawe Cultural Study, Volume 1: Historical Documentation. Prepared by Environmental Impact Study Corp., prepared for U. S. Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawaii. 1983.

Spriggs, M.

'Preceded by Forests'; Changing Interrelations of Landscape Change on Kaho'olawe. Asian Perspective. Vol. 30, no.1. University of Hawaii Press. 1991.

Takasaki, K. J.

Water Resources of the Island of Kaho' olawe, Hawaii: Preliminary Findings. USGS Water Resources Investigations Report 89-4209. Prepared in cooperation with the Division of Water and Land Development, Department of Land and Natural Resource. Honolulu, Hawaii. 1991.

Thrum, T. G.

Hawaiian Almanac and Annual for 1903. Honolulu, Hawaii. 1902.

SITE PHOTOS

Photo 1: Smuggler's Cove, Honokanai'a side of Kaho'olawe

Photo 2: Sailor's Hat, Honokanai'a side of Kaho'olawe

Photo 3: Typical Kiawe scrub forest heading from Honokanai'a towards Hakio'awa via the Makahiki route

Photo 4: Typical Kiawe scrub forest heading from Honokanai'a towards Hakio'awa via the Makahiki route

Photo 5: Typical hardpan desert with revegetation effort - Makahiki Route towards Hakio'awa

Photo 6: Typical hardpan desert - Makahiki route towards Hakio'awa

Photo 7: Hardpan desert with rain catchment tank - Hakio'awa area

Photo 8: Typical wash-out areas in hardpan desert area - Hakio'awa area

Photo 9: Typical erosion wash from hardpan desert to ocean - Hakio'awa area

Photo 10: Typical erosion wash from hardpan desert to ocean - Hakio'awa area

Photo 11: Desert hardpan merging with Kiawe scrub forest - Makahiki route between Honokanai'a and Hakio'awa

Photo 12: Desert hardpan merging with Kiawe scrub forest - Makahiki route between Honokanai'a and Hakio'awa

Photo 13: Aerial view of Hakio'awa - Northeast side of Kaho'olawe

Photo 14: Aerial view of Hakio'awa - Northeast side of Kaho'olawe. Wahine Heiau in foreground.

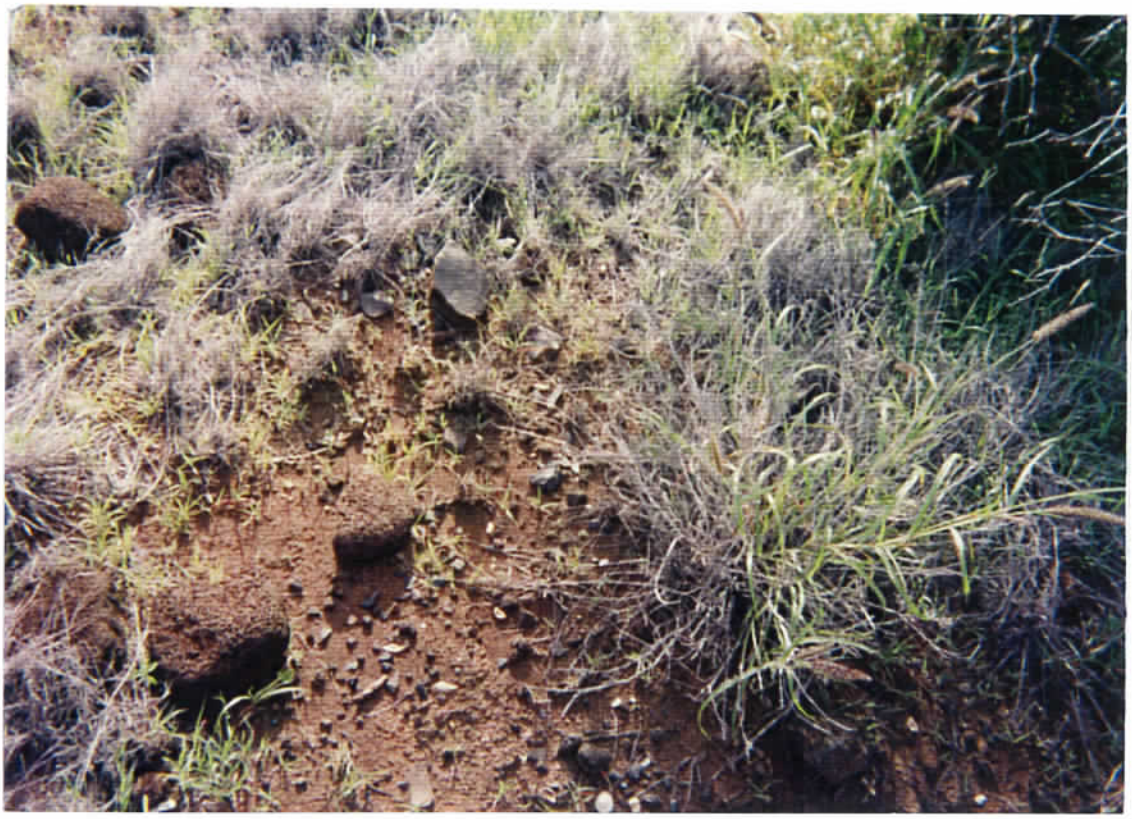

Photo 15: Rock chips from adze rocks and volcanic glass chips - Quarry area

Photo 16: "Hale" in Hakio'awa

Photo 17: Petroglyphs - Hakio'awa area

Photo 18: Petroglyphs - Hakio'awa area

Photo 19: Wahine Heiau - Hakio'awa area

Photo 20: Kane Heiau - Hakio'awa area

Photo 21: Typical Heiau walls - Hakio'awa area

Photo 22: Typical Heiau walls - Hakio'awa area

Photo 23: Ceremonial site - Hakio'awa area

Photo 24: Ko'a Shrine/Homesite - Hakio'awa area

Photo 25: Unknown Shrine - Hakio'awa area

Photo 26: Fishing Shrine - Hakio'awa area

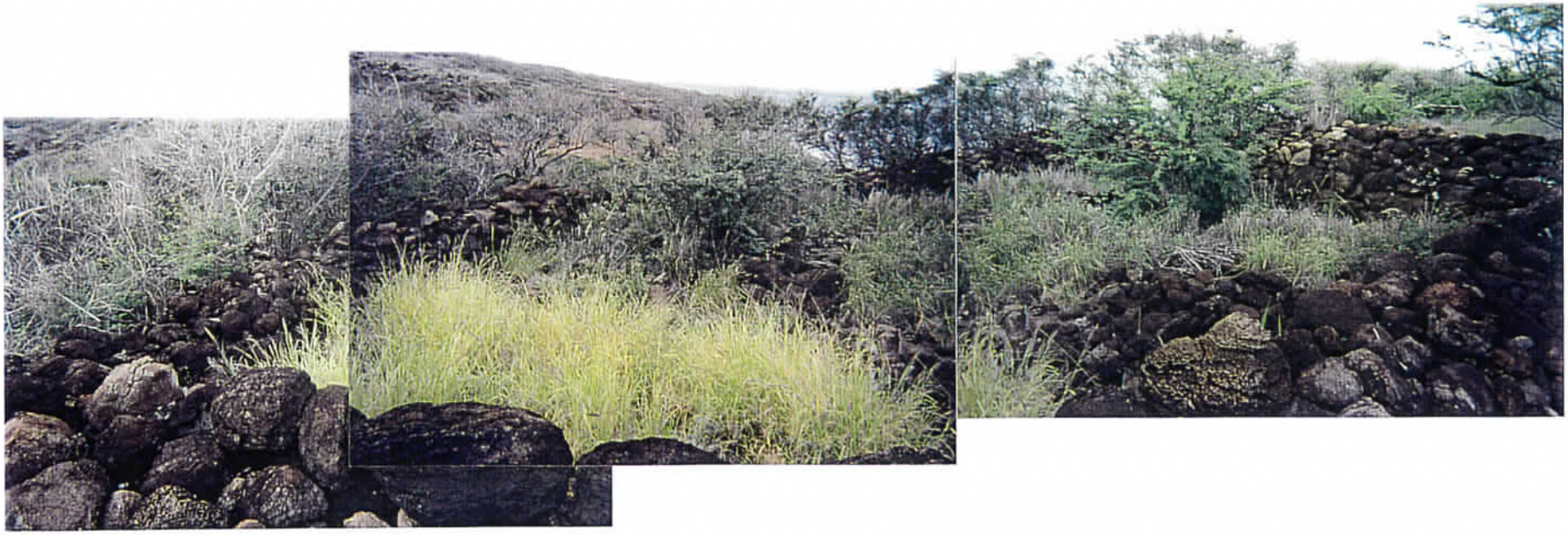

Photo 27: Inside walls of ancient Fishing Heiau - Hakio'awa area

Attachment on Chemical Data Sampling Plan to be added here.

