

HO'ONA'AUAO NO KAWAI NUI
(Educating About Kawai Nui)
A Multi-Media Educational Guide

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With
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DEDICATION



This multi-media educational guide is dedicated to Hauwahine, the mo'o guardian goddess of Kawai Nui, in celebration of her living presence in the marsh.

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PREFACE

Reasons for this Guide

Environmental education objectives — which seek to encourage awareness, understanding and respect for natural and cultural environments — would be sterile without instilling valuing skills, leading to effective environmental problem-solving. Educators who utilize their own communities to provide learners with opportunities to become personally involved in positive action toward the solution of environmental problems, will find such environmental objectives pertinent, possible, and pragmatic. This written guide, and companion slide/tape production, are the outgrowth of such an effort, with the objectives and intended outcomes listed above providing the driving force.

Kawai Nui Marsh is located less than fifteen miles from downtown Honolulu and the University of Hawaii at Manoa, on the Island of O'ahu — the most heavily developed and populated of the Hawaiian Islands. Yet it remains the largest freshwater wetland in the State of Hawaii, whose natural, cultural, and educational values have been widely recognized as significant by numerous government agencies, private organizations, and citizens' groups, at the local, state, national, and international levels. This area once supported a large native Hawaiian settlement with hundreds of acres devoted to fishpond and taro cultivation and contains some of the oldest known Hawaiian agricultural sites. Few other areas in the Hawaiian Islands have as many landforms named for sacred persons revered in over 1,500 years of Hawaiian tradition. Today, the marsh performs many "invisible" and valuable functions for the surrounding urbanized community: a nursery ground for marine organisms; a flood control basin; a ground water recharge aquifer; a wildlife habitat for endangered waterbirds; a sediment filter; a nutrient recycler; an open space vista; and a buffer protecting surrounding communities against erosion and storm damage.

Although the natural wetland, flood control, wildlife, and cultural values of Kawai Nui Marsh have long been widely recognized, a variety of use conflicts along its periphery for different types of development — residential, commercial, or recreational — have kept its future fate uncertain for nearly twenty-five years. In the meantime, the marsh's currently "official" use is as a "dump" (eg. auto-wrecking yard; sanitary landfill; repository for wastewater from sewage treatment plants). After years of such use, peoples' perceptions of the natural and cultural values of this special place have declined accordingly, to the point that maps erroneously demarcate the marsh with the more pejorative, ecologically-inaccurate label of "swamp".

Nevertheless, a number of initiatives — both public and private — have begun to preserve and restore the natural and cultural values associated with this place in the public consciousness. Symbolic, perhaps, of this shift toward more positive perception of the marsh's intrinsic values is the recent ruling by the Hawaii State Board on Geographic Names in Hawaii to officially change Kawai Nui's name on maps from the inaccurate label "swamp" to the more accurate label of "marsh". Management and planning processes sponsored by government agencies and citizen groups are currently on-going to facilitate resolution of the use conflicts surrounding the marsh and to come up with a resource management plan of a calibre that befits the marsh's ecologically, culturally, and historically significant status. These factors make the Marsh area unique not only for educational

activities such as water sampling, vegetation mapping, wildlife observations, archaeological investigations, chanting, hula, and handicraft demonstrations, but also for studies of the political process and environmental problems associated with resource planning and management.

As the number and scope of initiatives to improve the environment at the Marsh have increased, demand for a consolidated and refined packet of information about all aspects of the Marsh has increased accordingly. Numerous UH-Manoa faculty already use the Marsh as a field site or subject to illustrate concepts, issues, and environmental resources related to the objectives of the courses that they teach, from Hawaiian history to limnology. The Marsh provides a favorite topic for term papers and theses for UH students from an equally wide-ranging set of interests and disciplinary orientations. Other educational institutions and private organizations continuously utilize the Marsh for educational and recreational purposes, such as the National Audubon Society, the Sierra Club High School Hikers' Program, the Lani-Kailua Outdoor Circle, the Historic Hawaii Foundation, the Congress of Hawaiian People, the Kamehameha Schools, the Hālau Mōhala 'Ilima, the local media, and the British Broadcasting Corporation. All of these groups, and others, are the intended beneficiaries of this multi-media guide production.

The guide does not pretend to be a complete encyclopedia-like reference on the marsh. Rather, it represents the outgrowth of a team effort, involving the principal investigator, working with her students in environmental studies, key community resource people, faculty, and other professionals, to solve the problem of pulling together much useful information about the marsh, which already exists but has been scattered about in a variety of places and forms, (published; unpublished; newsclippings; personal records; government documents; etc.) for more effective educational and general use. It is intended to stimulate awareness of the many values and resources that can be found at this highly accessible, highly special environment, by residents and visitors alike, in the State of Hawaii.

The process of people working together to develop a cohesive, informative source on an environment that is accessible to a majority of the local population serves another useful function. One of the founding fathers of the environmental education movement in this country, Aldo Leopold, eloquently summarized the value of devoting such attention to "backyard ecology" as a means of sharpening peoples' perceptions:

The weeds in a city lot convey the same lesson as the redwoods; the farmer may see in his cow pasture what may not be vouchsafed to the scientist adventuring in the South Seas. Perception, in short, cannot be purchased with either learned degrees or dollars; it grows at home as well as abroad and he who has a little may use it to as good advantage as he who has much.

It is hoped that the users of this guide will not just learn about Kawai Nui Marsh, but will also be inspired to notice the values in the environmental resources where they live, and to mobilize their own inner resources to become personally involved in positive action toward the solution of environmental problems and quality of life issues that they encounter there.

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Contributing Authors and Others Who Supported This Project

A synergistic interaction of people and events made this production possible, and I would like to acknowledge the most significant among them. First and foremost, I wish to thank the Selection Committee whose grant award from the University of Hawaii President's Educational Improvement Fund made this project possible. The EIF fund was designed to enhance the quality of the curriculum for undergraduate students. This project involved undergraduates in its design and production. Undergraduates are also intended to be one of the primary users of the finished product. Others in the faculty, student body, and community will find the product useful to enhance general awareness of a culturally and ecologically significant local environmental resource and I am very grateful for the Committee's willingness to support the "extension" aspects of this project.

Next, I wish to thank the UH students in a graduate seminar on Environmental Education (EdEf 686) who joined me in a team effort to identify the controversial issues surrounding the Marsh and the unique contributions educators might make to the resolution of these issues. After "immersing" themselves in the Marsh problems, many of them took positive actions on their own to formulate solutions to the problems and to capitalize on personal growth opportunities they saw there. For example, two of these students -- Marion Lyman-Mersereau and Jeannette Simons -- literally immersed themselves in the marsh as volunteer archaeological assistants to Jane Allen-Wheeler, a Bishop Museum archaeologist, who supervised them in an excavation there during the summer of 1981. Another, Nick Huddleston, wrote a term paper on the aesthetic values of the marsh that was reworked and refined to become an acknowledged contribution to the State of Hawaii's resource management planning efforts. Mike Monnette developed a biology curriculum incorporating the marsh as a study area, which he later pilot tested during his practice teaching assignment at Washington Intermediate School. Two of his students there went on to win a district science fair award for their marsh research project.

