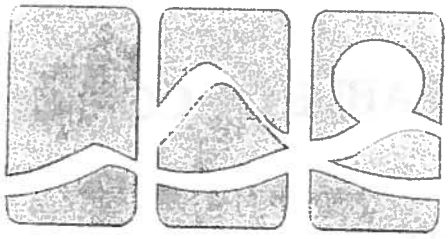

THE KOHALA CENTER
for pacific environments

Assessment of Natural Resources

Assessment of Cultural Resources

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INTRODUCTION

This draft report assesses the natural resources of the Kealakekua Ranch (Ranch). The Ranch includes approximately 11,000 acres and extends from 2,200 to 6,000 feet above sea level. The report provides a brief overview of the ahupua'a and watershed in which the Ranch resides and is followed by summaries of the climatic conditions influencing the resources and the physical, hydrological, and biological natural resources of the Ranch.

Initial possibilities for educational and research opportunities (in addition to those already identified by Noe Noe Wong-Wilson and Tom Pace) related to these resources are presented after the assessment. The assessment recognizes that the remnant native forests patches and the hydrology of the Ranch are intimately related. The forest and the water offer compelling opportunities to develop new knowledge regarding these resources, their relationship to one another, and how human inhabitation can affect and enhance these resources with benefits that extend to the surrounding community. To borrow from Dr. Tangaro's report on cultural resources:

Hahai no ka ua I ka ulu la'au
The rain always follows the forests.

KEALAKEKUA AHUPUA'A & WATERSHED

The land area that drains to a common point defines a watershed. An ahupua'a may contain one or more watersheds or, if the ahupua'a is smaller, a watershed may contain one or more ahupua'a. The Kealakekua Ranch is part of the Kealakekua ahupua'a. The Kealakekua ahupua'a is the largest of eight ahupua'a which drain to Kealakekua Bay and comprise the Kealakekua watershed. Within the ranch are twenty-two drainage areas, which are subwatersheds of the larger Kealakekua watershed.

Actively or passively managing water resources was integral to the ancient ahupua'a land management and social system, just as understanding and managing the human relationship to water is central to contemporary watershed management. The health of a watershed's natural resources--and ultimately the health and quality of life of those that use and inhabit a watershed--are dependent on the movement, availability, and quality of the water.

CLIMATE

Both a draft 1991 environmental assessment for the Ranch (R.M. Towill, 1991) and the Kona Soil and Water Conservation District describe the unusual climatic conditions for the Ranch and Kona as unique in Hawaii. Warm ocean air is pushed up the slopes of Mauna Loa by convection currents and onshore breezes. The air cools as it rises up the mountain, creating clouds, fog and precipitation. Kona's wet season is between April and September when the days are longer and convection and uplift of moisture are more active. During each of these months, the Ranch receives five to seven inches of rain. During the dry months of October through March, the Ranch receives between two to four inches per month.

An inversion layer between 4,000 and 6,000 feet effects the convectional weather system. The cold air layer blocks uplift causing reduced rainfall in the upper elevations. The spatial variation of rainfall on the Ranch is congruent with this. Upper elevations receive 25 to 35 inches per year of rain, where the mid elevations below the inversion--also the areas of the greatest fog and mist--receive 75 inches per year. The lowest elevations of the Ranch receive 45 inches of rainfall per year.

This weather system is unique in the State because it is a summer maxima system that does not depend on trade wind flow for precipitation. The trade winds are blocked in Kona by three large volancoes.

The average annual temperatures on the Ranch range from 68 degrees Fahrenheit at 2,000 feet to 65 degrees Fahrenheit at the higher property boundary. The average annual temperature at sea level is 75 degrees.

In Kona the conversion of forested areas to pastureland can change precipitation patterns. The heating and cooling of the earth's surface affects convectional rainfall patterns. Clearing of forests decreases interception and the return of water through evapotranspiration back to the atmosphere. Conversions can contribute to decreased rainfall and higher surface temperatures. Reciprocally, reforestation and restoring vegetation can positively influence local climatic and hydrologic conditions.

Kona and the Ranch experienced extended dry periods and droughts through much of the late 1980's to 2003. A combination of factors have been implicated for the drought, although not definitively proven, including the eruption of Kilauea Iki Volcano in the 1983, deforestation in the upper slopes of Mauna Loa and Hualalai, and global warming. The most severe events have been associated with the El Nino phenomenon (DLNR-CWRM, 2004). The state's Hawaii Drought Plan notes that the "drought of 1998 to 2003 has wreaked havoc on the farmers and ranchers of Hawaii, especially those on the southeastern end of the State."

In extremely dry times almost any area populated by brush and weedy species, such as the pasturelands of the Ranch, can readily ignite. In the driest of years a lowland-generated brush fire could move uphill, pushed by strong convectional winds, igniting upland native forest areas and threatening any inhabitants on the Ranch. Increasing forest cover and reducing fire fuel load through grazing are management strategies for reducing fire risk.

PHYSICAL CHARACTERISTICS

Geology

The geology of this area is relatively young and underlain by typical thin basalt lava flows to great depth. There is no evidence of a rift zone or other geologic features that interferes with the monotony of the flank lavas. Exposed surfaces consist of the Kau and Kahuku volcanic series, which are both extremely permeable baslats through which water passes easily.

Soils

The Ranch includes seventeen soil types as defined by the Natural Resource Conservation Service's Soil Survey (R.M. Towill, 1991). Most of these soils are highly permeable with very thin layers of topsoil. Ranch soils have had little time to develop and are therefore shallow to non-existent in some areas. However, some "soil islands" do exist. The lower portion of the ranch contains an area with topsoils with depths ranging from 18 inches to six feet, which would be more suitable for agriculture activities.

Topography

The upper and middles portions of the Ranch have slopes of five to ten percent or less. The lower elevations have significantly steeper slopes, reaching gradients of fifteen percent or more. Between the lowest portions of the Ranch and Route 11, slope gradients reach 20 percent.

Because the geology is young and the soils are permeable, erosive forces have not greatly impacted the surface. Drainage channels are shallow, not well defined and have limited capacity to carry storm runoff. Many of the channels are the result of collapsed lava tubes. A large volcanic crack (Kikuya Crack) traversing the southwest corner of the Ranch from the 2,500 foot to 2,800 foot elevation is mapped in a 1993 drainage study (R.M. Towhill, 1993). This study also notes another crack, Pauahi Crack, in the upper portion of the Ranch. The study advises that scientists have documented that runoff entering these types of cracks may act as a lubricant and cause slippage and failure. Therefore, these natural features should not be used to control storm or flood waters.

BIOLOGY

Because Hawaii's life forms evolved in complete isolation, without influence from the continents for millions of years, many of these species are found only in Hawaii . Unfortunately, a great number of Hawaii's plants and animals are endangered or threatened by extinction, primarily due to loss of habitat and the introduction of alien species.

Hawaii's flora and fauna are also very diverse. Biological diversity is a strong measure of environmental health and includes not only the number of species, but also the species' interactions, functions, and processes that benefit people. These processes include flood buffering, air and water purification, climate regulation, and soil regeneration. Many of these processes are essential to human survival and occur on such a large scale and in such intricate and little-explored ways that most could not be replaced by technology. (Daily *et al.* 1997). For instance, it is estimated that the Ko'olau watershed on Oahu provides 4.5 to 8.5 billion dollars in groundwater protection and treatment (The Nature Conservancy, 2003). Similar valuations have not been made for any of Hawaii Island's watersheds or ahupua'a, but the general economic value of diverse, intact forests and ecosystems is well documented (Benotto, 2002).

Plant Communities

There are at least three plant communities present on the Ranch: 'Ohi'a Montane Forest, Koa/'Ohi'a Montane Mesic Forest, and pastureland. Ohi'a Montane Forests are moderately imperiled, while Koa/Ohi'a Montane Mesic Forests are considered rare and imperiled. An environmental assessment completed in 1993 by R. M. Towill Corporation for Kealakekua Ranch included studies of the Ranch's flora and fauna. The botanical study categorized 70 percent of the Ranch lands as pastureland with scattered trees or with small stands of 'ohia'a trees. The study found that open to closed canopy 'ohi'a forest covered the remaining 30 percent of the Ranch.

The pastureland was found to be dominated by introduced grasses and herbs, although a few remnant native species were identified. The 'ohi'a forest patches contained a large number of native species. The environmental assessment concluded that none of the native plant species that were identified in 1991 are endangered or threatened by extinction. The validity of this conclusion is not known for 2005. Both O'hia Montane Forests and Koa/'Ohi'a Montane Mesic Forests are often important habitat for endangered birds and Mesic Forests often contain rare plants. The 1991 report also stated that the forest understory had been badly damaged by pigs in some areas.

One of the conclusions of the 1993 environmental assessment was: "The patches of native forest, particularly those with a diverse understory of native plants, are the most important environmental resources on this property."

The environmental assessment concluded this in part because native birds especially, the rare endangered species, are most likely to be found in the less disturbed forest. The benefits these patches of forest provide are also outlined in the Hydrology section below.

The forested areas of the Ranch have also been identified as important habitat areas based on a dominant canopy cover of trees and limited "ground truthing" by the Kona Soil and Water District.

During an aerial tour of the Ranch in August 2005, two wetlands or bogs and spring areas were identified around the 2,600 foot elevation level. These were not identified in the 1991 botanical or bird and mammal studies. This could be because Kona was in the midst of an extended dry period in 1991 that may have altered these areas.