ARCHEOLOGICAL QUALITY CONTROL PLAN - TO BE INSERTED HERE WHEN GUIDELINES ARE DETERMINED.

Cultural Surveys Hawai'i, Inc.

founded 1982

Hallett H. Hammatt, Ph.D., owner
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Tel/fax (808) 332-7071, Gerald K. Ida, Manager

Services – a small company offering expertise in archaeological reconnaissance surveys, inventory surveys, archaeological monitoring, excavations, site and area management and assessments, site stabilization and development. Interpretive and educational planning and displays. The emphasis is on a professional but realistic approach to archaeology and its relation to land development.

Cultural Surveys Hawai'i has an excellent record of timely completion of reports. The proprietor is not simply a name to be used in proposals but is a participant in every project. This accounts for the consistency and high quality of the work and the first-hand nature of the reports.

Personnel and Associates

Three of the 4 principals have at least 14 years of experience in Hawaiian archaeology and three were born and raised in the state. Well over half of the principals and staff are born and raised in Hawaii.

Hallett H. Hammatt, Ph.D. (Proprietor)

Twenty-seven years experience in archaeology, 16 years in Hawaiian archaeology, directed and completed approximate 400 archaeological projects in Hawai'i, involving work on all major islands and in most aspects of Hawaiian archaeology. Fifteen years experience in consulting with over 50 governmental agencies and private companies in Hawai'i. Member of the Hawaii Historic Places Review Board for 11 years, expert witness at many public hearings.

Douglas Borthwick (Project Director)

B.A. in Archaeology, graduate studies in Pacific Islands Studies, 17 years experience in Hawaiian archaeology; work on all major islands, specialty in site survey, artifact analysis, historical research.

David Shideler (Project Director)

B.S. in Zoology, B.A. Anthropology, M.P.H. Environmental Health Management, M.A. Asian religions, 15 years experience in Hawaiian archaeology, Lecturer in Hawaiian and Polynesian religions at U.H. Manoa, specialty in environmental utilization, analysis of faunal remains from archaeological sites and site interpretation.

William H. Folk (Project Director)

B.A. Anthropology, U.H. Hilo, graduate studies in Pacific Island Studies; 20 years experience in Hawaiian archaeology; field experience on all major Hawaiian islands; experience in underwater archaeology - member of National Park Service survey crew on the U.S.S. Arizona; field experience in South American Pacific Coast archaeology.

Gerald K. Ida (Project Director - Kauai)

B.A. in History U.H. Manoa (Hawaii and the Pacific) 1977, 6 years full-time experience in Hawaiian Archaeology, Historical Research, Survey, Excavation, Archaeological Monitoring. Archaeology and History of Kaua'i. Charter Appointee Kaua'i Historic Preservation Review Commission; Appointed under 2 mayors 1987-1992, Chairman, 1992. Resident of Kaua'i, Manager of Cultural Surveys Hawaii Kaua'i Office.

Jennifer J. Robins (Project Director)

B.A. in Arthropology, University of Vermont, 5 years experience in northeastern archaeology; 5 years experience in Hawaiian archaeology. Field experience in over 20 projects in Vermont, New York, Maine, and on all major Hawaiian islands. Involved in all aspects of report production.

Rodney Chiogioji (Project Director)

B.A. in Literature, 4 years experience in Hawaiian archaeology, archaeological drafting, writing and historical research, and editing.

Brian Colin (Research Associate)

B.A. in Anthropology, University of Hawaii, 4 years experience in Hawaiian archaeology; recent course work in Pacific/Hawaiian archaeology, anthropology and Hawaiian language. Historical Research, Survey, Excavation, Archaeological Monitoring, Report Research, Writing, Drafting and Production.

Kaipo Akana (Field Technician)

3 years field experience in archaeology on Kauai (monitoring and excavation), Kauai Burial Council Member, Retired Federal (NASA) employee.

John Winieski (Lab Supervisor)

B.A. in Classics, U.C. Irvine, M.A. English as a Second Language, 11 years experience university research and data management. 2 years experience in geological and quantitative analysis; Laboratory Assistant; U.S. Borax Research; 9 years university bibliographic research & data management; 1 year industrial data management; 1 year newspaper production; data processing & final production; Water Lifesaving Techniques

Victoria S. Creed (Office Manager & Historian)

Certificate of Historic Preservation, Univ. of Hawaii/Manoa; Ph.D. 17th Cent.French, Univ. of Pennsylvania, M.A. French lit., B.A. German lit., minor in Italian, Spanish, History. 20 years teaching experience, computer technology, Report Design & Production; Scholarly writing; 3 projects on Ahupua'a-wide Settlement Patterns in Hawaiian pre-history. Research project of computerizing and compiling 1848-1851 Land Commission Awards - Island of Kaua'i near completion, Maui to follow next, followed by Hawaii and Oahu.

There are also other support personnel and part-time associates

Other Associates and Sub-Consultants

William Kikuchi, Ph.D.

Kaua'i Community College, Crafts Hawaii, volcanic glass dating, petrographic studies, Hawaiian fishponds.

Michael Pietrusewsky, Ph.D.

University of Hawai'i, Manoa, physical anthropology, osteological analysis.
Other consultants in Hawaiian language, Hawaiian history, radiocarbon dating, botany, floral and faunal identification, planning.

Areas of Experience

Reconnaissance, survey, excavations, coring, site stabilization, site and area management, mapping, aerial survey, recovery of human burials, stratigraphy, historic research, fishponds, beach sites, cave sites, petroglyphs, survey of unaccessible areas, historic archaeology, urban archaeology, federal and state regulations in historic preservation, cultural landscape studies

Field and Laboratory Equipment and Facilities

Cultural Surveys has a full range of field and laboratory equipment. The laboratory and office facility of 3,600 square feet is equipped with measuring and photographic equipment, scales, etc. and a Nikon petrographic microscope. There is also a sizable reference library of maps and books on Hawaiian archaeology and history.

Clients

County: Kaua'i County, Maui County, Honolulu Board of Water Supply, Honolulu Department of Public Works, Honolulu City and County Dept. of Transportation, Dept. of Housing, Board of Water Supply.

State: Div. of State Parks, Hawai'i Community Development Authority, Dep't of Transportation, Hawai'i Housing Authority, State Dep't of Agriculture, Hawai'i Air National Guard, Dep't of Hawaiian Home Lands, Dep't of Accounting and General Services, Dep't of Business and Economic Development

Federal: U.S. Army Corps of Engineers, U.S. Air Force,- National Radio Astronomy Observatory

Resumé of Project Director

Hallett H. Hammatt, President
Cultural Surveys Hawaii, Inc.

Education:

Washington State University, Ph.D., Anthropology, 1976
Dissertation: Late Quaternary Stratigraphy and Archaeological Chronology in the Lower Granite Reservoir Area, Lower Snake River, Washington.