The encouraging results of such teaching experiences led me to develop even more ambitious plans for engaging students in efforts to increase their own awareness of the marsh environment while making a positive contribution to the solution of problems which they discovered there. It was then that I became a successful applicant for a grant from the University of Hawaii-Manoa President's Educational Improvement Fund to help finance the materials and student assistants that were needed to carry out this project. I am deeply grateful to the following people who gave official endorsements of my grant proposal in the earliest application stages:

- (1) UH Faculty Members: Duane Preble (Art); Sheila Conant, Gordon Bigelow, and William Burke (General Science); Bryce Decker (Geography); Ben Finney (Anthropology); Marion Kelly (Ethnic Studies) and Everett Wingert (Cartography).

(2) Community Resource People and Agency Representatives:

- a. City and County Government - Willard T. Chow, Chief Planning Officer, Department of General Planning, City and County of Honolulu.
- b. State Government - Lt. Governor Jean King; Secondary Marine Education Coordinator, John Hawkins with the State of Hawaii Department of Education; R. Lokomaika'iokalani Snakenberg, Educational Specialist, Hawaiian Studies Program, State of Hawaii; and Hideto Kono, Director of the Department of Planning and Economic Development.
- c. Federal Government - Robert Shallenberger, Supervisory Wildlife Biologist, U.S. Fish and Wildlife Service.
- d. Individuals and Private Organizations - Phyllis Fox, Executive Director, Historic Hawaii Foundation; Hardy Spoehr, Project Director at the Nature Conservancy; Muriel B. Seto, Congress of The Hawaiian People; Robert Herlinger, architect/planner; Sandra Braun, Ad Hoc Committee for Kawainui representative to State's Advisory Committee on Kawai Nui Marsh; Hope Morley Miller, Secretary of The Ad Hoc Committee for Kawainui (a committee sponsored by the Lani-Kailua Outdoor Circle); Lola Mench, retired marine science teacher and Legislative Chairman of the Sierra Club, Hawaii Chapter; Susan Miller, Conservation Committee Chairman of the Sierra Club, Hawaii Chapter; and Barbara Mills an individual with extensive experience in the visitor industry as head of the Visitor Satisfaction Committee of the Hawaii Visitors Bureau.

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Chuck Burrows, a Hawaiian and a science teacher at The Kamehameha School, grew up near the marsh and was one of the pioneers in utilizing this resource for environmental education purposes. I accompanied him during field trips with his students and learned, by his example, how to fully utilize this resource as an outdoor classroom. Later, we joined forces by bringing students sponsored by the Sierra Club High School Hiker's Program together with my University of Hawaii students, for a three-day "Ecology Camp" at the Marsh, which involved over 100 students and dozens of resource people. Many of the photographs in the slide/sound show and artwork in this written guide were taken from activities performed during this Ecology Camp event. Through Chuck Burrows, I came to know Janet Myers, T.V. producer at The Kamehameha School, without whose creative and technical skills, the slide/sound production would never have been completed. Wayne and Betsy Harrison Gagné, Jane Allen-Wheeler, Marion Kelly, and Barry Nakamura, all scientists with the Bishop Museum, were both helpful as resource people to share their expertise, guide field trips, or to edit portions of this guide. UH faculty members Sheila Conant (General Science) and Marion Kelly (Ethnic Studies) were especially helpful in allowing my students to present drafts of their contributions in front of classes for critical feedback purposes.

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I cannot conclude these acknowledgements without crediting my husband, Rob Reed, who -- in his words -- put up with muddy marsh boots at the kitchen doorway.

Regardless of the substantial and original contributions credited to all the individuals and organizations acknowledged above, this principal investigator, editor, and part author remains solely responsible for how these contributions were interpreted, edited, and arranged for guidebook presentation purposes.

INTRODUCTION

Title of this Guide and Its Meaning

As explained in the Hawaiian Dictionary, (Pukui and Elbert, 1973), the expression "ho'ona'auao" means "to educate", or to "instruct". The phrase "na'auao" refers to "being intelligent, or enlightened". The word "no" has several meanings, among which the following are applicable here: "of", "for", "concerning", "about", "because of" and "resulting from". Thus, Kawai Nui is a special place which provides both the source material of this educational guide; while the guide itself is a source which can enhance one's understanding and appreciation for Kawai Nui as a resource of both scientific and cultural value.

Kawai Nui Marsh — Its Names; Synonyms; and Misnomers

As indicated in Place Names of Hawaii, (Pukui, Elbert, and Mookini, 1976), the name Kawai Nui is a two-worded expression which — when broken down into its constituent parts, "Ka-wai-nui", -- can be literally translated to mean "the great water". It is also instructful to note that "wai" refers to "freshwater" while "kai" refers to "saltwater". Kawai Nui is -- today -- the largest freshwater marsh in the State of Hawaii, located on the windward side of the Island of O'ahu. One of the main access routes to the marsh is at a distance of approximately 13 miles from Honolulu's central business district through the Koolau mountains, down the Pali Highway, along Kalaniana'ole Highway toward Kailua town. Kailua town itself sits on a sand accretion barrier separating the Kawai Nui freshwater Marsh from the saltwater of Kailua Bay.

Maps today erroneously indicate Kawai Nui Marsh as "Kawainui Swamp". Although both marshes and swamps are similar in that they are both "wetland" environments, they are different in biological character. A marsh consists of "soft", herbaceous vegetation on wet land that is periodically inundated and generally treeless, characterized by grasses, cattails, or other monocotyledons. By contrast, a swamp is a spongy land area which is saturated and sometimes covered with water, supporting more "woody" vegetation such as various shrubs and trees.

In the early 1900's, Kawai Nui Marsh was inaccurately labeled "Kawainui Swamp" and the misnomer has been carried over on all maps up to the present day. Recently, however, steps have been taken to correct this situation. Thus, at the September 14, 1982 meeting of the Hawaii State Board on Geographic Names, the members voted to at least partially correct the misspelling of this resource and voted to substitute the name "Marsh" for "swamp" as the official one. The similarities and distinctions between "swamps" and "marshes" as well as the history of how Kawai Nui began to be referred to as a "swamp" are more fully explained in the text of the guide which follows.

Rationale for the Contents and Emphasis of this Guide

The preceding section indicates that a great deal of effort has been put into the task of correcting the official name of Kawai Nui from "swamp" to the more ecologically-correct label of "marsh". Why, some might ask, all the fuss and bother?

In addition to the need to be scientifically correct, and thus label Kawai Nui as a "marsh" rather than a "swamp", it is also important to note that the word "swamp" has a deep-seated pejorative connotation in the American tradition, as a useless place or wasteland in its natural state and thus an obstacle to the pursuit of "progress".

This negative association is not surprising when one considers that our country's heritage is bound up in over 200 years of continual westward expansion by American pioneers, even to these islands, and that the very survival of these pioneers often entailed clearing, draining, dredging, filling and otherwise "reclaiming" wet land areas such as swamps. These areas were often disease-ridden (eg. full of disease-carrying mosquitoes), and presented physical barriers to the pursuit of settlement goals.

When one pauses to think about it, our language is full of vivid references to "swamp" as a negative, troublesome place or situation. When, for example, feeling overwhelmed by work or otherwise feeling out of control of one's situation, we often use the expression "I am swamped". In such a situation, the reference is usually interpreted to be a pejorative one, or — at the very least — an uncomfortable, undesirable, or bewildering state of affairs.