Hawaii island bogs are characterized primarily by sedges, sphagnum moss, and low-stature 'o'hia of varying density (Cuddihy, 1990). These type of wet natural features can provide unique habitats for rare species. Further field reconnaissance is required to confirm the presence of the bogs and determine the nature of and possible unique attributes of these bogs on the Ranch.

As mentioned in the Hydrology section below, fog drip is likely an important part of the hydrology of the Ranch. Fog drip not only influences hydrology, but can also support ecosystems with unique floristic form. The relationship between fog drip and possible distinctive plant communities on the Ranch is not known.

Birds and Mammals

The 1991 study of the birds and mammals of the Ranch noted two short-eared owls or pueo were foraging over the pasture. The Pueo is an endemic raptor and inhabits dry forests and rainforests, most often seen hunting in leeward pastures. Pueo is sighted and active during the day and evening. Rodents comprise the bulk of its diet, but before rodents arrived, pueo is believed to have fed on the small Hawaiian rail, a flightless bird that is now extinct (MKSWCD, 2005).

One Io or Hawaiian Hawk was recorded in 1991. The Hawaiian Hawk only inhabits the Island of Hawaii, although research on Maui and Kauai indicate that the 'Io may have been widespread through out the Islands (Olson and Olson 1982; Burney *et al.* 2001). The 'Io is an endangered species. The bird sighted in the 1991 study was seen soaring over the forest along the southern boundary of the property. Although the 1991 environmental assessment for the Ranch stated that 'Io range over a wide variety of habitats, recent research states that the distribution of 'Io essentially follows that of native forests and its preferred nesting trees are large Ohia (Klavitter 2000). The 'Io's diet consists primarily of rodents, although it once fed mainly on forest birds (Klavitter 2001).

Four other endemic species were recorded in the 1991 survey: Common Amakihi, Apapane, I'iwi, and 'Elepaio, none of which are endangered. These species are most abundant in closed-canopy forests of ohia and olapa (MKSWCD, 2005). The patches of native forest with an understory of ferns and other native plants contained higher numbers of these birds than did the forest patches that contained grass and were more heavily impacted by cattle and pigs.

The 1991 study listed 'Akepa, 'Akia Pola'au, Hawaii Creeper and 'Alala or Hawaiian Crow as likely candidates of endangered birds that could occasionally occupy the Ranch's forested areas given the native forest composition and elevation. The study indicated that the 'Alala was believed to occur only on lands south of the Ranch.

Nine plover, which are migratory indigenous (native) birds, were recorded in the survey. No resident native birds were recorded. The 1991 environmental assessment stated that this was because of the absence of wetland habitat that precludes the occurrence of this species or any other water bird. However, as stated above, when the environmental assessment was conducted, Kona was in the midst of an extended dry period that lasted until 2003 and an aerial tour in August of 2005 identified two possible bogs.

In other areas of Hawaii extreme reductions in the numbers of forest and sea birds is believed to have affected terrestrial ecosystems and their inhabitants because of the loss of vast quantities of organic waste, including guano, lost eggs, dead birds, spilled food, and molted feathers (Loope 1998). The nitrogen and phosphorus-rich guano deposits would have enriched soils and might have affected vegetation and ecological community structure (MKSWCD, 2005).

The 1991 bird and animal survey recorded 16 exotic bird species. The most abundant species were Japanese White-eye, Yellow-fronted Canary, and Nutmeg Mannikin. Small Indian Mongoose, feral cats and dogs, and pigs were also recorded. The understory in some areas was badly damaged by pigs. During the August 2005 helicopter tour of the Ranch feral goats were also spotted.

HYDROLOGY

The Ranch lands are a significant portion of the Kealakekua watershed area, approximately 25%. See Figures 1 and 2 for delineations of the Kealakekua watershed within the Kona District and greater Hawai'i Island. Water assumes various forms as it cycles through the watershed. Understanding these forms how land use can impact the hydrology of the area and the water's relationship to the land, and its inhabitants--is critical to understanding how to best inhabit the land for optimal health and well-being for all. Various aspects of the hydrology of the Ranch, including surface water and ground water and fog drip, are presented below.

Surface Water

Because the geology is young and the soils are permeable, surface water drainage pathways and channels are shallow, not well defined, and have limited capacity to carry storm runoff. Many of the channels are the result of collapsed lava tubes and not the result of the erosive forces of water. There are no perennial (year round) streams. In-channel flow occurs when the rainfall intensity exceeds the rate of water infiltration into the ground.

In 1993 a drainage study for the Ranch was conducted by R.M. Towill Corporation. The study identified 22 distinct drainage channels. See Figure 3 for a delineation of the 22 drainage areas. The land areas draining to each of these channels are subwatersheds to the larger Kealakekua watershed.

The deforestation of the ranch has reduced the amount of water that is intercepted and stored by vegetation. This has increased surface runoff and contributed to downslope flooding. Removal of vegetation can also effect local climatic conditions and fog drip (see discussion below). Steep slopes along with split and braided channels in the lower portion of the Ranch also complicate floodplain management.

In the last century surface water leaving the Ranch resulted in flooding makai of the Ranch. Flooding is a concern throughout Kona and especially in the 1,000 to 5,000 foot

elevations of South Kona, where the rainfall intensity is the greatest, where forests have been cleared, and where forest and pasture lands have been converted by development. The Federal Emergency Management Agency has evaluated flood boundaries for numerous drainageways in South Kona as part of the Flood Insurance Study (FIS) for the County of Hawaii. This map identifies only one drainage area on the Ranch to be of concern, channel 21. It is generally thought that the FIS maps are not accurate and need to be updated.

The US Department of Agriculture, Natural Resource Conservation Service's flood hazard analysis for the South Kona area identified three drainage areas on the Ranch that have caused flood damage, 8, 18, and 21. The 1993 Towill drainage study confirms that flood easements need to be considered in land use planning for the Ranch to accommodate the 100 year rainfall event for at least four channels, 8, 10, 11, and 21. All future development needs to be in accord with these floodplain boundaries to minimize hazards to future inhabitants and to avoid increasing flows to these channels and increasing off-site flooding.

In the early 1970's the former Ranch owner created several drainage features to mitigate flooding from the Ranch. The drainage features have effectively redirected much of the surface flow to manmade sumps and the volcanic fissure, Kikuya Crack or volcanic. Knowledge of these features assists in understanding how the natural resources and hydrology of the Ranch have been altered and the possible connection to future land uses. These features include,

- A large manmade pit about 700 feet makai of the Ranch at about the 2,350 foot elevation.
- A small manmade ditch cutting across the northwest corner to intercept and divert water from drainages 1-5 into the pit.
- Two clusters of manmade sumps along drainage channel 8 at the 2,500 and 2,850 foot levels. The lower cluster consists of two sumps, which drain to lava tubes. The upper cluster has three sumps, which overflow to a small opening in a lava tube.

- A berm across an access road diverts drainageway 10 into the sump cluster described above.
- A small dam and overflow along channel 21.

As mentioned in the Topography section above, scientists advise against diverting runoff to lava tubes. These features continue to mitigate downstream flooding, but the 1993 drainage study does not rely on them for use in evaluating future development. Due to the age and unknown construction of the dam, its integrity may need to be evaluated to ensure failure is not likely under heavy flows.

Groundwater

A major portion of Hawaii Island's fresh water exists underground, near sea level, as a fresh water lens above salt water. Some freshwater is perched in aquifers above this lens at higher elevations. These perched aquifers are created by subsurface geological features called dikes, which are low-permeability rock that impede water flow. These perched aquifers allow freshwater resources to be tapped at higher elevations, resulting in lower costs for drilling and pumping water compared to drilling costs to access the Island's freshwater lens.

The Kealakekua aquifer is the primary source of water for South Kona. A recent groundwater study by the state identified a decline in water levels in wells accessing this aquifer (DLNR-CWRM, 2003). A review of the County of Hawaii's Department of Water Supply's annual water quality reports shows that pollutants, likely from surface sources (agriculture, septic systems), reach the Kealakekua aquifer (DWS, 2001-2003).

Not all water that percolates into the ground at higher elevations flows to aquifers. Some water flows subsurface to the ocean. Because the geologic and climatic conditions are so variable in Hawaii, it is difficult to generalize about the subsurface flow paths of water and the connectivity between surface water, groundwater, and freshwater inflow to the ocean. No specific research regarding this connectivity has been conducted in the Kealakekua area. However, research on Maui and other parts of Hawaii Island have identified subsurface connectivity between rainfall, fog drip, and freshwater inflow to the ocean (Scholl et al., 1996, 2002).

Understanding the connectivity between the upper watershed and the ocean is significant because, if there is subsurface connectivity in the Kealakekua watershed, runoff and pollution from mauka land use activities could reach Kealakekua Bay regardless of whether there are surface flows (streams) directly draining into the Bay. Tropical marine environments of Hawaii are naturally nutrient poor and are sensitive to nutrient input. Both surface and subsurface untreated runoff can contain fertilizer residue, pesticides, animal waste, fuel residue, bacteria, and sediment.

Fog Drip

Fog drip is the phenomenon in which forests and plants intercept moisture in the form of fog from the air. The amount of interception that then falls or flows to the ground as precipitation may be significant. Kona's forests, including those on the Ranch, have been beneficiaries of and contribute to maintaining fog and mist processes.