University of Edinburgh, M.A. Prehistoric Archaeology (Honors), 1967

Thesis: An Ethnographic Study of North American Indian Pottery

University of Pennsylvania, B.A. History, (Honors), 1963

Professional Experience:

1982-present	Cultural Surveys Hawaii, incorporated January 1994, a small private contract archaeological firm, owner and president.
1979-1982	Archaeological Research Center Hawaii, Senior Archaeologist, Author of 200 reports on Hawaiian archaeology.
1979 (Spring)	University of Hawaii/Manoa, Visiting Assistant Professor, Department of Anthropology, Teaching Geo-archaeology and Quarternary Studies, undergraduate and graduate levels.
1977-1978	Director of Archaeological Survey of the Island of Kaho'olawe for DLNR and the U.S. Navy
1977 (Spring)	University of Hawaii/Manoa, Visiting Assistant Professor, Department of Anthropology, Teaching Geo-archaeology and Quarternary Studies, undergraduate and graduate levels.
1975-1976	Washington State University, Department of Anthropology, Teaching Assistant assisting Professor Fekri Hassan, Quarternary Studies
1975	Washington Archaeological Research Center, Washington State University, Research Assistant
1974	Alpowa Project, Lower Granite Reservoir, Snake River, Washington, Research Assistant, Project Geologist. Professor Frank C. Leonhardy, Director
1972-1974	Washington State University. Department of Anthropology, Teaching Assistant assisting Professor Roald Fryxell, Quarternary Studies
1973	Alpowa Project, Lower Granite Reservoir, Snake River, Washington, Field Foreman, Professor Frank C. Leonhardy, Director

1970-1971	Archaeological and Environmental Research in the Domebo Canyon, SW Oklahoma, Principal Investigator
1970-1971	Museum of the Great Plains, Lawton, Oklahoma, Director of Research
1969-1971	Oklahoma Anthropological Society, Southwestern Chapter, Archaeological Advisor
1968-1970	Great Plains Journal, Lawton, Oklahoma, Assistant Editor
1968-1970	Museum of the Great Plains, Lawton, Oklahoma, Curator of Anthropology, Marvin E. Tong, Jr., Director.

Research:

Britain

Excavations of early Christian sites in England and Scotland under the direction of Charles Thomas, University of Edinburgh

1965-1967	Abercorn, near Edinburgh
1964-1965	Island of Ardwall, southwestern Scotland
1963	Island of Iona, west coast of Scotland

Romano-British Sites

University of Birmingham, Field Courses, Wroxeter, England

1967	Site Supervisor, Site Supervisor Course: labor management, stratigraphic analysis, drawing, surveying
1966	Site Supervisor, Advanced Course: excavation techniques, surveying, drawing, find classification

United States: Plains

1968-1971	Many short-term salvage excavations and surveys in western Oklahoma
1970	Archaeological and environmental research in the Domebo Canyon, a Paleo-Indian site in southwestern Oklahoma, funded by the National Science Foundation
1968-1970	Excavation and analysis of the Gore Pit Site, an Archaic site in southwestern Oklahoma
1969	Survey of the Tonkowa Creek Watershed, Caddo County, funded by National Park Service

United States: Plateau

1975 Laboratory identification of volcanic ash samples under the supervision of Professor Henry Smith and Rose Okazaki, Department of Agronomy and Soils, Washington State University

1975 Washington Archaeological Research Center, Washington State University, the effect of Lower Granite Pool raising on archaeological sites, short and long-term geological considerations, funded by the U.S. corps of Engineers.

1974-1976 Alpowa Project, Lower Granite Reservoir, Snake River, Washington, Project Geologist, directed by Professor Frank C. Leonhardy, cultural and natural stratigraphy, geological mapping, Late Quarternary geochronology and environments of the Lower Snake River (Ph.D. research), funded by National Park Service

1973 Alpowa Project, Lower Granite Reservoir, Snake River, Washington (directed by Professor Frank C. Leonhardy) Field foreman in the excavation of the prehistoric and historic village

1973 Research in the causes of natural fractures on basalt cobbles from the Columbia Plateau

Research Grants

1979 Wenner Gren Foundation for Anthropological Research, $2,000

1976 Signa Xi, Grant in Aid of Research, $100

1970-1971 Archaeological and environmental research in the Domebo Canyon, southwestern Oklahoma, National Science Foundation, $5,600

Publications 1969-1978

1978 Later Quarternary Geology of the Lower Snake River, Geological Society of America, Map and Chart Series C18

1976 Late Quaternary Stratigraphy and Archaeological Chronology in the Lower Granite Reservoir Area, Lower Snake River, Washington, University of Microfilms, Ann Arbor

1976 Later Quarternary Stratigraphy in the Snake River Canyon & A Revised Chronology for Scabland Flooding, Geological Society of American Bulletin

1976 (with G. Cleveland, B. Cochron, and J. Giniger) Archaeological Reconnaissance on the Mid Columbia and Lower Snake River Reservoirs. Washington Archaeological Research Center, Project Report No. 27

1976 The Gore Pit Site and a Review of the Archaic of the Southern Plains, Plains Anthropologist, Vol. 21

1975 (with David R. Brauner, Glenn Hartman) Lower Granite Dam Pool Raising: Impact on Archaeological Sites, Washington Archaeological Research Center, Project Report No. 22

1975 Spheroidal Weathering and "Potlid" Fractures: Analysis of a Sample from the Columbia River, Newsletter of Lithic Technology 4:1.

1970 A Paleo-Indian Butchering Kit, American Antiquity, 35:2

1969 Paleo-Indian Points from the Domebo Canyon, Bulletin of the Oklahoma Anthropological Society, Vol. 18

1969 Paleo-Indian Blades from Western Oklahoma, Bulletin of the Texas Archaeological Society, Vol. 40.

Papers Presented

1992 The Koloa Field System, Kauai Island, and Russian Fort Alexander in Hanalei: the Conception and the Reality; Society of Hawaiian Archaeology, Annual Meeting, Lihue, Kauai.

1989 Excavation of 118 Burials from Queen Street, Honolulu, Society of Hawaiian Annual Meeting, Wailuku, Maui.

1988 An Ethnohistory of Taro Farming in the Hawaiian Islands, Annual Meeting of the Society for Hawaiian Archaeology

1980 Hawaiian Use of Lava Tubes, Case Study in the Kona District, San Diego, Society of American Archaeology

1978 Geoarchaeology in the Hawaiian Islands, Society of American Archaeology Annual Meeting, Tuscon, Arizona

1976 Geological Processes and Apparent Settlement Densities along the Lower Snake River: A Geocentric View, Northwest Anthropological Society, Annual Meeting, Ellensburgh, Washington

1976 Late Quarternary Stratigraphy in the Lower Snake River Canyon: Toward a Chronology of Slackwater Sediments, with Lucy Foley and Frank Leonhardy. Geological Society of America, Cordilleran Section. Annual Meeting, Pullman, Washington

1975 Piqunin: Natural and Cultural History of the Lower Snake River, a slide narrative with Professor Frank C. Leonhardy and Bill Adams, presented to: (1) joint meeting of the American Archaeological Society, Walla Walla Chapter,

and the American Archaeological Society, Walla Walla Chapter, Walla Walla, Washington, (2) Anthropology Club, Washington State University, Pullman, (3) Lewiston Historical Society, Lewiston, Idaho

1975 Geological Frameworks for the Study of Human Adaptations in the Snake River Canyon, Northwest Anthropological Society, Annual Meeting, Seattle, Washington

1971 The Gore Pit and the Archaic of the Southern Plains, Society of American Archaeology, Annual Meeting, Norman, Oklahoma

1970 Paleo-Indian Research in the Domebo Canyon, Oklahoma Anthropological Society, Annual Meeting, Norman, Oklahoma

Professional Organizations

Society of American Archaeology
Society of Hawaiian Archaeology

William H. Folk

Cultural Surveys Hawaii

Military Service: 1967-1973	United States Navy Reserve, Viet Nam, Honorably Discharged
Higher Education:	B.A. Anthropology, University of Hawaii at Hilo, 1977 Graduate Studies, Pacific Island Studies, University of Hawai'i, 1982

Employment:

1981-1994	Archaeologist, Cultural Surveys Hawaii
1984-1990	Commissioned Police Officer, Honolulu Police Department, Resigned 1990.
1983	Ranger, U.S.S. Arizona Memorial, National Park Service
1978-1981	Archaeologist, Archaeological Research Center Hawaii, Inc.