In my experience as an educator and community resource person on policies and projects related to Kawai Nui, it has been my observation that the word "swamped" can appropriately be used to describe the conventional attitude toward the usefulness of this place in its present "undeveloped" state (eg. a wasteland, or waste repository for the unwanted by-products of our modern urban society, such as junked automobiles and effluent sewage from treatment plants). It can also be associated with the feeling one gets who makes the effort to find out about the natural values and historical/cultural traditions associated with Kawai Nui. Students and concerned citizens and even government agencies have often turned to me at the University of Hawaii, Environmental Center, for guidance in helping them out of the "swamp" of insufficient information for making more effective management decisions about the marsh or for more effective utilization of this resource for environmental education purposes. After steering these information-seekers to various sources to satisfy their needs, they were often bewildered by the voluminous amount of information available to them regarding the marsh and related projects; and frustrated by the fact that this information was difficult to access, and interpret, and was scattered about in many different locations and formats (museums, school libraries, government office files, organizational minutes records, personal libraries, memoirs, etc.). Furthermore, the information available was also focused not on the marsh's historical/cultural values and resource attributes *per se*, but on the impacts that various proposals for change might have on these existing values and attributes. Hence, much of the available literature included information on Kawai Nui as a "backdrop" for various plans and proposals to change the existing environment of the marsh into a form that would suit their project purposes and desired outcomes. Little information was available which focused on the nature of the historic and existing environment at the marsh and its current, often invisible functions, (eg. as a marine nursery, a flood control basin, a groundwater recharge aquifer, a habitat for endangered waterbirds, and an erosion buffer for the surrounding communities). Even less was focused on how these historic and existing functions would be affected by future alterations to the environment and the associated social "costs" of losing these values. In addition, although the marsh was being and still is frequently being used by all age groups for

educational excursions of one sort or another, documentation of that use for interested potential users was difficult to obtain and interpret, in many instances. Hence, this project made a conscientious and deliberate attempt to focus on the historical/cultural and current ecological aspects of the existing marsh environment. It is aimed at increasing one's knowledge of these factors which can lead to more effective management decisions and improved educational use both in the present, and in planning for the future of the area.

Components of This Guide

Before the reader becomes immersed in the written portion of this educational guide, it is recommended that -- if possible -- (s)he view the companion slide/sound portion of this multi-media production, which is available through the University of Hawaii, Sinclair Library, Listening Center. The 20-minute slide/sound show, "Ho'ona'auao No Kawai Nui", comes in a kit including 80-slides in a single Kodak-type carousel tray; a cassette-tape sound recording of the narrated, music-enhanced script; and a written copy of the script. The user can follow the written script as a guide, in order to know when to change the slide, while playing the sound recording of the script.

The slide/sound accompaniment to the written guide gives an overview of Kawai Nui Marsh's evolution, from geological origins to present-day uses, covering changes in attitudes and values exhibited by humans from early Polynesian times to the present. The slide/sound production, by itself, is self-sufficient in educating the user about all aspects of the Marsh, and is designed to raise questions in the user's mind as to what could or should be the uses and values of Kawai Nui Marsh in the future. Detailed information about the major themes covered in the slide/sound production is contained throughout the written portion of this guide.

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Chapter 1. KAWAI NUI MARSH: HOW IT EVOLVED TO ITS PRESENT STATE AS A RESULT OF MANY FACTORS — BOTH NATURAL AND HUMAN-MADE

Section 1.1 Early Origins and Occupancy Period at Kawai Nui Marsh

On the Island of O'ahu, at the highest point along the Pali highway, along the crest of the Ko'olau mountain range, there is a scenic lookout which affords a panoramic view of windward O'ahu. From that vantage point, one can see north up to Moko Li'i, or Chinaman's Hat, a conical-shaped island just off the coast of Kualoa Beach Park in Kaneohe Bay. The view to the south continues past Mokapu peninsula, across Kailua Bay to the beach at Lanikai. On the left side of this viewing range lies Kaneohe town and to the right lies Kailua town. The Pali Golf Course and the City and County's Ho'omaluhia Park ramble along the base of the Ko'olau mountain range below. Down to the right, in front of the view of Kailua town, one can see a grassy green area of open space snuggled between Mt. Olomana and the Kapa'a Hills. (See Figure 1.1)

This triangular spot, which actually spreads out below the hills for a thousand acres, is an area known as Kawai Nui Marsh. The early Hawaiians who named the area had a propensity for naming places after their physical characteristics and this place was no exception. Its full name during pre-European contact days, when pre-historic Hawaiian society was in full flourish, was Kawai Nui Loko, or "the big freshwater fishpond". Although no longer managed as it was then — as the largest freshwater fishpond in the Hawaiian Islands — the marsh which exists there today is able to exist as a marsh in this area for the same reasons as the fishpond once did -- its underlying water-retention properties. (See Figure 1.2)

A volcanic plug of dense basaltic rock lies below the surface of the present-day marsh, the top of which has been measured to be reached at a depth of approximately 1.6 km. This dense rock prevents stream runoff and rainfall water entering the marsh from seeping down and out of this catchment basin. (See Figure 1.3 and Figure 1.4) The existence of this volcanic rock and plug here is a reminder that, about two and a half million years ago, this tranquil scene was the site of violent and explosive volcanic activity. (See Figure 1.5)

Ko'olau volcano began to emerge from the sea, twenty-five miles southeast of an already existing prominent Waianae volcano. As Ko'olau volcano grew, with layer upon layer of erupting lava, the older Waianae vent began to quiet down. The land building layers of lava from these two active vents accumulated in such a way as to merge with each other, thus forming the island of O'ahu.²

The perimeter of O'ahu island in these earliest formative years was much greater than it is today. (See Figures 1.3 and 1.4) The shape and form of O'ahu today, including the steep pali cliffs from which the overview of the marsh can be enjoyed, are the product of continuous wind and water-induced erosion action affecting this area since those earliest primigenial times. (See Figure 1.6)

After the Ko'olau volcano became dormant, rain falling on the porous lava rock began to disintegrate the rock into soil and the seaward sides of the two volcanoes forming O'ahu began to erode into the sea. Colonizing vegetation such