Clearing a forest or harvesting a stand can eliminate a significant source of moisture in a given area (Ingweresen, 1985). Recent studies in cloud forests, including those in Hawaii, have found that the water intercepted by vegetation typically ranges between 10% and 25% of rainfall or more and comprises a larger proportion (up to one-third) of the total precipitation during dry periods (Juvik and Nullett 1995; Bruijnzeel 2000; Bruijnzeel and Hamilton 2000; Bubb 2004; and Scholl et al. 2004).

A study in East Maui found that even though fog drip was only a small component of soil moisture, fog drip was a large component of Ohia tree sap. This same study also determined that cloud water interception adds significantly to rainfall at dry and wet cloud forest sites, contributing an equivalent of 10.6 and 42.3 inches per year, respectively (Scholl et al. 2004).

Watersheds of Hawaii Island

Figure 1

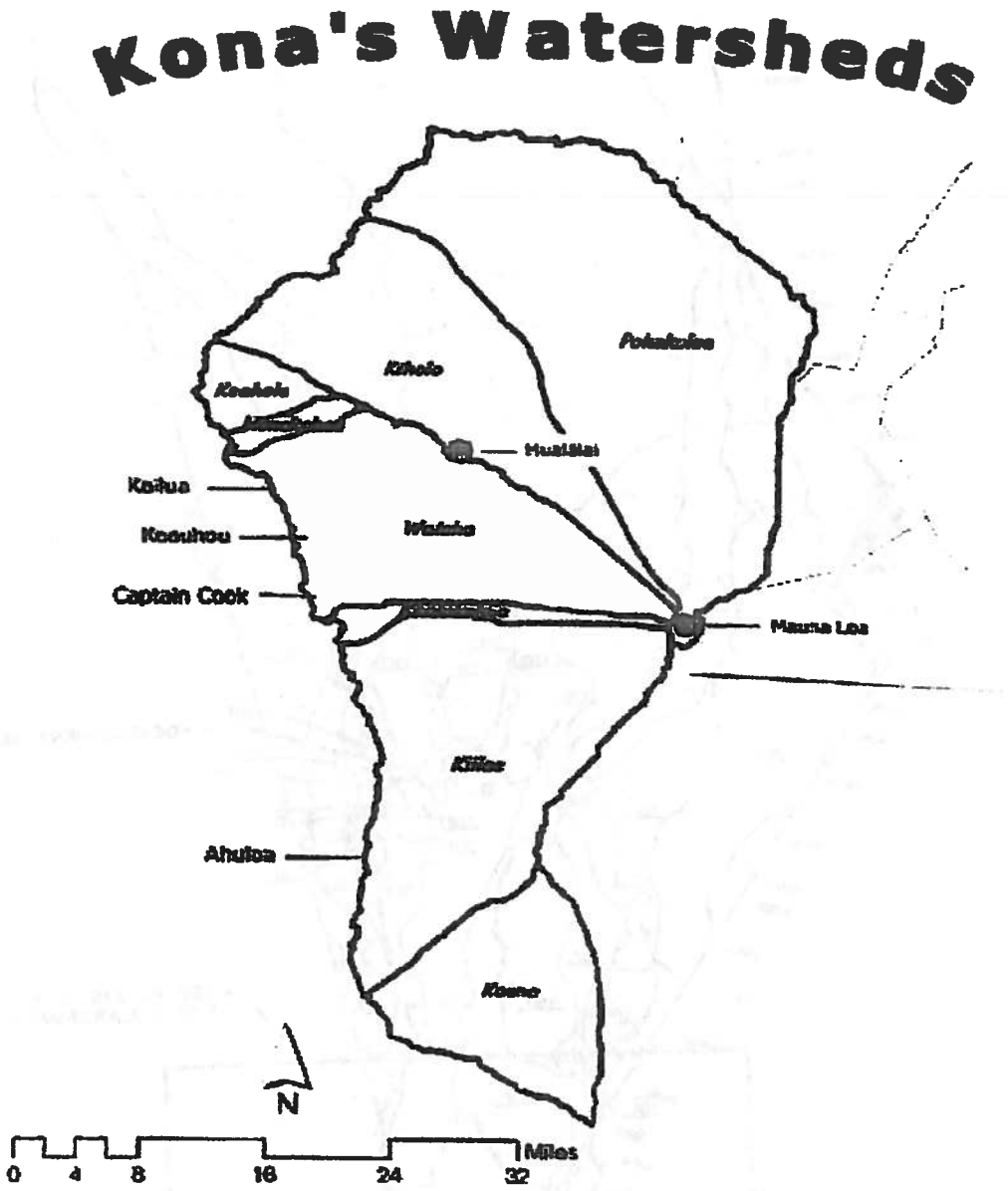

Figure 2

Figure from http://kswcd.org/watersheds.htm

22 Drainages

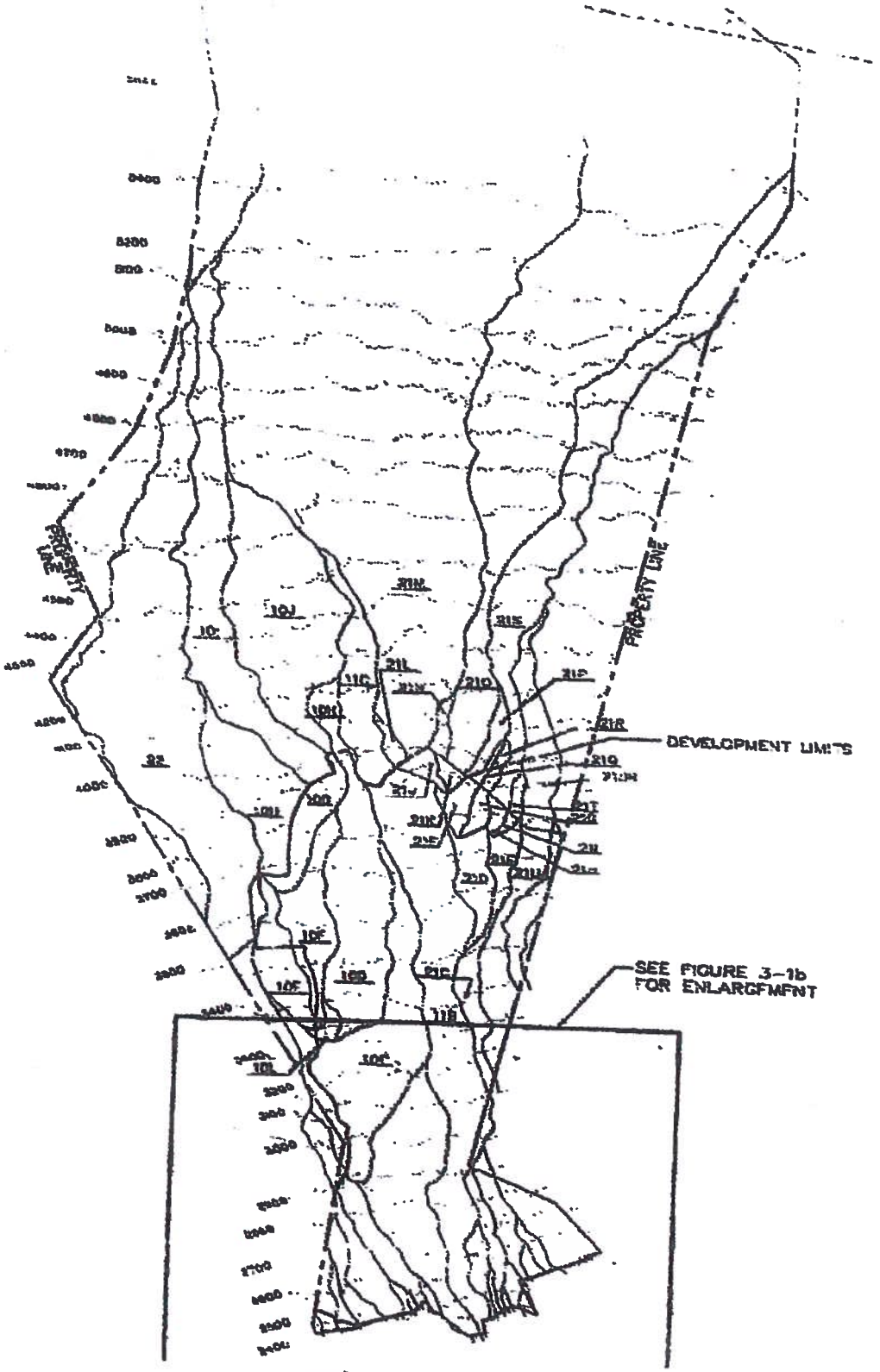

Figure 3

Figure from Drainage Study for the Kealakekua Ranch Lands, 1993, by R.M. Towill Corporation

WATER QUALITY & LAND USE

Water quality is primarily defined by how safe water is for drinking and whether it supports certain uses such as fishing or swimming. Water quality is less of an intuitive subject for the Ranch and its inhabitants since there are no perennial streams or other surface water bodies, except for the possible presence of two bogs. The relationship of Ranch activities to water quality is less direct. However, as stated previously, data shows that surface activities in South Kona do impact the aquifer. And, as discussed in the hydrology section, research in some areas of Hawaii has shown that groundwater can flow from upper elevations to the ocean. Certainly during heavy rains and flooding, surface water from the Ranch impacts the lower elevations of the watershed.