Archaeological Field Experience:

1975-1977	Survey of archaeological sites in Puna and Kā'u Districts of Hawai'i. Excavation of archaeological sites at Mahana Bay. Directed by Dr. William Bonk of University of Hawai'i at Hilo.
1977	Excavation of a Fishhook workshop and 6,000 year-old human burials at Rio Camarones, Tarapaca Chile. Directed by Señor Hans Nimeyer and Dr. Virgilio Shiappacasse with Universidad del Norte, Chile.
1993	Underwater survey of U.S.S. Arizona as National Park Service ranger.
1978-1993	Participated in more than 100 archaeological projects on all of the major Hawaiian Islands, except Kaho'olawe & Ni'ihau.
1979-1993	Field Director of more than 50 archaeological projects on all of the major Hawaiian Islands, except Kaho'olawe & Ni'ihau.

Professional Meetings and Papers Presented:

1977	VII Congresso di Archaeologia de Chile, Alto De Vilches, Temuco, Chile
1980	Society of American Archaeology, San Diego, CA
1992	5th Annual Society for Hawaiian Archaeology Conference Paper: Slingstones: Techniques and Sequence of Manufacture. A Kaua'i Example
1993	6th Annual Society for Hawaiian Archaeology Conference Paper: Micro-Disposal Patterns in a West Moloka'i Fishhook Workshop
1994	7th Annual Society for Hawaiian Archaeology Conference

Professional Reports:

1980-1993	Principal author for 30 archaeological technical reports
1980-1993	Supporting author for over 15 archaeological technical reports.

Resumé of Archaeologist Gerald Ida

Gerald K. Ida
Manager, Kauai Office
Cultural Surveys Hawaii, Inc.
P.O. Box 498
Lāwa'i, Kaua'i, HI 96765
Tel. & Fax (808) 332-7071

EDUCATION: B.A. Hawaiian and Pacific History, University of Hawaii/Mānoa, 1977

PROFESSIONAL EXPERIENCE:

1978-1982, **Archaeologist and Historian** with Archaeological Research Center hawaii (ARCH) responsibilities in field survey, excavation, artifact analysis, monitoring, historical research. Specialty archaeology and history of Kaua'i.

1982-1992, **Report, Researcher, Photographer, and Advertising Manager**, Garden Island Newspaper, Līhu'e, Kaua'i.

1987-1992, Appointed under Two Mayors as a **Charter Appointee of the Kauai Historic Review Commission**, an Advisory Commission to the Kauai County Planning Department.

1992-Present, **Manager of Cultural Surveys Hawaii, Inc.**, Kaua'i office, responsibilities include project coordination, project direction, community relations, monitoring, report writing and historical research.

Bibliography for Gerald K. Ida

Primary Author
Ida, Gerald K.
1984 *Personal observations during a five-day hike through portions of Waimea Canyon and Koai'e and Wai'alae Valleys.*

Ida, Gerald and Hallett H. Hammatt
1993 *Archaeological Subsurface Inventory Survey of A Residential Lot in Kekaha, Kaua'i, Waimea, Kaua'i (TMK 1-6-01:4)*, Cultural Surveys Hawaii, Kailua, HI.

Ida, Gerald and Hallett H. Hammatt
1993 *Archaeological Subsurface Survey of The Campos Property, Waimea, Kaua'i (TMK 1-6-01:4)*, Cultural Surveys Hawaii, Kailua, HI.

Ida, Gerald and Hallett H. Hammatt
1992 *Archaeological Subsurface Survey of Two Adjacent House Lots in Wainiha, Halele'a, Kaua'i (TMK 5-8-06 Lots 279A, 279B)*, Cultural Surveys Hawaii, Kailua, HI.

Ida, Gerald, Hallett H. Hammatt and Edward D. Duncan
1993 *Archaeological Survey of Proposed Telecommunication Hut for GTE Hawaiian-Tel at Wainiha, Kaua'i (TMK 5-8-02:3)*, Cultural Surveys Hawaii, Kailua, HI.

CULTURAL RESOURCE MANAGEMENT

AKI SINOTO CONSULTING 2333 Kapiolani Blvd. No.2704 Honolulu, Hawai'i 96826 Tel/Fax (808) 941-8538

VITA

Aki Sinoto
Consulting Archaeologist

Affiliation:

Self-employed (since 1991) / Aki Sinoto Consulting

Education (Degree/School/Year/Specialization):

B.A. (Honors) / University of Hawaii / 1973 / Anthropology
Graduate Studies / University of Arizona / 1976 / Anthropology

Accreditation (Year Awarded/Discipline):

Society of Professional Archaeologists / 1979 / M.A. Equivalency in Archaeology

Employment History (Years/Firm/Position):

1991-present / Aki Sinoto Consulting / Archaeological Consultant
1987-1991 / Bishop Museum / Administrator, Applied Research Group
1977-1987 / Bishop Museum / Supervisory Archaeologist, Contract Manager for Public Archaeology
1976 / Southwestern Regional Archaeology Center, National Park Service, Arizona / Curatorial Tech
1973-1976 / Bishop Museum / Supervisory Archaeologist, Anthropology Dept.
1970-1973 / Bishop Museum / Archaeological and Curatorial Assistant
1967-1970 / Bishop Museum / Curatorial Assistant, Marine Zoology Dept.

Experience:

Over 20 years of supervisory experience in contract and research archaeology primarily in Hawaii, Polynesia, and the Mariana Islands.

Conducted the Archaeological Inventory of Guam in 1974 with Dr. Fred Reinman and participated in the formulation of the Guam Historic Preservation Plan.

Extensive background in archaeological projects involving cultural, prehistoric/historic, and interpretive/educational components.

Specialized in contracts administration and cultural resource management for the past sixteen years.

Participated in five field sessions over the past two years on Kaho'olawe.

Currently Specializing In:

Consultation for regional cultural resource sensitivity assessments.

Proposal review; budget and scope assessments.

Report editing and review.

References available upon request.

CULTURAL RESOURCE MANAGEMENT

AKI SINOTO CONSULTING 2333 Kapiolani Blvd. No.2704 Honolulu, Hawai'i 96826 Tel/Fax (808) 941-9538

Selected previously completed and current projects include:

1) Archaeological surveys and resource management for Kagman, Unai-Alaihai Village Homestead Subdivision Project, Saipan; the Dandan Subdivision Extension, Saipan; and the Dugi, Campapa Agricultural Subdivision, Rota. Marianas Public Land Corporation, Govt. of the Commonwealth of the Northern Mariana Islands. 1991-present.

2) Archaeological Assessment for the Proposed Liliha Civic Center, Honolulu. Okita, Kunimitsu, and Assoc. 1991.

3) Archaeological Inventory Survey for the Electrical Transmission Corridor for the Ritz Carlton Hotel in Kapalua, Maui. Munekiyo and Arakawa. 1992.

4) Archaeological Consultation at Pu'u Mo'iwi for the Kaho'olawe Conveyance Commission. Office of State Planning. 1992/with Mountain Archaeology Research Corporation.

5) Appurtenant Water-Rights Project for the State Water Commission. 1993/with Cone Dashiel Planning Services.

6) Archaeological and historical data compilation for the Kona holdings of the Kamehameha Schools/Bernice Pauahi Bishop Estate. KS/BE Asset Management - Hawai'i Region. 1993.

7) Archaeological Survey for the East Maui Water Project. Parametrix/Norman Saito Engineering. 1993.

8) Archaeological Inventory Survey for the North Waihee Water Transmission Project. Munekiyo and Arakawa. 1993.

9) Archaeological Monitoring During Two Closures: Free-roam Zone Stake-out and Ordnance Re-sweep of the Hunakanaia Base Camp Area. U.S. Department of the Navy. 1994.

10) Archaeological Inventory Survey for the Proposed Poopoo Bridge Replacement. Richard Sato & Associates. 1994.

11) Archaeological Subsurface Sampling for the Proposed Maui Lani Development. Maui Lani Partners. 1994-present.

12) Archaeological Monitoring and Mitigation for the Lower Main Street Improvements. Sato and Associates. Current/with Scientific Consultant Services.

13) Continued Archaeological Consultation for Golf Course Improvements and Development Projects in the Wailea Resort. Wailea Resort Company. 1991-present.

14) Continued Archaeological Consultation for Golf Course Expansion and other Development Planning in the Makena Resort. Seibu Hawaii-Makena Resort Corporation. 1991-present.