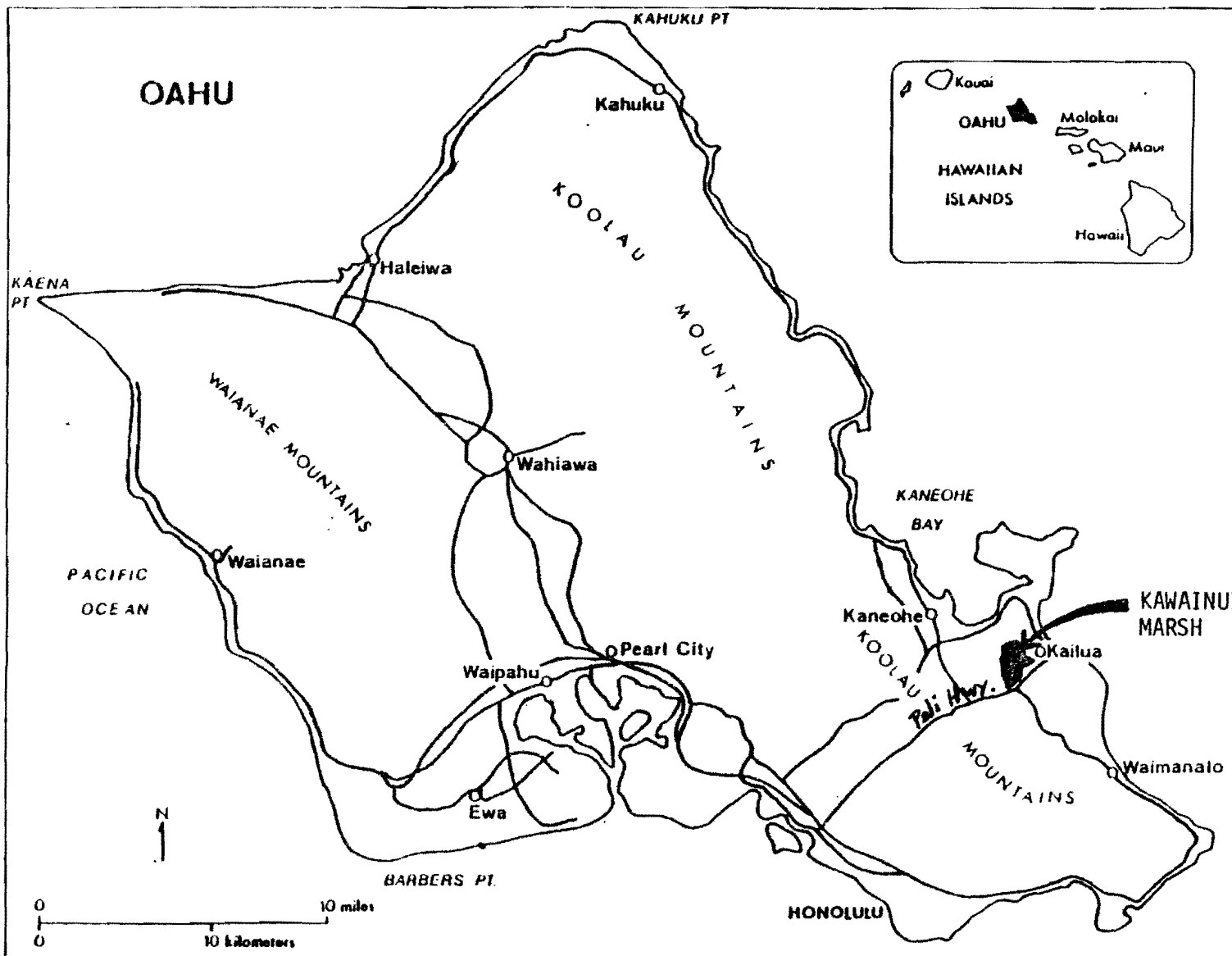


Figure 1.1 Location Map -- Kawai Nui Marsh, on O'ahu Island, State of Hawai'i, U.S.A.
 (Taken from: Elliott, Margaret and Erin Hall, Wetlands and Wetland Vegetation of Hawaii, (Honolulu: Earthwatch, Inc., 1977), for U.S. Army Corps of Engineers, p. 71.)
 -- with some modifications --

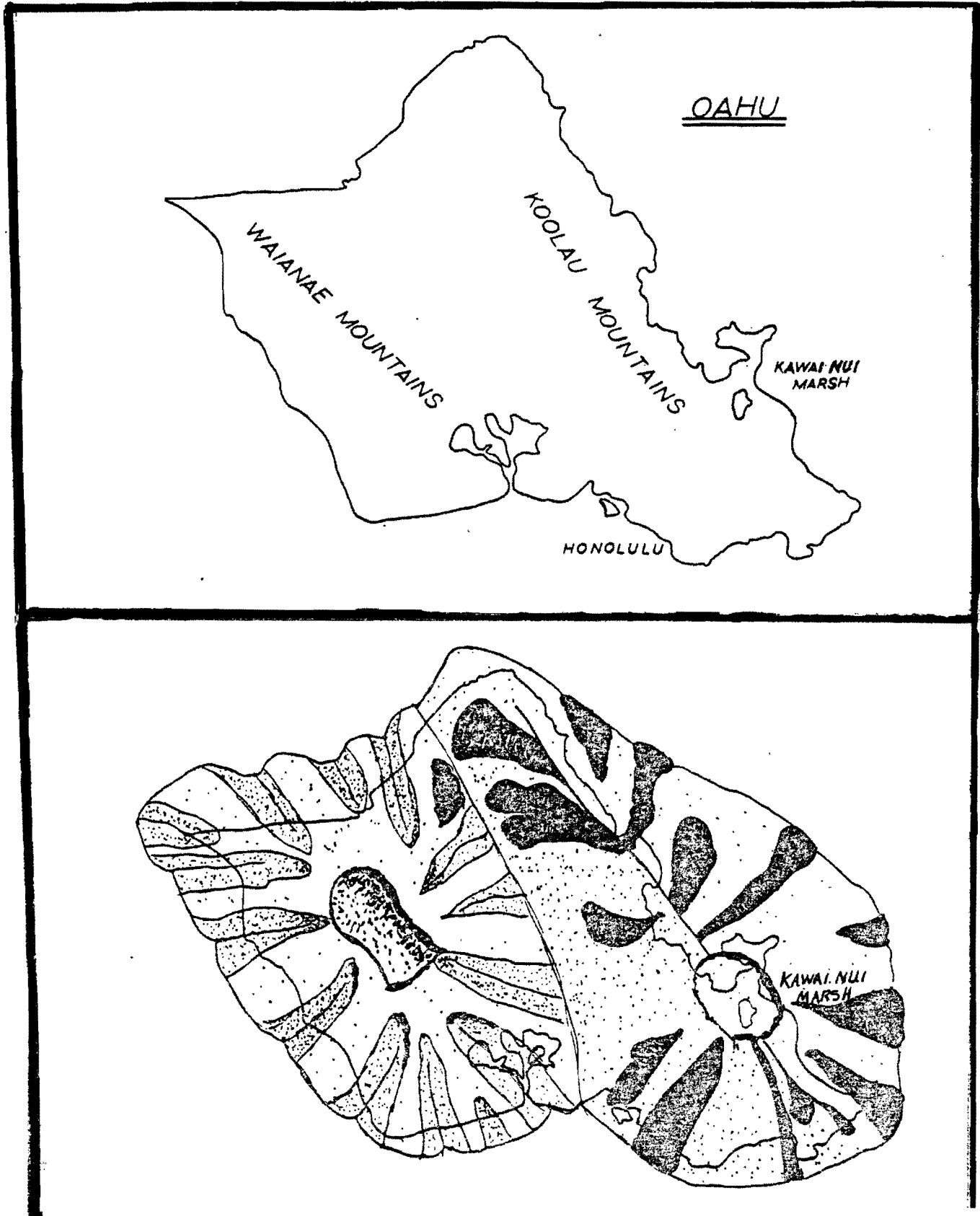


Figure 1.2 Kawai Nui Pond and Wetland Cultivation as seen along the "New Pali Highway". (Photo by Brother Bertram, ca. 1898, Brother Bertram Collection, Hawaii State Archives (Used With Permission))

Figure 1.3 (Top) Base Map of O'ahu Today, Highlighting Location of Kawai Nui

Figure 1.4 Base Map of O'ahu Today, Overlain by Representation of O'ahu During Early Volcanic Phase, Showing Kawai Nui Marsh in Center of Former Ko'olau Vent

(Artist: Jennifer Tyau)