When impacts to resources are less direct and immediate, the phenomena of cumulative effect(s) can still negatively impact natural resources. Cumulative effect is the sum of human activities or pollutants over time that impacts a natural resource. The adverse consequences of pollutants can occur long after they are introduced into the environment. For example, the European forest diebacks in the early 1980's were a sudden, unanticipated, delayed response to pollution in previous decades. Understanding land use can assist in identifying and proactively mitigating potential threats to water quality and other natural resources to avoid contributing to the cumulative impacts on resources. Considered action that takes into account long-term effects will support the unique historical and ecological nature of Kona's forests and associated resources and Kealakekua Bay.

Current land uses on the Ranch include grazing and limited recreational use. A private inholding on the Ranch at the mid-upper elevations is used for educational purposes and outings. Land uses within the last thirty years have included lumber milling, cattle grazing, orchid farming, and equestrian activities. During the aerial tour in August 2005, abandoned machinery and automobiles were noted. Future land uses likely include limited home site development integrated into the landscape, agricultural and farming activities, an equestrian area, high altitude training and research, and large scale preservation of forested areas.

Each one of the current and possible future land uses can introduce negative changes to the physical characteristics and biology of the Ranch, including: increasing and concentrating surface runoff from paved and develop areas, exacerbating flooding; introducing pollutants from home sites and agricultural areas to groundwater and surface runoff; disturbing forest structure with grazing; etc. However each one of these land use activities can be managed to minimize or eliminate negative impacts and can even provide benefit to the natural resources, including: onsite retention and treatment of runoff, managed grazing that reduces fire threat, agricultural practices that incorporate agroforestry and integrated pest management principles, reforestation and management of alien species by inhabitants to support native plants and animals and water supplies, etc.

Over the last 200 years, land use practices in Kona, including the Ranch, have altered the relationship between the forest, the land, the aquifers, and the rain. The disturbed relationship between the health of Hawaii's forests and its water supply for its inhabitants was recognized in 1902 by U.S. Forester E.M. Griffith.

. . . the whole problem is conserving the water supply which depends upon the preservation of the existing forests and restocking some of the denuded slopes either by natural reproduction or planting....Forest protection means not only increasing the rainfall but - more important still - conserving the water supply. Upon the right solution of this problem depends to a very large extent the future welfare and agricultural prosperity of the Hawaiian Islands.

Mr. Griffith's concerns and those of others resulted in an extensive forest reserve system for the state. However continued preservation and reforestation efforts are needed. In 2003, Michael Buck, Administrator of the State's Division of Forestry and Wildlife stated that, "Hawai'i faces a situation where we may run out of drinking water in the next 25 years if we stay on the course we are on (not protecting forest lands). On Oahu, the window of time may be shorter."

Land use on the Ranch can positively influence the relationship between the forests, land, and water and assist in reestablishing balance to human use of these resources. Reforestation, stormwater management, integrated agriculture, management of alien species, etc. will not only provide a long-term benefit to future inhabitants of the Ranch, but to the watershed and region.

EDUCATIONAL & RESEARCH OPPORTUNITIES

In addition to the opportunities identified by Noe Noe Wong-Wilson and Tom Pace, the following are possible educational and research opportunities.

1. Develop and test technologies that restore and preserve the natural resources while providing functional and aesthetic value to Ranch inhabitants.

   Restoration Technologies

   Field testing low cost restoration technology: Some of these restoration best management practices are being developed by The Nature Conservancy and National Park Service. These technologies need to be implemented in varying conditions (TNC and NPS lands are significantly different than active Kona ranch lands) for convenience, cost, and effectiveness. For example, a recent literature review panel concluded that successful invasive species control depends more on commitment and continuing diligence than on the efficacy of specific tools themselves (Mack et al. 2000). Perhaps the least expensive, most effective practice for eradicating the invasives on the Ranch would be for a group(s) to adopt, with a long-term commitment, areas of the Ranch similar to the adopt-a-highway program for litter control. Perhaps a hula halau, as suggested by Noe Noe and Taupouri. or school or church could adopt a section of forest or islands of forest. Partial pig exclusions are another possible low cost restoration technology. There is some evidence that native birds respond to these Islands of exclusion, though other native species may not benefit.

   Stormwater Retention & Treatment

   Design, implement, and test stormwater management features specific to the unique geological conditions of Hawaii that not only retain runoff for slower release or on-site infiltration, but implement features that *treat* storm water: Currently, during intensive rainfall, runoff picks up and carries sediment and a variety of pollutants. Some of this pollutant load eventually ends up in the Island's groundwater or the ocean. Very little research has been done on constructing stormwater control features that mimic natural systems of Hawaii and that use native vegetation to retain and treat stormwater. These features are usually attractive in appearance and their appearance can add cash value to developed properties. This is similar to how a single mature tree adds an average of $10,000 in value to a home because of the aesthetics of older trees.

2. Create knowledge and data regarding the impact to resources and cost-effectiveness of the type of inhabitation planned for the Ranch:

Local data will assist other landowners and policymakers to consider this type of place appropriate "development" balanced with large-scale preservation of land. Generate economic data from computer models with GIS mapping that show the difference in the environmental footprint between how the Ranch could have been developed and how it will be inhabited. Modeling scenarios is a very impactful educational tool. Models can be developed by local high schools and/or community college or university students. Modeling can show the differences in impervious areas created, effects on hydrology, local climate, forest areas impacted, etc. An economic analysis of the different modeled scenarios will provide compelling local data that that show that conservation development/inhabitation is cost-effective and can provide benefit to natural resources and the larger community in intangible (access for cultural and spiritual purposes, visual) and tangible ways (groundwater protection, cottage industries supported by limited resource harvesting, etc.).

REFERENCES

Benotto, C., 2002. Greenbacks in the greenery: Never forget the economic value of trees, parks and open spaces.

Bruijnzeel, L.A. .2000. Hydrology of tropical montane cloud forests: a re-evaluation. In: Gladwell, J.S. (ed.) Proceedings of the Second International Colloquium on Hydrology of the Humid Tropics. CATHALAC, Panama City, Panama.

Bruijnzeel, S. and L.S. Hamilton. 2000. Decision Time for Cloud Forests. IHP Humid Tropics Programme Series No. 13. UNESCO Division of Water Sciences, Paris.

Bubb, P., May, I., Miles, L., Sayer, J. 2004 Cloud Forest Agenda. UNEP-WCMC, Cambridge, UK.

Cuddihy, L.W. and C.P. Stone. 1990. Alteration of Native Hawaiian Vegetation: Effects of Humans, their Activities and Introductions. Honolulu. University of Hawaii Press for University of Hawaii Press for University of Hawaii Cooperative National Park Resources Studies Unit, Honolulu, HI.

Daily, G.C., GC, PA Matson, and PM Vitousek. 1997. Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems. ESA Journal Issues in Ecology, No. 2, Spring 1997.

Hawaii Chapter of the Nature Conservancy, 2003. Economic Impact of Watershed Protection In Hawaii.

Hawaii County Department of Water Supply (DWS), Water quality reports for South Kona, 2001, 2002, 2003.

Hawaii Department of Land and Natural Resources, Commission of Water Resource Management (DLNR-CWRM), 2003. A study of the groundwater conditions in North and South Kona and South Kohala Districts of Hawaii Island, 1999-2001.

Hawaii Department of Land and Natural Resources, Commission of Water Resource Management (DLNR-CWRM). 2004. Hawaii Drought Plan: 2004

Ingwersen, J.B., 1985, Fog drip, water yield, and timber harvesting in the Bull Run municipal watershed, Oregon, Water Resources Bulletin, American Water Resources Association, Vol. 21, No. 3.

Juvik, J.O., and D. Nullet. 1995, Relationships between rainfall, cloud-water interception, and canopy through-fall in a Hawaiian montane forest. *In:* Hamilton, L.S., J.O. Juvik, and F.N.Scatena (eds.). Tropical montane cloud forests: New York, Springer-Verlag.

Klavitter, J.L. 2000. Survey Methodology, Abundance, and Demography of the Endangered Hawaiian Hawk: Is Listing Warranted? MS Thesis, University of Washington. 102 pp.

Klavitter, J.L. 2001. Abundance, Habitat Selection, and Habitat Quality of the Hawaiian Hawk ('io; *Buteo solitarius*). Report to U.S. Fish and Wildlife Service, February 26, 2001.

Loope, L. 1998. Hawaii and the Pacific Islands. *In:* Mac M.J., P.A. Opler, C.E. Puckett Haeker, and P.D. Doran. Status and Trend of the Nation's Biological Resources. 2 vols. U.S. Department of the Interior, U.S. Geological Survey, Reston, Va.

Mack, R.N., D. Simberloff, W.M. Lonsdale, H. Evans, M. Clout, and F. Bazzaz. 2000. Biotic Invasions: Causes, Epidemiology, Global Consequences and Control. ESA Journal Issues in Ecology, No. 5, Spring.

Mauna Kea Soil and Water Conservation District (MKSWCD), 2005. Draft Kohala Mountain Watershed Management Plan. Ornithologists' Union, Washington, D.C.

Olson, S.L. and H.F. James. 1982. Prodromus of the Fossil Avifauna of the Hawaiian Islands. Smithsonian Institution Press, Washington, D.C.

Scholl, M., S. Gingerich, L. Loope, T. Giambulluca, and M. Nullet. 2004. Quantifying the importance of fog drip to ecosystem hydrology and water resources in windward and leeward tropical montane cloud forests on East Maui. Venture Capital Project Final Report, 2004.

Scholl, M.A., Ingebritsen, S.E., Janik, C.J., and Kauahikaua, J.P., 1996, Use of precipitation and groundwater isotopes to interpret regional hydrology on a tropical volcanic island: Kilauea volcano area, Hawaii, Water Resources Research, 32 (12).