The following references are all current clients:

1) Wailea Resort Company, Ltd.
161 Wailea Ike Place
Wailea, Kihei, Maui, HI 96753-9599
Contact Person:
Mr. Clyde Murashige

2) Makena Resort Corporation
5415 Makena Alanui
Kihei, Maui, HI 96753
Contact Person:
Mr. Roy Figueiroa

3) Mauilani Partners
810 Richards Street
Suite No. 200
Honolulu, HI 96813
Contact Person:
Mr. Kimo Steinwascher

4) Sato and Associates, Inc.
2046 South King Street
Honolulu, Hawai'i 96826
Contact Person:
Mr. Richard Sato

5) PBR Hawaii
Pacific Tower, Suite 650
1001 Bishop Street
Honolulu, HI 96813
Contact Person:
Mr. Vincent Shigekuni

6) Munekiyo and Arakawa, Inc.
1823 Wells Street, Suite 3
Wailuku, Maui, HI 96753
Contact Person:
Mr. Michael Munekiyo

7) Group 70 International
925 Bethel Street, 5th Floor
Honolulu, HI 96813
Contact Person:
Mr. George Atta

8) Kemper Real Estate Management Corp.
Hawaii Kai Corporate Plaza
Suite 300
6600 Kalanianaole Highway
Honolulu, HI 96825
Contact Person:
Mr. Michael Morita

Curriculum Vitae

Name Samuel M. Gon III

Address [redacted]
Honolulu, Hawai'i 96817

Phone [redacted]
(808) 537-4508 (wk)
(808) 545-2019 (FAX)

Employment

1986 - present: The Nature Conservancy of Hawaii, Hawaii Heritage Program, 1116 Smith St., Suite 201, Honolulu, HI 96817. Initially hired as Ecologist, currently Coordinator/Ecologist,Hawaii Natural Heritage Program (see professional experience)

1986 - 88. University of Hawai'i at Manoa, Entomology Department, Honolulu HI 96822. Post-Doctoral Associate. Invertebrate Survey of the Waimanu Estuarine Sanctuary.

1985-86. Bishop Museum, 1525 Bernice Street, Honolulu, HI, 96817. Editorial and Research Assistant

1978-82. University of California at Davis, Department of Zoology, Davis, CA 95616. Various positions during tenure as graduate student: Research Assistant, Teaching Assistant, Readership in Animal Behavior

Education

B.A., Zoology 1978, University of Hawai'i at Mānoa, Honolulu
M.A., Zoology 1979, University of California, Davis
Ph.D. Animal Behavior 1985, University of California, Davis

Honors Research Support and Awards

University of Hawai'i Dean's list 1973-76
NSF-SOS Grant SMI-76-07608 1976
NSF-SOS Grant SMI-77-05153 1977
Gamma Sigma Delta (International Honor Society in Agriculture) 1977
University of California Regents Fellowship 1980 - 1983
Jastro Shields Research Scholarship 1980, 1981
University of California Graduate Research Scholarship 1982
Sigma Xi Grant in Aid of Research 1983
Hawai'i Evolutionary Biology Program Research Grant 1983
Exline-Frizzel Fund for Arachnological Research Grant 1984
NOAA Basic Grant for Estuarine Research 1986
Whitehall Foundation Research Grant 1987

Publications

1976. Mammalogy report. in: *The Scientific Report of the Manawainui Research Project*. D. Peterson, ed. Univ. of Hawai'i. (NSF/SOS SMI-76-07608) pp. 121-60.

1976. A preliminary report: The freshwater fauna of the Manawainui region. in: *The Scientific Report of the Manawainui Research Project*. D. Peterson, ed. Univ. of Hawai'i. (NSF/SOS SMI-76-07608) pp. 289-300.

1978. Altitudinal effects on the general diversity of endemic insect communities in a leeward Hawaiian forest system, Manukā Forest Reserve, South Kona, Hawai'i. in: *Proc. 2nd Conference Natural Sciences Hawai'i Volcanoes National Park*. pp. 134-49.

1982. 'Alalā reported from the ahupua'a of Manukā, South Kona, Hawai'i. *'Elepaio* (J. Hawai'i Audubon Soc.) 43(6):47-8.

1984. Reciprocal courtship experiments between allopatric populations of *Theridion grallator*: Asymmetrical isolation and incipient speciation depends on habitat heterogeneity. in: *Proc. 5th Conference Natural Sciences Hawai'i Volcanoes National Park*. pp. 62-77.

1985. *Comparative Behavioral Ecology of the Spider Theridion grallator (Simon) (Araneae : Theridiidae) in the Hawaiian Archipelago*. Doctoral dissertation. University Microfilms. x + 365 pp. illus.

1985. The residence leaf as a prey-monitering surface for *Theridion grallator* Simon, (Theridiidae : Araneae). *Proc. IXth Int'l Congr. Arachnol.* pp. 101-8.

1985. A Hawaiian wolf spider (*Lycosa* sp.) foraging in the top of a *Metrosideros* tree. *J. Arachnol.* 13:393.

1988. Hono O Nā Pali Natural Area Reserve survey. *Hawai'i Wildlife Newsletter*. 3(2):5.

1988. Observations of the endangered Hawaiian Dark-rumped Petrel (*Pterodroma phaeopygia sandwichensis*) on the island of Kaua'i. *'Elepaio* (J. Hawai'i Audubon Soc.). 48(12):113.

1989. *Aves Hawaiiensis: The Birds of the Sandwich Islands*. Hemmeter Publishing Co., Honolulu. [species updates for centennial reprint of the color plates of the Wilson and Evans.] 28 pp., illus.

1993. Bog discovered on Oahu. *Hawaii Wildlife Newsletter*.

Recent publications update on request

(continued next page)

Publications (continued)

Coauthored publications:

Daws, G., S. M. Gon III & The Nature Conservancy of Hawai'i. 1988. *Hawai'i: The Islands of Life.* Signature Publ., Honolulu. 156 pp., illus.

Evenhuis, N. & S. M. Gon III. 1989. Culicidae. in: *Catalog of the Diptera of the Australasian/Oceanic Region.* Bishop Museum Press, Honolulu.

Fujioka, K. & S. M. Gon III. 1988. Unusual concentration of the Hawaiian hoary bat in South Kona, Hawai'i. *J. Mammalogy.* 69(2):369-71.

Gon, S. M., III, R. Kimsey, R. O. Schuster & M. A. Willis. 1986. Prodromus of the water bear fauna of Haleakalā National Park. in: *Proc. 6th Conference Nat. Sci. Hawai'i Volcanoes National Park.* pp. 15-22.

Gon, S. M., III, A. L. Newman & The Hawai'i Heritage Program. 1987. *Biological Summary of Rare Species and Communities of Hawaiian Anchialine Pools.* Prepared for Hawai'i County Planning Dept., Hilo.

Gon, S. M., III, A. L. Newman & The Hawai'i Heritage Program. 1988. *Biological Overview of Hawai'i Natural Area Reserves System.* Prepared for Hawai'i Department of Land and Natural Resources, Division of Forestry & Wildlife, Honolulu. 52 pp. + appendices.

Gon, S. M., III, A. L. Newman & Hawai'i Heritage Program. 1989. *Hawaii's Natural Area Reserves System: Resources and Management Summary Report.* Prepared for Hawai'i Department of Land and Natural Resources, Division of Forestry & Wildlife, Honolulu. 34 pp. + appendices (62 pp.).

Gon, S. M., III & Hawai'i Heritage Program.
Numerous coauthored publications 1990-95 on request only.
Includes the biological survey of Kaho'olawe for the Kaho'olawe Island Conveyance Commision.

(continued next page)

Publications (continued)

Coauthored publications: (continued)

Gon, S. M., III & L. W. Pinter. 1980. Annotated list of the arachnid fauna of Kïpahulu Valley below 2000 feet. in: *Resources Base Inventory of Kïpahulu Valley below 2000 feet.* CPSU/UH (Joint publication by the University of Hawai'i and The Nature Conservancy). pp. 109-18.

Gon, S. M., III & E. O. Price. 1984. Behavioral considerations in invertebrate domestication. *Bioscience* 34:575-9.

Loope, L. & S. M. Gon III. 1989. Biological diversity and its loss. in: Stone, C. ed., *Conservation Biology in Hawai'i.* pp. 109-17.