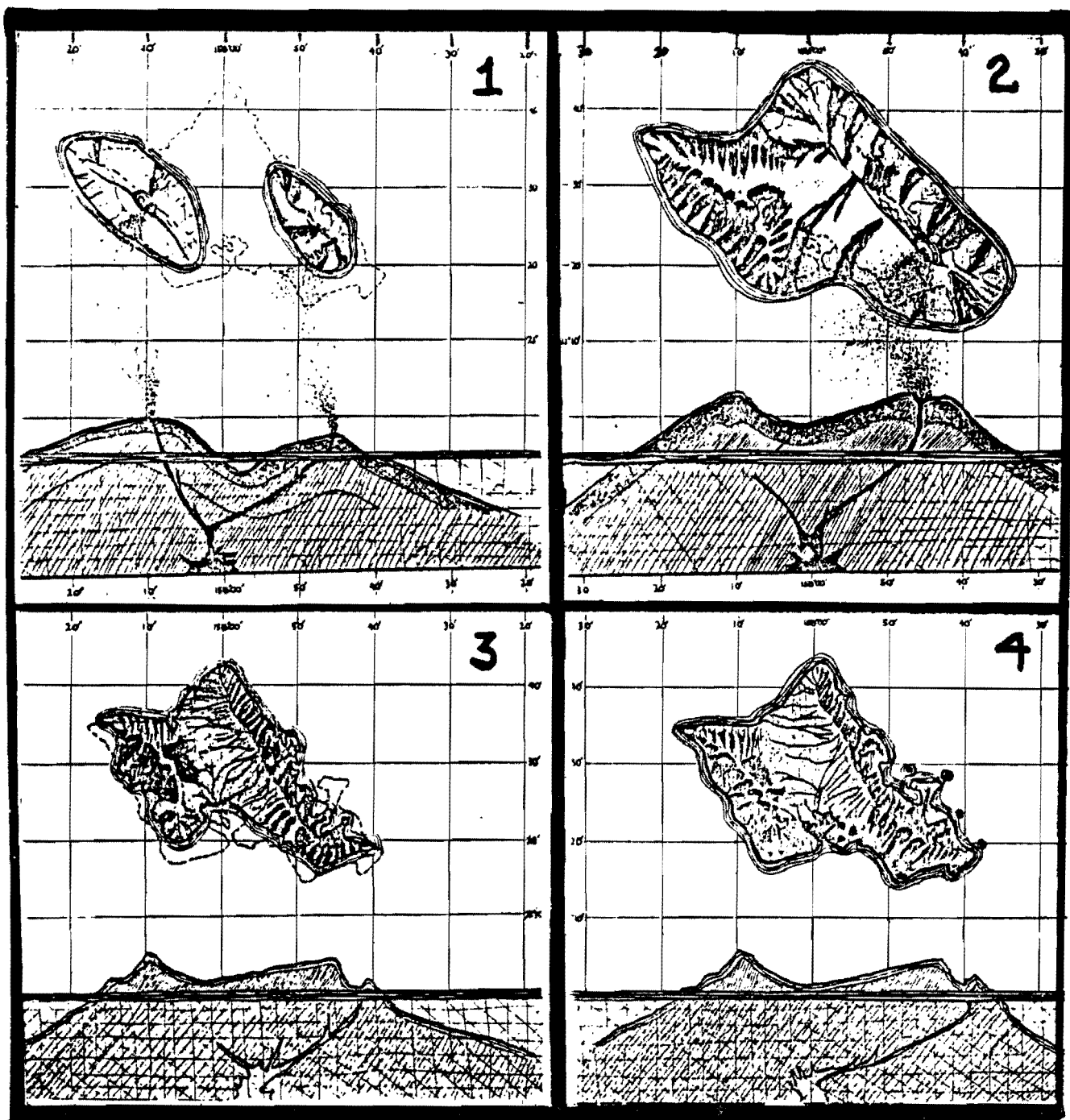


Figure 1.5 Selected Stages: Geographic Origins and Topographic Changes of O'ahu Island, from Volcanic Origins to the Present.

(Artist: Taeyong Kim)

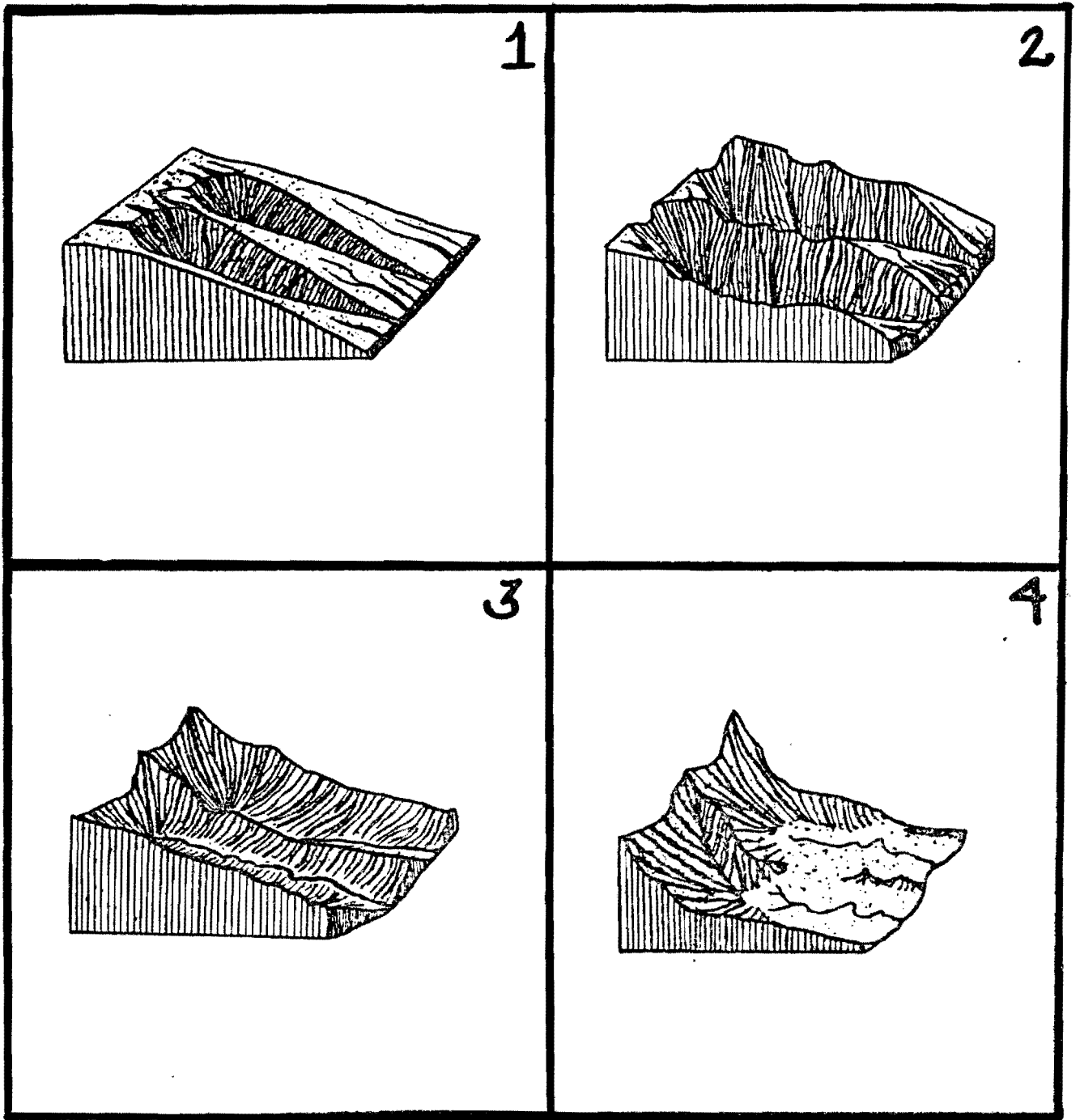


Figure 1.6 Stages of Erosional Change on O'ahu leading to Steep Pali Cliffs Formation along the Ko'olau Mountain Range (Artist: Taeyong Kim)