Scholl, M.A., Gingerich, S.B. and Tribble, G.W., 2002, The influence of microclimates and fog on stable isotope signatures used in interpretation of regional hydrology: East Maui, Hawaii, Journal of Hydrology, v. 264, no. 1-4.

Stadtmuller, T. 1987. Cloud Forests in the Humid Tropics. A bibliographic review. United Nations University, Tokyo and CATIE, Turrialba, Costa Rica.

R.M. Towill Corporation, 1991. Draft Environmental Assessment for the Kealakekua Ranch, South Kona, Island of Hawaii.

R.M. Towill Corporation,1993. Drainage Study for the Kealakekua Ranch Lands, South Kona, Hawaii, 1993. R.M. Towill, March.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service, Soil Survey for Hawaii Island, 1973.

U.S. Department of Agriculture (USDA), Soil Conservation Service, in cooperation with the County of Hawaii, 1977. South Kona Food Hazard Analyses, Basic Technical Data on Flood Prone Areas.

Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1999. Manual of the Flowering Plants of Hawaii. Bishop Museum Press, Honolulu, HI.

Assessment of Cultural Resources

By

Dr. Taupōuri Tangarō

KEALAKEAKUA:
In the Path of the Gods

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INTRODUCTION

This report on the Kealakeakua Project Area is largely based on previous reports on this area or areas contiguous to the project, namely the *Archaeological Study for the Kealakekua Master Plan* (Hammat, H.H. Etl., 1991,) and *He Wahi Mo'olelo No Nā Ke'ei Ma Kona Hema, Hawai'i, A collection of Traditions, Historical Accounts, and Kama'āina Recollections of Ke'ei, South Kona, Hawai'i* (Kepā and Onaona Maly, 2002). These reports are not exhaustive, but represent an amalgamation of cultural and historical detail that are fundamental in its informative and directive contributions to any future planning for the project area. Because these previous reports are formal research documents, facts based on primary and secondary resources, the interpretation of these "facts" are absent in most cases. So here we have an anthology of primary and secondary resources but no interpretation of why and how these tidbits of historical and cultural information speaks to a people's spiritual intercourse with an entire region and or how this spiritual relationship with the region of "The Path of the Gods" confer upon the residence the prescribed and proscribed practices for living on such hallowed ground. This report that I am submitting to the Kohala Center takes these primary and secondary facts of previous research and interprets them as they relate to the maintenance of a spiritual environment, inclusive of the rituals that allow for human habitation through ritual reciprocation. From this prospect the reader will begin to see not fragments of historical and cultural tidbits as they appear static in many research papers and or publications, but profound and dynamic evidence that speaks to a peoples' undeniable beliefs and practices of what it takes to live on this hallowed ground known as "Path of the Gods." For the purpose of this report, I have elected to use Kealakeakua (the non-abbreviated spelling for Kealakekua) throughout the body of the document except when quoting secondary sources that refer to the project site in its abbreviated form.

To the degree that the native Hawaiian lived in oneness with their environment, reciprocating the basal ritual of "life for life" practices through religious sacrifice, is exemplified here in Kealakeakua. And, although much has changed since the time of Kamehameha the Great, a window into the sacred landscape of Kealakakua will present yet another reason toward reclaiming the sacred in living in the age of technology and spiritual demise, grounding reason toward the return, in some proximity, to the truth of living on hallowed ground. Kealakeakua is but one of numerous ahupua'a, or pig-shrine plot of Hawai'i's universe when considering the entire archipelago. It is my belief that Kealakeakua exemplifies, again, the degree to which the native Hawaiian intercourse with the spiritual and physical properties of this land, ocean and upper stratosphere. To focus on one land section at this time may give reason for other practitioners, cultural experts, researchers, landowners and developers to recover the sacred in their own environs.

KĀ`AO

Kā`ao is simply defined as myth. Myth is defined by this study as "profound truth." Kā'ao, in its literal translation, is defined as the "meshing of the universe," or the "webbing of the universe." Kā'ao, to the mainstream Occident, and as reflected in the 'dictionary translation,' are fictitious stories of a preliterate people for entertainment. This is, however, far from the truth. Kā'ao is a language of metaphor that speaks to a sacred relationship of the human person and the environment into which he or she is born. The Hawaiian kā'ao traditions of creation are numerous, some of which the occidental science may fall in alignment. The creation chant, He Lua I Ka Hikina, is a chant establishing the Pele Fire Clan here in Hawai'i. A closer look, however, will disclose that the Hawaiian had definite knowledge of geography, geology and volcanology.

The Kumulipo (Dark Origin) is a 2,000-line creation chant of Hawai'i's universe. This genealogical document outshines in detail the myth of the Christian's Book of Genesis. This chant establishes Hawai'i's universe as a product of the primordial female, Pō. From the dark (unconscious) is born light (consciousness). The Kumulipo also documents the simultaneous emergence of the ancestral and conceptual minds, metaphored in the chant by the birth of an ocean (tacit zone of knowing) life form with the simultaneous birth of its land (conscious zone of knowing) counterparts. This kā'ao establishes that from the beginning the native Hawaiian functioned equitably on both the left and right hemispheres of the brain. This hemispheric synchronization is reflected in all aspects of their living, for the absence of this hemispheric synchronization would otherwise jettison their psyche into a range outside of Primal Reality.

Primal Reality is defined here as the inherent inseparability of human from the natural numinous environment into which he or she is born. Furthering this definition, Primal Reality foundations itself on a profound reciprocation of life. Life for life is the basal definition of ritual. The ritual reciprocation for Primal Reality is well established in Hawai'i's kā'ao. To understand Kealakeakua, the Path of the Gods, is to first establish

an understanding of Hawaiian kā'ao systems as they dynamically speak to the balance of sacred and the profane, the temporal and the spiritual, and to experience the profound merger of the two into the sacred union of wholeness. It is from this sacred union of night and day that the native was born and it is to this sacred union of maintaining the connection to the past while pursuing the future that was the hallmark of the native existence. Thrust into this axis from where all life revolves were foreign ideals fueled by environmental and human exploitation. The recovery of this sacred axis of Primal Reality is slow in the return, but definite, nonetheless. This research is an intrepid engagement toward the recovery of the sacred.

TRADITIONAL RECORDS OF ORIGIN

The kāʻao of the Pele, or lava, establishes the geology of Hawaiʻi; the kāʻao of the Kumulipo establishes the simultaneous birth of the biological and biographical brain of the native Hawaiian, as well as showcasing their scientific knowledge of their island environment in which they live in continual reciprocation. The kāʻao of Kanalu, a class of priests whose primary function was to re-establish the population of Hawaiʻi's native after the Great Deluge of Hawaiʻi[1], calls upon the names of Koleinaliʻi and his wife Noheo as the priest/king responsible for the repopulation of the Kona districts of Hawaiʻi Island (see notes 4).

Another kāʻao that establishes the cycle of life and living is that of the coming of Kāne and Kanaloa, the earlier male gods established in Hawaiʻi. Kealapolohiwaakāne (northern limit of the sun of Kāne) and Kealapolohiwaakanaloa (southern limit of the sun of Kanaloa), together with the Kealaulaakāne (eastern sky) and the Alanuimaʻaweakanaloa (western sky) establishes the parameters of not only the geography of Hawaiʻi but the psychological understanding of the cycle of life as metaphored by the corridor of the rising and setting sun. This union of opposites also speaks to the emergence of Primal Reality, for Kāne is light and consciousness, and Kanaloa is darkness and ancestral connections. Kona falls in the zone of Kanaloa, the western coast that experiences the sun before it enters into the seas of ancestral connections. This is significant, as the setting sun along the coast was understood to be the daily return to our ancestors. And as the native Hawaiian is psychologically oriented to the west[2], to the setting sun of Kanaloa, daily contemplation of life in the face of the setting sun played largely on how one viewed life.

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[1] Kahinaaliʏi, Hinaʏaimalama, Kaiahulumanu, are names of mythic floods that may metaphorically refer to the insurgence of foreign dominance over Hawaiʏi in remote historical times.

[2] The right hand is called ʻäkau (which also means north) and the left hand is called hema (which also means south). This orients the front of the kanaka to the west, the back to the east.

There exists one children's game that is, according to tradition, unique to Kona people. The game is called "Nāʻū," which means to hold the breath. Here, as soon as the sun came into contact with the horizon, the children would inhale, emitting a low 'ū sound until the entire breath is expended. The children believed that the sun would not set as long as they held their breath. The ritual behind this game is that the children fed their breath to the reality of ancestral return as metaphored by the cyclic return of the sun. Prepubescent children were often used in ceremonies relating to longevity and purity, human vessels of their ancestors. The word naʻu (without the kahakō) also means "mine, of my creation, for me exclusively." Claiming the sun as "mine" is not only to claim the day, but claim life in its full cycle as it enters into the dark ocean of ancestral connections.

Kealakeakua literally translates as "The Path of the God/s." This name of the ahupuaʻa establishes what is termed as a Wahi Pana (Legendary Place). A closer look at the word wahi pana discloses that it's more than just a legendary place, but a locale that "pulses" with life, as the word pana also means heart beat. What constituted this name to this place is recorded in kāʻao, mythic documentations. For one, it is said that the gods would slide down the cliff of Kealakeakua to cross the bay quickly (see note 1).