Nagata, K. & S. M. Gon III. 1988. *Sanicula mariversa* (Apiaceae), a new species from 'Ōhikilolo Ridge, Wai'anae Mountains, O'ahu, in the Hawaiian Archipelago. *Systematic Botany.* 12(3):406-9.

Stamps, J. A. & S. M. Gon III. 1984. Sex-biased pattern polymorphism in the prey of birds. *Ann. Rev. Ecol. Syst.* 14:231-53.

Publications in preparation:

Gon, S. M., III & L. W. Pinter. Convergent diurnal cryptic postures of Hawaiian leaf-dwelling spiders. *J. Arachnol.* (target publication).

Gon, S. M., III. Facultative herbivory in a spider: Resource-dependent shifts in foraging behavior. *Animal Behaviour* (Target publication).

Gon, S. M., III. Reversal of vulnerability in predatory interactions of the spider *Theridion grallator* and the fly *Lispocephala* sp. *Behav. Ecol. Sociobiol.* (Target publication).

Gon, S. M., III & Hawai'i Heritage Program. Numerous publications in prep, by request only.

Gon, S. M., III, J. Jacobi & L. W. Cuddihy. *Hawaiian Ecosystems.* (Book project).

Gon, S. M., III & M. M. Bruegmann. 'Ihi'ihilauākea, a Hawaiian vernal pool with distinctive anhydrobiotic crustaceans, reappears after a decade. *'Elepaio* (J. Hawai'i Audubon Soc.) (Target publication).

Professional Experience

Research:

- Stipended Field Researcher. Mammalogy/Vegetation Ecology. 1976
  NSF project: Resources Base Inventory of Manawainui Valley, Maui.
- Stipended Field Researcher. Limnology. 1976
  NSF project: Resources Base Inventory of Manawainui Valley, Maui.
- Stipended Field Researcher. Entomology. 1977.
  NSF project: Resources Base Inventory of South Kona, Hawai'i.
- Student Research Assistant. Comparative Psychology. 1977 - 1978.
  Language aquisition studies in the bottlenose dolphin *Tursiops truncatus*.
  University of Hawai'i Marine Mammal Facility, Kewalo Basin.
- Laboratory Researcher. Biological Control. 1978.
  Evaluation of a potential biological control organism for *Clidemia hirta* (Pseudococcidae). Hawai'i State Department of Agriculture.
- Contract Field Researcher. Taxonomy. 1980.
  Taxonomic survey of the arachnid fauna of Kīpahulu Valley below 1000 feet. University of Hawai'i (CPSU/UH)
- Doctoral Research. Behavioral Ecology. 1979 - 1983.
  Comparative behavioral ecology of the spider *Theridion grallator* (Simon) in the Hawaiian Archipelago. Animal Behavior Graduate Group, University of California, Davis.
- Contract Field Researcher. Taxonomy. 1985
  Taxonomic survey of the arachnid fauna of the Central Crater District. Haleakalā National Park and University of Hawai'i (CPSU/UH)

(continued next page)

Professional Experience (continued)

- Editorial and Research Assistant. Taxonomy. 1985 - 1986.
  Catalog of Diptera of the Australasian/Oceanic Region.
  Bernice Pauahi Bishop Museum.
- Post-Doctoral Associate. Invertebrate Zoology. 1986 - 1988.
  Invertebrate Survey of the Waimanu Estuarine Sanctuary.
  University of Hawai'i, Entomology Department.
- Ecologist. Community Ecology. 1986 - ongoing.
  Hawai'i Heritage Program, The Nature Conservancy of Hawai'i.
- Field Ecologist, Community Ecology. 1988 - 1989.
  Hawai'i State Natural Area Reserve System Inventory.
  Hawai'i Heritage Program for Hawai'i State Department of Land and Natural Resources, Division of Forestry and Wildlife.
- Hawaiian culture & natural history consultant. 1995 - ongoing.
  Moanalua Gardens Foundation.

Teaching:

- Teaching Assistant, University of California Zoology Department.
  General Zoology Laboratory Course. 1978 - 1981.
- Team Teaching, University of California Animal Behavior Group.
  Animal Behavior Course (Topics in Animal Behavior). 1982.
- Course Reader, University of California Zoology Department.
  Zoology Course (Introduction to Animal Behavior). 1982.
- Guest Lecturer, University of Hawai'i General Science Department.
  General Science Course (Science: Hawaiian Perspective). 1984.
- Additional Teaching/Lecture opportunities. 1985 - present.

Administration:

- Science Staff Director. 1991 - 1992.
  Hawai'i Natural Heritage Program, The Nature Conservancy of Hawai'i.
- Program Coordinator. 1992 - 1995.
  Hawai'i Natural Heritage Program, The Nature Conservancy of Hawai'i.
  Supervising professional scientific and production staff of 15, ca $1 million annual program budget.

See **Biographical Summary** for other pertinent skills and activities.

Membership In Scientific Societies

American Society for the Advancement of Science
American Arachnological Society
Animal Behavior Society
Bishop Museum Association
Centre International de Documentation Arachnologique
Hawai'i Audubon Society
Hawaiian Entomological Society
Natural Areas Association
Sigma Xi (Scientific Research Society)
Society for Conservation Biology
Society for the Study of Evolution

References

Mr. Kelvin Taketa
Vice President, Pacific Region
The Nature Conservancy
Honolulu, Hawai'i
phone: (808) 537-4508

Mr. Alan Holt
Director of Science and Stewardship
The Nature Conservancy, Hawai'i Field Office
Honolulu, Hawai'i
phone: (808) 537-4508

Mr. Steven P. Perlman
Endangered Species Exploratory Botanist
National Tropical Botanical Gardens
Lawai, Kaua'i, Hawai'i
phone: (808) 332-7324

Mr. Lorin T. Gill
Educational Director
Moanalua Gardens Foundation
Honolulu, Hawai'i
phone: (808) 839-5334

Biographical Summary

Born: [redacted]
Status: [redacted]

Volunteer work in conservation/education projects:

- Hawai'i Service Trip Program (HSTP). 1973 - 1990. Resource management projects for Hawai'i state, federal & private conservation agencies: trail building/maintenance, feral animal & alien plant control and field education. Participant, Leader, Steering Committee member.
- Member, The Nature Conservancy of Hawai'i. 1983 - ongoing.
- Conservation Chair, Honolulu Group, Sierra Club, 1983.
- Kahana Valley State Park Advisory Committee Member. 1985.
- Executive Committee at large member, Chapter Secretary, Chapter Vice-Chair. Sierra Club, Hawai'i Chapter. 1985 - 1987.
- Certified Outings Leader. Sierra Club, Hawai'i Chapter. 1979 - 1990.
- Advisory Committee Member, 'Ōhi'a Project. 1989 - ongoing. Educational curriculum project for Hawaiian environmental topics.
- Advisor & Construction assistant, Hawai'iloa Canoe Project. 1993-94. All natural material Hawaiian voyaging canoe.

Biological and Ecological Consultation:

- Biological research and environmental assessment of Haleakalā National Park, boundary fence project. 1984 - 1986.
- Biological consultant, National Geographic article: Hawaiian ecosystem succession, W. Amos, author. 1989.
- Biological research, writing and design, State of Hawai'i Natural Area Reserves public information brochures, State Department of Land and Natural Resources. 1991 - 1993.
- Biological consultant, National Geographic article: Hawaiian extinctions, 1995.

Art, Music,Writing, Hawaiian Studies:

- Linoleum block printing. Works have been displayed at the Volcano Art Center, Hawai'i and Bishop Museum, Honolulu. 1983 - 1988.
- Mixed media illustration. Contract work with Moanalua Gardens Foundation depicting Hawaiian cultural and historical events of Moanalua area. 1984 - 1986.
- Mixed media illustration. Contract work with Hawai'i Educational Television depicting the making of Hawaiian paper cloth (kapa). 1986.
- Ancient Hawaiian dance in the hālau of Edward Kalahiki. 1985 - 1987.
- Hawaiian slack key guitar. Self taught as a pastime. 1974 - ongoing.
- Poetry and short story author. Examples published in issues of *Bamboo Ridge: The Hawai'i Writers' Quarterly*, 1989 - 1993.
- Hawaiian chant (oli). in the hālau Nā Wa'a Lālani Kahuna o Pu'u Koholā, under Kumu John Keolamaka'āinana Lake. 1994 - ongoing.