as lichens and ferns, helped this erosion process along. Streams flowed down the volcano, cutting into the surface, and making steep, v-shaped valleys all along the landward rim of the caldera. This downward cutting by streams was offset by lateral cutting of the valleys along the stream banks and these actions led to the formation of wide-mouthed valleys. Over time, even the sides of these wide-mouthed valleys were worn away by continuous stream flow action, leaving the steep cliffs or pali, which form the backbone of O'ahu island today. This cliff formation extends for twenty-two miles along the northeast side of O'ahu, comprising the Ko'olau mountain range.³ The seaward boundary is represented today by the remnant hills of Mokapu and the Moku Lua Islands.

The Ko'olau s form the backdrop of the Maunawili valley, which contains many streams and springs that feed into the Kawai Nui Marsh. This feeder stream drainage system flows into the Marsh today at the measured rate of approximately 6.8 million gallons of water per day, thus helping to make Kawai Nui the largest fresh water marsh in the Hawaiian Islands.⁴ (See Figure 1.7)

However, these were not always the physical conditions that prevailed here. Core samples from underneath Kawai Nui Marsh reveal marine coral and calcium-containing deposits under clays and organic sediment.⁵ These findings indicate that from approximately six thousand to about four thousand years before the present, (See Figure 1.8) Kawai Nui Marsh was an open saltwater marine bay, similar to the present day Kaneohe Bay. Coral sands washed up on the silty beaches along the inland portion of the bay, while the peripheral slopes supported a natural tropical forest. This marine embayment, having by then become a lagoon, with carpeted mud bottom, was existing here when the earliest polynesian pioneers discovered Hawaii, about 1500 years before present. (See Figure 1.9) In fact, archaeological and geological evidence from Kawai Nui and nearby areas indicate that O'ahu was one of the earliest areas occupied by these polynesian voyagers, as early as the fourth century A.D.⁶

At that time, the accretion barrier, that would eventually close off the lagoon, was already formed from the north to south ends of the bay on the reef tract. The sand barrier at the makai end (i.e. the ocean side) of the lagoon could have supported coconuts and hala. And the wet plains in the valley would have provided natural garden plots for the newcomers to plant taro shoots for lo'i farming (i.e. water-terrace taro agriculture). The crops would provide forage for the pigs they had brought with them on their cross-ocean voyages.

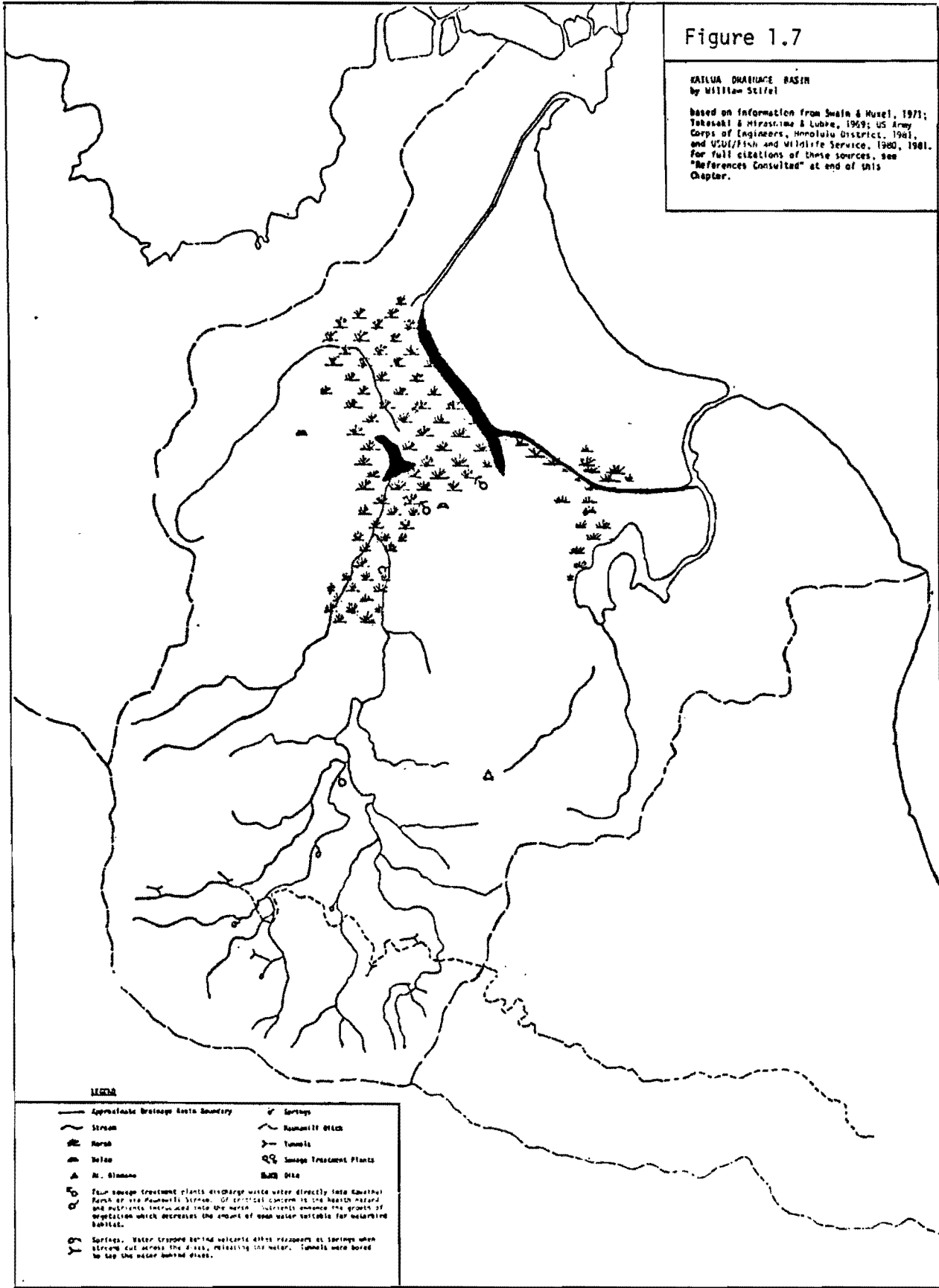
Inland from this lagoon were plots suitable for taro cultivation along the valley streams, as this was their staple food. Lagoon fish were available for gathering, and offshore deep ocean canoe fishing could have provided aku and alua, favored and plentiful local fish. Basaltic outcroppings in the immediate vicinity of Kawai Nui could have provided materials for stone tools. Ohia trees grew here, and kauila in the valley that could be used to make their 'o'o, the only cultivation tool. Coconuts and sweet potatoes for eating, noni for medicine, and kukui to light the night would have been able to grow there on the wooded slopes surrounding the lagoon, if forests were removed by controlled burning. Thus, this area was rich in potential resources. It is no wonder that it was among those earliest occupied in Hawai'i.