The myth of Kamiki gives even more credence to the reality of life cycle as realized by South Kona natives (see notes 3):

> "...From atop the cliff of Manuahi, Ka-miki and Makaʻiole saw spirits of god-beings (akua) playing at the temple Hikiau. These gods were beating the temple drum of Hikiau, diving form the cliffs, and playing all manner of games along the dunes of Heakeakua[3], and their voices were heard calling out. It was the regular practice of these ghosts to travel the steep cliff of Manuahi from their home in ʻĀlanapō[4] (Keʻei), as they descended to the sea. And because of this practice, the name, Kealakekua (the path of the gods) came about. There was also a grove of fragrant ʻiliahi (sandalwood trees)[5] that once grew along the cliffs, above Kealakekua, and the ʻawa of this region was famed for its sandalwood fragrance..."

[3] Heakeakua translates as "the gods call a welcome"
[4] Alana means to "awake, to arise"; ʻÄlana is "a free-will offering." Alanapö, means to either offer freely unto the night (ancestral connections) or to "experience an epiphany at night."
[5] ʻIliahi, because of its scent, were used in the preparation of the dead.

A closer look at this kā'ao document reaffirms that here the akua would make a game of returning to and fro the dark water of 'Ālanapō to the heiau at Hikiau and play the temple drum and or call from the sand dunes. It is no secret that the kapu remains of the ancients, and perhaps these sand dunes Heakeakua were also internments of the dead. For what better place is there to entomb the dead but a place known by many to be visited by the gods? Hikiau means "Returning currents." Does this "currents" perhaps be the akua who returns daily from the 'Ālanapō to call a welcome into the dark origins of ancestral connections?

Another affirmation to this reality is the fact that Hikiau is a luakini heiau dedicated to Kūnuiākea. Luakini heiau are heiau of the state where the paramount chiefs made periodic human sacrifices to the ultimate ritual of life for life. The temple drums of the luakini heiau are called pahukanaloa. The function of the pahukanaloa, a coconut drum stained black, was to announce the return of human life via sacrifice to the Kumulipo, or dark source from where life originates. Pahukanaloa literally means Kanaloa's drum. Here again we have the image of Kanaloa, the male god of ancestral return, imaged in a drum stained in the pigments of night, a drum that announces and ushers the life of the human toward the sacred return in behalf of the human living in the physical world.

In its natural primal environment, Kealakeakua pulses with the life of its forests, ocean and skies; augmented with the return of human life to its natural environs, Kealakeakua becomes indeed a path by which the gods find profound intercourse with its human occupants.

SPIRITUAL LIFE

It was noted that there existed at one time 40 heiau along the road from Kealakekua to Kailua-Kona (see notes 1). This concentration of heiau speaks volumes to the organized adherence of native life to the cosmos.

The ultimate sacrifice to the cosmos is that of a human. Human sacrifices were by far no small and rare practice. Human sacrifices were done in regular intervals. Human sacrifices were conducted in the uplands of Kealakekua. Circa 1754, Keaweʻōpala sacrificed the human victims acquired during his battle with Kalaniʻōpuʻu at a place called Kauluwai (see notes 2). Kauluwai translates to mean the growing water sources; hence the dedication of the human sacrifice at this site infers that the sacrifices were for the establishment of a new water source, or life-line through a new Paramouncy.

Tradition has it that an incarnation of the great god Lono was said to have left Hawaiʻi from the Path of the Gods, promising a return to his domain. This historical fact is not exclusive to even the elementary scholar of Hawaiian. For Captain James Cook did return as Lono, was addressed as Lono, sacrificed as Lono, and deified as Lono. Yes, he was sacrificed as Lono is what I am positing for other culturalists to consider. That his death was due to realizing he was mortal is but a small fact playing almost no significant role in the ritual death of Lono via the body of Captain Cook. The justification behind this fact is that if James Cook was considered just mere mortal, an imposter impersonating the god Lono, then his body would have not undergone deification and relic distribution.

The death of a god for the betterment of humanity is the ultimate return of human life as modeled by numerous Hawaiian deity. Kāne was interned as a mortal in an imu at Kaʻūpulehu, South Kohala, after which the famine of the time was ended on the flesh of his mortal body. Kū also, during the time of need, gave of his body. Born from his grave is the ʻulu. The goddess Hinaikeahi of Hālaʻi, Hilo, likewise had her body interned in the imu to feed her own flesh to her famished people. In time of utter cold, when the natives used only leaves to shelter themselves from cold, Maʻikōhā had his two daughters bury him. They reluctantly did so, watering his grave with their tears.

From this sprouted the wauke, the plant from which kapa is made. The famed kapa of Hawai'i is actually the flesh of Ma'ikōhā.

The greatest sacrifice is that of Haloa, the first born son of Wākea (Sky Father) and Ho'ohōkūkalani (Maker of Starry Constellations). From his infant death sprouted the kalo, the main staple of the traditional Hawaiian diet. The death of Hāloa is ritualized at every burying (planting), harvesting (death), cooking (transformation), and consumption (vivication through human-temples). Ritual death is not uncommon in the life of traditional Hawai'i, and understanding this allows for one to conjecture on the sacrifice of Captain Cook as Lono as intentional and premeditated, not due to human struggle. Again, his body was taken to the heiau of Puhinaolono[6] and underwent the ritual of deification and relic distribution.

Even presenting more evidence of intentional sacrifice of Lono is Kamakau's reference to Cook's 1779 anchoring off of Ka'awaloa (see notes 3). The natives called Cook Lono, saying, "Now shall our bones live, our 'aumakua has come back." In addition, Cook was taken to Hikiau Luakini, and seated above the altar were the sacrifices were offered. Lono-Cook was now dressed in a red kapa; the kind that is used about the images. What are images if not tree people sacrificed to the spiritual health of the human? Here the Lono-incarnate was now marked for sacrifice so that the "our bones may live."

The greatest evidence, however, is the prayer chanted by the high priest. When deposited under the schema of ritual sacrifice, the images speak clear to the premeditated sacrifice of Lono's incarnation, of Captain James Cook. Here is this chant (my translation):

[6] Puhinaolono translates as the Lono's oven, or the Oven of Lono. This "O" class possessive form indicates that the oven was for Lono's body forms to be cooked in. If it were Puhinaalono, with an "A" class possessive, this would mean that Lono built the oven.

OU MAU KINO E LONO I KA LANI

1. Ou mau kino e Lono i ka lani	For your many bodies, Lono of heaven
2. He ao loa[7], he ao poko, he ao kī'ei	A long cloud, a short cloud, a cloud peeking
3. He ao hālō, he ao ho'opua i ka lani	A peering cloud from above, clouds emerging in the heavens
4. Mai Uliuli, mai Melemele, mai Kahiki	From profound Darkness, from the glow of day, from the horizon where heaven unions with the ocean
5. Mai Ulunui, Mai Ha'eha'e	From great inspiration through spirit possession, from the gate of the rising consciousness
6. Mai 'Ōma'oku'ululū, mai Hakalau'ai[8]	From 'Ōma'oku'ululū, from Hakalau'ai
7. Mai ka 'āina o Lono i wāhi aku ai	From his dominion Lono has broken through the portal
8. I ka lewa nu'u, i ka lewa lani	And onto the zenith of the sacrificial tower
9. I ka papakū, i ka pāpākāhui[9] a Laka	To the nadir, in search for the fish of Laka
10. O lalo hana, o 'ole pu'u ka honua	Product of the western sea so that our land will not be entombed
11. E Kū, e Lono, e Kāne, e Kanaloa	Pay heed oh Kū, Lono, Kāne and Kanaloa
12. E ke akua mai Kahikikū, mai Kahikimoe	The gods from the rising sun of life to the setting sun of profound return
13. Eia ka mōhai, eia ka 'ālana	Here is the sacrifice, the sacrifice of free-will
14. E ola e ke ali'i, e ola i nā pulapula	So that the chiefs may live as will the offsprings
15. A kau I ke ao mālamalama, ia lana honua	Until sun is right overhead[10] and the lowest floor of the oracle tower is bathed in brilliant light
16. Amama. Ua noa...	All is said, our ritual complete...

[7] He ao loa, he ao poko, he ao kīʏei, he ao halo refers to every extremity of conscious awareness. This line evidences that the native were engaged in the dynamics of their reality.

[8] 'Ōmaʏokuʏululū is a glistening star, Hakalauʏai is another star that is a sign of coming pestilence.

[9] Pä-paka-hui literally means "in search for the ulua fishing ground." Ulua were huge fish often used as the ultimate sacrifice before the introduction of human sacrifice. The term iʏa, or fish, still denotes sacrifice either of fish or human.

[10] When the sun is right over the oracle tower is when the sun is at its zenith and all shadows return to the body. Here the sacrifices that when done at noon insured that the sacrifice of the victim to the gods was whole and complete, the aka (shadow essence) having returned to its fleshy domain.

This incarnation of Lono is the aka, or shadow essence that is redirected back to its sources, to the greater Lono. For the reason that the god Lono has returned to the land of the gods required that his essence be released from human bondage and returned to the environment of his origin.

Here exists yet another tidbit of information that has high probability in its associations with the Pele religion. In the late 18th century, there was noted to have been positioned in the upland forest of Kealakeakua poles with white flags attached to its top. It was mistaken by this foreign expedition to be property markers. In the tradition of Pele, these white flags attached to poles are called lepa that are used to mark tabu areas, especially the areas designated by Pele herself. A lepa-designated territory is always for the protection of a place from desecration. It would not be unheard of in Hawaiian religion that lepa are sometimes put up to keep an area from being contaminated by outsiders. Could it be perhaps that these foreigners were nearing concentrated sacred territory? It is also very Hawaiian for the native guides not to disclose the meaning behind the flags, allowing the foreigners to think it as land divisions.