Curriculum Vita

Puanani Onāpali Anderson-Wong

August 1995

Education:

M.S. in botanical sciences (botany), University of Hawai'i at Mānoa. May 1994.
B.A. in biology (with highest honors), Grinnell College, Iowa. Dec 1981.
7th form certificate (first in biology), Rotorua Girls' High, New Zealand, Dec 1975.
High school graduate (valedictorian), Kamehameha H. S., Honolulu, May 1975.

Research, Academic, and Administrative Employment (Chronological listing):

Research Associate IV, Dept. of Entomology, University of Hawai'i at Mānoa. 30 May 1994 to 31 August 1995.

Field botanist and private contractor, 1984 to present. Contractor has designed, implimented, executed, and composed final reports for botanical surveys on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i.

Instructor in Hawaiian botany and ethnobotany for the Elderhostel Program, University of Hawai'i at Mānoa. 1 Jan 1989 to present.

Field botanist, contractor, grant awardee for the Native Hawaiian Culture and Arts Program, Honolulu. 1 Apr 1991 - 30 June 1993.

Stockroom organizer, Botany Dept., Univ. of Hawai'i at Mānoa. 1 Jan 1990 - Sept 1992. Supervisor, Geraldine Ochikubo.

Research assistant and lab organizer for Dr. Sterling Keeley, molecular plant systematist, University of Hawai'i at Mānoa. 1 Jan 1992 - 30 June 1992.

Research assistant in Hawaiian ethnobotany for Dr. Isabella Abbott, Wilder Endowed Chair, University of Hawai'i at Mānoa. 1 June 1989 - 30 May 1991.

Teaching assistant, Botany Dept., Univ. of Hawai'i at Mānoa. Courses taught: Plant Taxonomy (Bot 461); General Botany (Bot 101); Hawaiian Ethnobotany (Bot 105); Plants in the Haw'n Environment (Bot 130); Natural History of the Hawaiian Islands (Bot 450); and Campus Plants (Bot 160). 1 Aug 1987 - 30 June 1991.

Personal administrator for terminally ill cancer patient and, subsequently, decedent's estate. 1 August 1986 - 31 July 1987.

Teaching assistant in biology, Biology Dept., University of Hawai'i at Mānoa. Taught cellular & organismal biology (Bio 221/222). 1 Aug 1984 - 30 July 1986.

Research assistant and secretary (a computer/data entry/word processing position), QED Research, Palo Alto, California, August 1983 - June 1984.

Full-time teacher of science and mathematics (biology, elementary physics, and prealgebra through precalculus) at Sierra High School, Palo Alto, California. Wrote own biology course. August 1982 - June 1983.

Word processor and secretary for three USDA plant physiologists and their lab, University of Illinois at Champaign/Urbana, Jan. 1982 - July 1982.

Laboratory and teaching assistant for Biology Dept., Grinnell College, Iowa. Worked in taxonomy, ecology, and anatomy. August 1977 - December 1981.

Assistant Vegetation Ecologist, Multidisciplinary Survey of Manukā, South Kona, Hawai'i. An N.S.F. Student Originated Study. May 1977 - August 1977.

Project director & initiator, Waonahele Garden Project (an arboretum of native lowland plant species), Kamehameha Schools, Honolulu, Jan. 1976 - June 1977.

Description of experience in Hawaiian natural history:

Research associate. Performed extensive field work to document and investigate the effect of the two-spotted leaf hopper (*Sophonia rufofascia*) on native plant communities on the islands of O'ahu and Hawai'. Performed botanical surveys of weed species emerging in *uluhe* (*Dicranopteris linearis* and *D. emarginata*) patches on O'ahu. Ran research lab that supported research on pests of macadamia and performed extensive weed survey and identification work in macadamia orchards on the island of Hawai'i.

Master's research. Thesis title: "*Some environmental indicators of feral pig activity in a Hawaiian rain forest.*" Research demonstrated a relationship between earthworm density and the level of feral pig activity in Upper Hāna Rain Forest, East Maui island, Hawai'i. Research includes publishable reviews of earthworms in Hawai'i and of feral pig activities worldwide. 1984 - 1994.

Consultant research. Contracted by the Native Hawaiian Culture and Arts Program to locate and assess naturally occurring populations of *olonā* on the islands of O'ahu, Maui, and Hawai'i. Comprehensive reports were completed for each of 18 surveys. Recommendations were made to NHCAP regarding the feasibility of harvesting and cultivating these plants. 1 Apr 1991 - 30 June 1993.

Research assistant and lab organizer for Dr. Sterling Keeley, molecular plant systematist, University of Hawai'i at Mānoa. Completely cleared and cleaned existing lab and established new one. Duties included disposal of hazardous materials, installation of shelves and furniture, ordering equipment and supplies, and organization of new lab. 1 Jan 1992 - 30 June 1992.

Research assistant in Hawaiian ethnobotany for Dr. Isabella Abbott, University of Hawai'i at Mānoa. Compiled extensive appendix (50 pp.) cross-referencing Hawaiian ailments and conditions with the treatments prescribed for them by a traditional Hawaiian healer (*kahuna lā'au lapa'au*)--part of a book-in-progress on traditional Hawaiian medicinal practices. Also co-authored appendix of scientific and Hawaiian plant names for previously mentioned work. Wrote and edited parts of Dr. Abbott's recently published (1992) book on ethnobotany, *Lā'au Hawai'i.* Wrote and delivered four different lectures for Dr. Abbott's ethnobotany course (Bot 105) at U.H. Mānoa. Job required knowledge of the Hawaiian language and Hawaiian plants, as well as expertise with computers and several different word processors. 1 June 1989 - 30 May 1991.

Assistant Vegetation Ecologist. Participated in a multidisciplinary survey of Manukā, South Kona, Hawai'i Island, sponsored by the National Science Foundation. Helped to survey transects from mountain top to ocean during three months of uninterrupted field work. Completed a 60-page report on a small portion of the data. 15 May 1977 - 15 August 1977.

Project director, Waonahele Hawaiian Garden. Began, implemented, and completed the restoration and replanting of Waonahele, a 1.5 acre garden of native Hawaiian plants on the campus of Kamehameha high school. Careful research was required to determine which plants species would grow on the site. Other responsibilities included: organizing volunteer labor, soliciting and shipping all plant donations, maintaining accession files, preparing annual budget reports, and composing extensive documentation for the Bishop Estate. Also advised a group of high school students, called the "Waonahele Club," who worked in the garden and attended meetings to learn about Hawaiian plants (non-paid position). Also wrote manuscript "The Plants of Waonahele," available in the Hawaiian Collection, Midkiff Learning Center, Kamehameha Schools. Jan 1976 - June 1977

Other Botanical and Ethnobotanical Experience:

Botany instructor for the UH Elderhostel Program. Have developed a day-long seminar including three lectures on Hawaiian plants and a walking tour of a Hawaiian ethnobotanical garden. (Paid position.) January 1989 to present.

Field interpretter (instructor) for natural history hikes for the Sierra Club and the Lili'uokalani Childrens Foundation. Have instructed students of all ages on Hawaiian ethnobotany, Hawaiian plant evolution, and Hawaiian ferns along O'ahu trails. (volunteer position). 1994 to the present.

Botanical tour guide for Lyon Arboretum. Lead walking tours of the Beatrice Krauss ethnobotanical garden and other areas in the arboretum. (Volunteer positioñ.) January 1976 to the present.

Academic & Botanical Awards and Honors:

Grant recipient, 1991. Native Hawaiian Culture and Arts Program.

Conservation Fellowship recipient for 1986-87. National Wildlife Federation.

Highest honors in biology (graduation with). Grinnell College, Iowa, 1981.

Phi Beta Kappa. One of six students elected to the society as a junior from Grinnell College, June 1981.

Rosenthal Honors Scholarship, four year recipient, Grinnell College. 1977-1981.