Imagine the awe and excitement of those ancient polynesian mariners as they arrived after months at sea to this place of paradise and verdant beauty! In

Figure 1.7

KAILUA DRAINAGE BASIN
by William Stefel

Based on information from Swain & Muzel, 1971; Takasaki & Mizushima & Lubbe, 1969; US Army Corps of Engineers, Honolulu District, 1961, and UOJ/Fish and Wildlife Service, 1980, 1981. For full citations of these sources, see "References Consulted" at end of this Chapter.



LEGEND

- Approximate Drainage Basin Boundary
- ~ Stream
- ▨ Marsh
- ▣ Tunnel
- ▣ Sewage Treatment Plant
- ▣ M. Shimano
- ▽ Springs
- ~ Kananalei Ditch
- ~ Tunnel
- ▣ Sewage Treatment Plant
- ▣ Salt Pile

Four sewage treatment plants discharge waste water directly into Kailua Bay or the Paumotu Stream. Of critical concern is the health hazard and nutrients introduced into the marsh. Nutrients enhance the growth of vegetation which decreases the amount of open water suitable for waterbird habitat.

Springs. Water trapped behind volcanic dikes reappears at springs when streams cut across the dikes, releasing the water. Tunnels were bored to tap the water behind dikes.

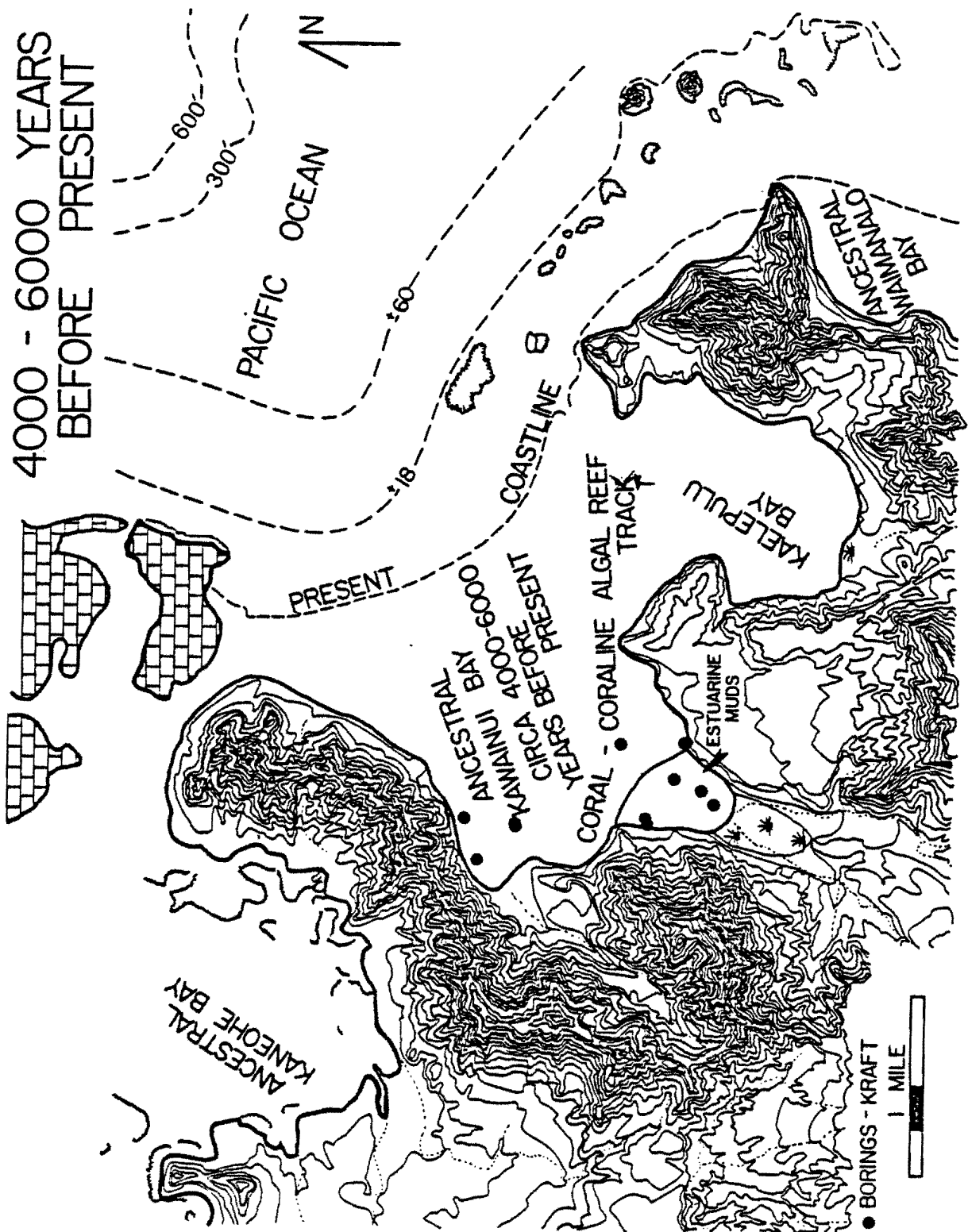


Figure 1.8 Probable Geographic Appearance of Kawai Nui Area, 4,000 to 6,000 Years Before the Present (Map by Dr. John C. Kraft, archaeo-geologist, and used with permission.)