RECENT HISTORY

Hammat's Archaelogical Study for Kealakekua Master Plan gives the demarcations in Kealakekua as follows (see notes 2):

1. Ahuwela ('A'ahuwela)[11] Cave is located where Hōkūkano ends and Kealakekua joins and bounds Keauhou, located at 5600'elevation, marked as "Kipuka Mamani" on U.S.G.S maps.
2. Waipāhoehoe is the location where Kahauloa[12] 1st ends and Kealakekua joins Kahauloa 2nd.
3. Nāpali Māhoe is boundary between Kahauloa and Kealakekua.
4. An awaawa (ravine) known by the names of Kaalanoho, Alanoho, Kaalomoku, and Ka'aimoku marks a mauka/makai trail.
5. Kalamakumu (bottom of a gulch) forms boundary between Kealakekua and Kahualoa.

The following boundary testimonies are from Maly's (2002) work (see notes 3):

6. Umi's Road, a major path associated with Umialīloa (circa 16th century) running along the east boundary from the NE corner. Believed to be a major trail linking Ka'ū and Waimea.
7. Kāneki'i Waterhole (near middle of east boundary)
8. Kolekole Knoll, highly probable that this is the 6,048 ft high hill in the SE corner of the project area.
9. Kūaialae Koa, SE corner of Kealakekua where the boundary turns makai.
10. Kawahapele or Kawaihāpele[13], SE corner of the project area.

[11] Ahuwela (Hot Shrine) may be reference to shrines used for sacrifice. 'Aÿahuwela (Hot-garments) may be reference to volcanic phenomena, such as lava tubes and or geothermal steam.
[12] Kahauloa interprets as the "Eternal sacrifice."
[13] Kawahapele (Pele's mouth) speaks of a lave tube. Kawaihäpele speaks to hot bogs

Kealakekua was documented in the late 18th century (see notes 3) to have extensive plantations as far as 6-7 miles inland. The crops were Kalo, 'uala, 'ulu, mai'a, and wauke. The famous 'awa scented with 'iliahi were also noted, not as a crop, but a famed product of Kealakeakua (see note 3). Kō was also noted to have been used extensively as wind block for much of the crops.

Traditional occupations were, of course, religion. In addition to this were farming, bird snaring and canoe production (see notes 3). Documentation of the sandal wood trade is still evidenced by the sandalwood pits (north central portion of the project area) carved out of the land to the dimensions of the ships haul (see notes 2).

The population of Keauhou circa 1824 was about 350 people in the immediate Kealakekua region, and about 300 in the population belt about 800ft. and 2,000 ft. elevation (see notes 2, Jerald Holland).

RECOMMENDATIONS

It is recommended that Kealakeakua aligns its resources toward the education of Hawaiian spirituality to a world audience, with the slant being on Hawaiian residence and practitioners. Establishing a lodging area that can accommodate small conferences may potentiate the spiritual pulse of Kealakeakua as it lends its energies toward the reclamation of the sacred in current day living.

Establishing a reciprocal relationship with local hula schools and charter schools will provide place-appropriate cultural practices in a sacred environ, as well as sharing the maintenance and upkeep of forests systems. Waipi'o families have, for greater than 20 years, opened up their taro patches to outsiders, allowing for a greater population to engage in the upkeep and experiential learning otherwise absence from classroom learning. Perhaps working off of their paradigm may expedite the process.

Establishing the celebrated 'iliahi scented 'awa of Kealakeakua as a marketable crop is recommended. Every district had its own celebrated contribution to society, and sacred 'awa scented with 'iliahi is traditionally identified as Kealakeakua's contribution. Another is an 'iliahi plantation.

Establishing an annual Makahiki festival may provide cultural education to both island and foreign residence, alike.

It is recommended that Kealakeakua capitalizes on its spiritual history in a non-exploitive way, researching trends in global spirituality in search for ideas that could find a place-appropriate activity in Kealakeakua mauka.

Provide the resources to augment the sacred activity of Kealakeakua in local and state museums and schools.

Partner with "green" agencies in every feasible way to educate the decision makers in maintaining a strong ecosystem within Kealakeakua and contiguous parcels.

Identify the natural and human-made boundaries, keeping them off limits, as they demark the portal from which the gods may manifest themselves in their many forms.

Furthering the study to include an inventory of flora and fauna of Kealakeakua and its contiguous districts is highly recommended. This component should require professionals in this particular field.

BIBLIOGRAPHY

Hammat, H.H., Etl. (1991). *Archaeological Study for the Kealakekua Master Plan.* R.M Towill Corp. Cultural Surveys Hawai'i

James, Van (1995). Ancient Sites of Hawai'i, Archaelogical Places of Interest on the Big Island. Mutual Publishing, Honolulu

Maly, Kepā & Onaona. (2002). *He Wahi Mo'olelo No Nā Ke'ei Ma Kona Hema, Hawai'i, A Collection of Traditions, Historical Accounts, and Kama'āina Recollections of Ke'ei, South Kona, Hawai'i.* Kamehameha Schools, Pa'auilo, Hawai'i.

Nāmakaokekahi, B. K., Chun, Malcolm (translator). 2004. This History of Kanalu, Mo'okū'auhau 'Elua. First People's Productions, Honolulu.

Pukui, Elbert, Mo'okini. (1976). Place Names of Hawai'i, Revised & Expanded Edition. University of Hawai'i Press. Honolulu

NOTES

1. Pukui, Elbert, Mo'okini. (1976). *Place Names of Hawai'i, Revised & Expanded Edition.* University of Hawai'i Press. Honolulu. (pg. 101):

   > Lit., Pathway [of] the god. There were many heiau on the road for Kealakekua to Kailua; Thrum listed 40 (Restarick). It was believed that a god slid down a cliff here leaving an imprint, and that the gods often slide here in order to cross the bay quickly (Wilkes, 90, 184)

2. Hammat, H.H., Etl. (1991). *Archaeological Study for the Kealakekua Master Plan.* R.M Towill Corp. Cultural Surveys Hawai'i:

   - The only reference that may apply to the present project area is in John Papa Ii's account (1963:4) of the ruling chief Keawe-opala. He records:

     > Keawe-opala marched with a procession to Kona and remained at Kauluwai in Upper Kealakekua where he encamped with his multitude in warlike display...[after winning a battle against Kalaniopu'u at Kepulu in the upland of Kahauola, circa 1754]. All of the victims of the battle were bourne up to Kauluwai, wehre Keawe-opala was staying with the young Kamehameha. When all the dead had be transported, Keawe-opala sacrificed the bodies.

     This account is of particular interest in that it suggests that the residence of a high chief and his entourage and an important ritual site (heiau) and probably many associated burials lie somewhere in "Upper Kealakekua" (p. 7).

   - Hikiau temple was a state temple (lua kini) dedicated to Kū-nui-a-kea and was a cultic center of the Kū lineage of priests. The residence of many Lono priests near Hikiau is well documented by the journals of Cook's third voyage....Jerald Holland, in his master's thesis on the Kona coasts, suggests (1971:15) that circa 1824 about 350 people lived in the immediate vicinity of the coast in Kealakekua ahupua'a and that about 300 people lived in an upland population belt lying between about 800ft. and 2,000 ft. elevation (p. 8).

- It should be noted that witnesses to land use in the uplands of South Kona typically refer to canoe makers, bird catchers and sandalwood...(p. 18)

- Ahuwela Cave (Aahuwela) is given as the name of a specific cave located where Hookukano ends and Kealakekua joins and bounds Keauhou. The accounts agree that this cave was located in the vicinity of the north boundary of the project area at 5600' elevation in the area marked "Kipuka Mamani" on U.S.G.S. maps. Three accounts relate that this cave had water in it thereby suggesting that this cave was a well-known waterhole and focus for people traveling through or working in the area (p. 18).

- 'Umi's Road (Kanoho'ana- the way of 'Umi) is described as a major path associated with the ruling chief 'Umi a Liloa (circa 16th cent.) which forms the north half of the east boundary of the project area. This trail is described as running along the east boundary from the NE corner of the project area south to Kanekii at which it heads SE to higher elevations. It is believed that this trail was a major prehistoric trail linking Ka'u District with Waimea and thus it is assumed that archaeological sites, in addition to the trail, may be found along its length (p. 19, 20).

- Haliilaukoa. This site is associated with the spreading of leaves before the ruling chief 'Umi a Liloa. The exact location is uncertain but it is believed to lie along the east boundary of the project area between the NE corner and Kanekii (p. 20).

- Kanekii Waterhole. This is described as a small waterhole which dries up in dry weather. This I assumed to be the site located on U.S.G.S. maps near the middle of the east boundary of the project area. The name could refer to an image of Kane located there (Kāne-ki'i) but may well refer to the waterhole's occasional overflowing (kā-neki) or figuratively to "anger" welling up (at the sight of people from other places stealing resources, for example) (p. 20).

- Kalulu Waterhole and Place for Catching Birds. Two sources refer to this as a particularly good place for catching birds (Uwao or Dark-rumped Petrel in particular). The exact location is unknown but this site is believed to be south of Kanekii along the east boundary of the project area in an area of Pahoehoe (20).

- Kolekole Knoll. This location is mentioned in only one account as an "ahua [knoll] with Koa [Acacia koa] on it in the middle of Kealakekua and the boundary of Keauhou is just mauka of it." It seems highly probable that this is the 6,048 ft high hill in the SE corner of the project area (p. 21).