First in biology, 7th form graduation, Rotorua Girls' High School. Jan 1976.

Valedictorian and Francis Lemon Award for outstanding female scholar. The Kamehameha Schools, Honolulu. May 1975.

American Field Service finalist & scholarship recipient. Jan 1975 - Jan 1976.

Yale Book Award. Outstanding junior scholar in the state. May 1974.

Ann Kaleilokelani Tsuha
[redacted]
Pā'ia, Hawai'i 96779
Telephone: [redacted]

Position Desired

Full-time/ Part-time Cultural Consultant.

Education

Maui Community College and UH Mānoa Outreach, 1993 to present.
Current standing: sophomore.
Major: Liberal arts, hawaiian studies, and education.

Baldwin High School, 1979-1983.
Graduated with general academic degree.

Employment History

Po'okela Program, peer-counselor for native Hawaiian and native American students.
Maui Community College, 1994 to present.

Maui Community College, language teacher.
VITEC, 1994.

Pūnana Leo O Maui, language teacher.
1991 to present.

Kula Kaiapuni O Maui, part-time Hawaiian immersion teacher.
1991 to 1994.

Department Of Education (Hawai'i), Hawaiian language teacher-adult ed.
1992-1994.
Hawaiian studies Instructor-D.O.E.-Kupuna program.
1992.

Cultural Experiences

Coordinated educational and cultural groups to Kaho'olawe.
Documentation coordinator for Restoration / Revegetation Project-Kaho'olawe.
Cultural consultant to Ka 'Ohana O Kahikinui.
Land management and feral eradication team for Ka 'Ohana O Kahikinui.
Hawaiian language/culture advisor for Nā Po'e Hawai'i Magazine.
Participant in ceremonies for the return of Kaho'olawe to State of Hawai'i.
Participant in ceremonies at Pu'u Koholā Heiau, Kawaihae.
Participant in Nāmaka'eha '93, state wide unification ceremonies at Kilauea Crater.

Affiliations

Member-Protect Kaho'olawe 'Ohana
Member-Ka 'Ohana O Kahikinui
Student-Pā'ū O Hi'iaka (Hālau Hula)
Student-Pā Ku'ialua (Hālau Lua-Sponsored by NHCAP Bishop Museum)

References

Academic:
Maui Community College, Student services
310 Ka'ahumanu Avenue
Kahului, Hi 96732

Employment:
Lui Hokoana
Maui Community College
310 Ka'ahumanu Avenue
Kahului, Hi 96732

Personal:
Hōkūlani Holt-Padilla
[redacted]
Wailuku, Hi 96793

Adam T. Kahualaulani Mick

Permanent Address
[redacted]
Kailua, HI 96734
(808) [redacted]

Formal Education: -B.A. Degree, Hawaiian Studies, Hawaiian Language concentration
University of Hawai'i at Manoa, December 1994
-Colorado State University, Fall 1989 - Spring 1990
-Kalaheo High School, June 1989

Related Education
and Experience:

Oct.1990-present **Protect Kaho'olawe 'Ohana**
-Various work and cultural accesses.
-Participant in 3 consecutive Makahiki opening and closing ceremonies.
-Currently in training as Mo'olono. (Mo'olono are cultural keepers with a five-year commitment to direct and carry out the Makahiki ceremonies on Kaho'olawe).
-Deep concern and interest in the future of Kaho'olawe, Kohemalamalama o Kanaloa.

Jan. - May 1995 **Kumu, Ho'olokahi Project, Polynesian Voyaging Society**
Honaunau, South Kona, Hawai'i and Wai'anae, O'ahu
-Taught students from various high schools and native-Hawaiian programs to sail a traditional double-hulled coastal voyaging canoe (Eala) with major focus on understanding, working with, and sustaining the natural enviroment by applying traditional native values in Hawai'i today.
-Students from Konawaena, Hale o Ho'oponopono, Hilo High, Ka'u

Na Pua No'eau, Na 'Imiloa, and Wai'anae learned traditional coastal sailing and navigation and then planned and carried out coastal voyages on their own, in conjunction with Hokule'a, Hawai'iloa, and Makali'i's voyage to the South Pacific and Back.

Aug.-Dec. 1994 **Papa Ho'okele HoloKahiki**
University of Hawai'i at Manoa and Pier 36
-Lab intensive course in traditional Polynesian navigation and sailing.
-Taught by Nainoa Thompson and Chad Babayan, traditional navigators for the Polynesian Voyaging Society's Double-hulled canoes.
-Course included star-labs, coastal and inter-island sails on Hokule'a, Hawai'iloa, and Eala, discussions on sustaining Hawai'i's future, and preparing the canoes for the 1995 voyage.

Sept. 1993-
Nov. 1994 KTUH, 90.3 fm
University of Hawai'i at Manoa
-Dee-jay for Hawaiian language radio show.
-Kaho'olawe, sovereignty, and language issues often discussed.

Feb. - May 1993 Kula Kaiapuni, Hawaiian Immersion School
Waiau Elementary
-Assistant teacher for first-grade Hawaiian immersion students as part of a university course exploring language in the classroom.

Sept.1990-
Jan. 1993 Ka Papa Lo'i 'O Kanewai
University of Hawai'i at Manoa
-Weekend volunteer in the lo'i taking care of the plants and the taro while learning cultural values, traditional food preparation, and Aloha 'Aina.

Jan. 1974 -
Dec. 1980

NahalauokalaniakeanuiamamaomenapualikolehuaoHawai'inei
Hanaiakamalama, Queen Emma Summer Palace, Nu'uanu, O'ahu
-Classes in Hawaiiana, hula, Hawaiian language, traditional herbs and healing, and Hawaiian spirituality. Included many excursions around the island.
-Taught by Auntie Emma Defries, a kahuna of the la'aukahea order (healing class) and one of the first kahu of the Protect Kaho'olawe 'Ohana. She performed healing ceremonies on Kaho'olawe with kahuna, Sam Lono in 1977.
-Kahualaulani is my Hawaiian name as given by Auntie Emma. Other than parents, has had the most impact in a profound way upon my life.

Honors Received:

Recognition and praise of radio show in the Honolulu Advertiser and the KTUH journal.
Acceptance into Mo'olono training on Kaho'olawe.

Organizations:

Protect Kaho'olawe 'Ohana
Polynesian Voyaging Society
Kawainui Heritage Foundation
'O Wai La - Hawaiian Band
Beta Theta Pi - national fraternity

faxrjh2.frm

NATIONAL PARK SERVICE
PACIFIC AREA OFFICE
300 Ala Moana Blvd., Box 50165
Room 6305
Honolulu, Hawaii 96850

FAX TRANSMITTAL

To: Mike Naho'opi'i
Voice Phone:

Fax Phone: 944-1618

From: **Robert J. Hommon** Voice Phone: **(808) 541-2693** Fax Phone: **(808) 541-3696**

Date: **25 Aug 95** Time: 1315
Number of pages, including this sheet: 1

SUBJECT: HARDTACK AND RADIOCARBON DATING

MESSAGE: **In response to your inquiry about the possible effects of Hardtack on radiocarbon dating on Kaho'olawe: I understand that Hardtack is simply corn starch and water, that your company would like to spray it on the ground surface to reduce wind erosion, and that the hardtack would wash away with the first rain. Your question was whether this carbon-based substance would skew the age determination of a radiocarbon sample if the hardtack came in contact with the sample.**

I discussed this issue with Dr. Tom Dye (SHPO Archaeologist), who has conducted a lot of research in the last few years with radiocarbon data. He believes, and I concur, that the routine thorough cleaning of samples by radiocarbon labs is very effective in ridding samples of introduced organic carbon. Such cleaning is routine because an uncleaned sample usually contains humic acids and other compounds from plant debris and other sources that are virtually always found in soils. If the skewing effect of such substances could not be dealt with by cleaning, the radiocarbon technique would be practically useless for charcoal. Spraying with hardtack could be a problem if the sample were a small piece of wood (rather than charcoal), but such cases are rare in Hawai'i, and are, in any case, also subject to error from the many other sources of carbon in the soil.

One word of caution: what I have said above may not be true of fertilizers, pesticides and other petroleum-based substances.

- Rob