- Kukaialae Koa- Koa Grove and Skirmish Site. This site is described as the SE corner of Kealakekua where the boundary turns makai and as the site of "a grove of koa trees small pahoehoe." Waiau's account suggests that this was an area of conflict between men of Kona and Ka'u Districts (p.21).

- Kawahapele Cleft. Testimony refers to the south boundary of Kealakekua and Keauhou 2nd as either a mawae (cleft or fissure) called "Kawaihapele" or "Kawahapele" or as an old lava flow called "Keauhou." Both appear to be references to land forms just south of the SE corner of the project area (p. 21).

- Waipahoehoe (Kawaaokanahiae). Kahula gives the name Waipahoehoe as the name of the place where Kahauloa 1st ends and Kealakekua joins Kahauloa 2nd. Kamauoha refers to a celebrated Koa tree which was cut at a place called Kawa'aokanahieae [possibly the name of the canoe made from the tree] where Kahauloa 1st ends and Kealakekua bounds it. This account suggest the felling of trees for canoes in this vicinity and perhaps some ritual activity as would be the norm with the felling of trees for canoes in this vicinity and perhaps some ritual activity as would be the norm with the felling of great trees for large canoes (p. 22).

- Nāpali Mahoe. This land form is described as the boundary between Kahauloa and Kealakekua. This could refer to a pair of scarps (pali: cliff, scarp; mahoe: twins) or to a series of scarps where a particular native tree grew (mahoe: Alectryon species) (p. 22).

- An awaawa [gulch, ravine, valley], the spelling of which appears variously as Kaalanoho, Ala Noho, Kaalaomoku, Kaaiamoku, is given as a south boundary of Kealakekua. The existence along this boundary of a trail mauka/makai (ala: path, road, trail) is suggested (p. 22).

- Kalamakumu refers to a gulch or the bottom (flat bottom land) of a gulch which forms a boundary between Kealakekua and Kahauloa (p. 22)

- Sandalwood pit (fig. 11) located in the north central portion of the project area....built to the dimensions of a ship's hold (p. 30).

3. Maly, Kepā & Onaona. (2002). *He Wahi Moʻolelo No Nā Keʻei Ma Kona Hema, Hawaiʻi, A Collection of Traditions, Historical Accounts, and Kamaʻāina Recollections of Keʻei, South Kona, Hawaiʻi.* Kamehameha Schools, Paʻauilo, Hawaiʻi.

   - Around 1754, Alapaʻinui died. His heir Keaweʻōpala and chief Kalaniʻōpuʻu soon met in conflict. Iʻi's account provides important documentation pertaining to Kauluwai, a place in the uplands of Kealakekua, where human sacrifices were offered, and other nearby locations:

     "Kalaniopuu, hearing of the death of Alapai, went to Waiea, South Kona. When news of his arrival reached Kawaihae, Keaweopala marched with a procession to Kona and remained at Kauluwai in upper Kealakekua, where he encamped with his multitudes in warlike display. Kalaniopuu heard of this and moved on to either Honaunau or Keei. The ensuing battle, fought at Kepulu in the upland of Kahauloa at Napoopoo, was won by Keaweopala. All of the victims of the battle were born up to Kauluwai, where Keaweopala was staying with the young chief Kamehameha. When all of the dead had been transported, Keaweopala sacrificed the bodies" (p. 3).

- Kamakau references traditional accounts regarding Capt. James Cook:

> ...on January 17, 1779, he put in at Ka'awaloa Bay. Kalaniopuu was fighting Kahekili on Maui at the time. Captain Cook arrived during the tabu time of the Makahiki when no man could paddle out to the ship without breaking the law and forfeiting all his possessions. But when Captain Cook appeared they declared that his name must be Lono, for Kealakekua was the home of that deity as a man, and it was a belief of the ancients that he had gone to Kahiki and would return. They were full of joy, all the more so that these were Lono's tabu days. Their happiness knew no bounds; they leaped for joy [shouting]: "Now shall our bones live; our 'aumakua has come back. These are his tabu days and he has returned..."
>
> ...When Captain Cook went ashore at Kealakekua the kahuna, believing him to be a god, led him to the heiau [Hikiau] and seated him above the altar where sacrifices were offered. The kahuna stepped back, and had a soft white tapa wrapped about his loins. Captain Cook was covered with a cloak of red tapa like that about the images. Then the kahuna prayed thus:
>
> Ou mau kino e Lono I ka lani
> He ao loa, he ao poko, he ao ki'ei
> He ao halo, he ao ho'opua I ka lani
> Mai Uliuli, mai Melemele, Mai Kahiki
> Mai Ulunui, Mai Ha'eha'e
> Mai 'Ōma'oku'ululu, Mai Hakalau'ai
> Mai ka aina o Lono I wahi aku ai
> I ka lewa nuu, i ka lewa lani
> I ka papaku, I ka papakahui a Laka
> O lalo hana, o ole puu ka honua
> E Ku, e Lono, E Kane, e Kanaloa
> E ke akua mai Kahikiku, mai Kahikimoe
> Eia ka mohai, eia ka Alana
> E ola e ke alii, e ola i na pulapula
> A kau I kea o malamalama, ia lana honua
> Amama. Ua noa...(p. 5).

- Ka'ao Ho'oniua Pu'uwai no Ka-Miki, The Heart Stirring Story of Ka-Miki (recorded in 1914-1917), This mo'olelo is set in the 1300's (by association with the chief Pili-a-Ka'aiaea)...In preparation for the completion of the first phase of their training, Ka-uluhe-nui-hihi-kolo sent Ka-Miki and Maka-'iole to gather some 'awa for a ceremony. The brothers departed from Kalama'ula on Hualālai, and went to the cliff of Manuahi overlooking Ka'awaloa and Kealakekua. The mo'olelo describes various features of the landscape, and how place names came to be given:

  > ...Ka-Miki and Maka-'iole traveled from Kalama'ula to the cliff of Manuahi, to gather some of the famous 'awa that grew in the plantation of Manu'a at Ka'awaloa. The 'awa kapu of Manu'a (sacred 'awa [Piper methysticum] gardens of Manu'a) grew amongst a grove of 'iliahi (sandalwood) trees. The variety of 'awa was an 'awa hiwa called mo'ī (a black, long stalked 'awa), and the fragrance of the 'iliahi permeated the 'awa and cliffs upon which ti grew.
  >
  > ...From atop the cliff of Manuahai, Ka-Miki and Maka-'iole saw spirits of god-beings (akua) playing at the temple Hikiau. These gods were beating the temple drum of Hikiau, diving from the cliffs, and playing all manner of games along the dunes of Heakeakua, and their voices were heard calling out. It was the regular practice of these ghosts to travel the steep cliff of Manuahi from their home in 'Ālanapō (Ke'ei), as they descended to the sea. And because of this practice, the name, Kealakekua (the path of the gods) came about. There was also a grove of fragrant 'iliahi (sandalwood trees) that once grew along the cliffs, above Kealakekua, and the 'awa of this region was famed for its sandal wood fragrance...(p. 8).

- The Journals of Captain James Cook on his Voyages of Discover, The Voyage of the Resolution and Discovery (1776-1780). The following narratives were produced by Commander Charles Clerke and Lieutenant James King who accompanied and survived Cook. They provide readers with the earliest recorded descriptions of life in the South Kona Region. They reported on the occurrence of extensive plantations (some of which were more than 6 or 7 miles inland), and among the crops seen were the taro, sweet potatoes,

breadfruit, plantains (cooking bananas), and wauke (the "cloth" plant). The plantation system was formally laid out, and in many instances bounded by walls....While in the forests above the Kealakekua-Hōnaunau region, various activities and features were observed as well. Among these were canoe making, bird catching, and the occurrence of trails. The Hawaiians also demonstrated a knowledge of upland resources and travel to the mountain lands. Figure 7 is a detailed map of the Kealakekua-Kaʻawaloa villages and plantations (extending to the top of the flats overlooking Kealakekua Bay), produced by Henry Roberts (member of the crew) in 1779 (p. 107)

> ...as far as the wild plantains grew, intermixt amongst the trees, were at certain distances white flags secur'd to poles, which they took fro divisions of property (p. 109)

- Trails (Ala Hele) and Government Roads (Alanui Aupuni) of the Kealakekua-Keʻei-Hōnaunau Region...Historical accounts (cited in this study) describe at least two primary trails of regional importance in the South Kona region. One trail crossed the makai (near shore) lands, linking coastal communities (such as Kealakekua to Hōnaunau) and resources together. The other major trail of this region is 'Kealaehu" (The path of 'Ehu), which passes through the uplands (in the vicinity of the Māmalahoa Highway) (p. 85).

4. Nāmakaokekahi, B. K., Chun, Malcolm (translator). 2004. This History of Kanalu, Moʻokūʻauhau 'Elua. First People's Productions, Honolulu.
   - This is a genealogical record of a priestly line named after their ancestor/first priest Kanalu. This line, as far as I can perceive, was significantly Kāne and Kanaloa worshipers, who served as the priest of Kū. After the mythic/historical deluge Kahinaalii and Kahinaʻaimalama, Kāne and Kanaloa began established the ways to establish another progeny of Hawaiʻi. Each district had their Kanalu priest/kings assigned to this task of establishing a greater population of people. The chief of Kona, responsible for this, was Koleialiʻi and his wife was Noheo (p. English 14)