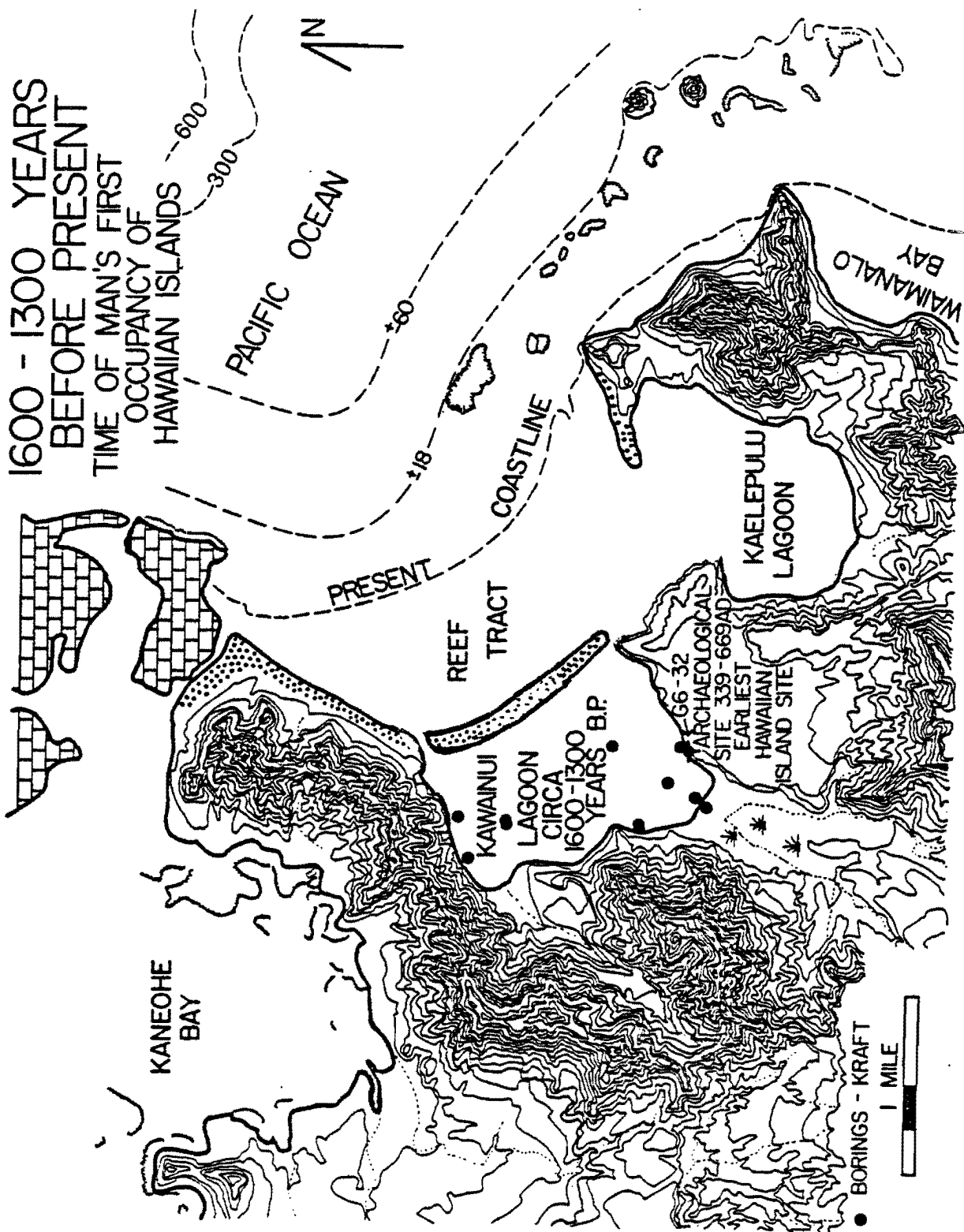


Figure 1.9 Probable Geographic Appearance of Kawai Nui Area at time of First Human Occupancy (1600 to 1300 Years Before the Present). (Map by Dr. John C. Kraft, archaeo-geologist, and used with permission.)

addition to the colorful community of flora and fauna which they undoubtedly found there, amenable to development for uses suggested above, freshwater was abundant and fish teemed in the ocean.

Throughout this earliest settlement period, the streams flowing off the Ko'olau mountains and through the taro gardens in the valley deposited increasing amounts of sediment and soil on the shores of the lagoon. A peat layer capable of supporting salt-tolerant vegetation began to develop, creating fringing marshes around the lagoon, an inviting environment for nesting waterbirds and migrating water fowl — a source of feathers and food. The streams continued to lay their sediments and soils while the ocean continued building the beach barrier, aided — perhaps — by increasingly sophisticated Hawaiian stream flow management. These natural forces continued to supply the nutrients necessary for support of the flourishing fringing marshes which probably expanded in area to encompass more and more of the open water lagoon. Meanwhile, the accretion barrier continued to expand from the north to the south end of the bay, as the fringing marshes grew.

By this time, approximately 1200 years ago, the population of Hawaiian settlers in the area had undoubtedly increased to the point that population pressures demanded more intense exploitation of the available resources of the valley to feed and clothe their growing numbers. It is thus possible that the Hawaiians augmented these natural processes by diverting the streams that flowed off the Ko'olau so that the sediments and soils would be deposited in a concentrated, controlled manner. Eventually, by late prehistoric times, the Hawaiians converted approximately two hundred fifty acres along the mauka (inland) edge of the marsh-fringed lagoon into a rich and productive taro-growing area by controlling the streams and damming the waters into a network of irrigation ditches or "auwai" approximately 500 years ago. A four hundred fifty acre inland freshwater fishpond or "loko wai" was also established, in which awa and mullet were raised. This inland freshwater aquaculture system was separated by an expanding barrier beach from the sea, and drained by a mile-long canal linking it with the drainage system of the nearby Kālelepu fishpond and its taro complex. Water from the mountain streams continued to feed the taro fields. The fishponds were fed by nutrient-rich water from the taro, which nurtured algae on which the fish fed. Hawaiians harvested the fish and taro, while maintaining the fishponds and taro fields. (See Figure 1.10)

The central role of taro production and the practice of aquaculture in the life of these ancient Hawaiians cannot be overstated. Taro was brought by polynesians on their pioneering voyages to this place, thus serving as the staff of life, as well as a foundation on which social customs were built. The Hawaiians believe taro to be descended from the gods. In one tradition, it is called Hāloa or the "shivering tall stalk". Man was the second born and is also called Hāloa. Thus taro is regarded as the older brother of man.

'Ohana, a term referring to "family" today, is an expression which has its roots as a reference to the people who were taro planters. When a taro sprouts, it is called 'ohā and thus 'ohana literally means offshoots of the taro plant. In terms of people, it means offshoots of a common stock. Similarly, the word for land, or 'āina, stems from 'ai, which means "food plant" and thus 'āina translates to "that which feeds". Hawaiians have always identified themselves with their homeland and the 'āina which nourishes their 'ohana.



Figure 1.10 Artist's Rendition of Hawaiian Planter Harvesting Taro from Wetland Cultivated Fringe of the Kawai Nui Loko (Inland Freshwater Fishpond), ca. 500 Years Before the Present (Artist: Donna Kamahele)

To the Hawaiian planter, taro was not only the staff of life but the source of wealth. Abundance of taro suggested that an ample water supply was available. Thus, it comes as no surprise that the word for "wealth" in Hawaiian, or "wai wai", is simply a reference to the word for "fresh water". The concept of law was also associated with water. "Kanawai" law, translates into "that which pertains to regulation of waters".¹⁰ This example shows the fundamental value associated with the availability of fresh water, for growing taro, the staff of life. The course of freshwater through the taro fields or lo'i patterned the entire subsistence economy and -- through this -- the cycle of individual and social activity.

As the human population increased, it is likely that lo'i farming began on the stream banks in the fringing marshes at this time. Terrace walls and lo'i on the valley floor were probably not built until a significant amount of silt from the surrounding slopes had eroded into the basin on top of the peat. This process allowed reclamation of former saltwater environments for freshwater agri/aquaculture. The presence of both terrace walls and lo'i on the valley floor are indicative that valley farming was intensive and a large population was being sustained in this area.

While their taro-based agricultural system was thus developing, a sophisticated aquaculture system was also in the making. Although almost every culture in the world has practiced aquaculture to some degree, Hawaii is the only place in the Pacific where the practice was developed to such a high level of sophistication. Nowhere else did the people of the Pacific develop the types and widespread numbers of ponds as found in Hawaii.¹¹ Although little documentation exists, the sequence of developments in the Kawai Nui area leading to the development of a sophisticated aquaculture system there proceeded somewhat as follows.

When the earliest polynesian occupants arrived in this formerly open marine lagoon at Kawai Nui, some canoe fishing probably provided the main source of fish protein, while the growing sand accretion barrier gave access to line fishing. A marine coral shelf existed on the floor of this marine lagoon, while saltwater marshes had begun to grow along its inland perimenter. An outer fringing reef shelf evolved in such a configuration as to provide an ideal physical set up for Hawaiians to develop a "loko kuapā" or shoreline-type of fishpond, whose primary isolating feature would have been a seawall (kuapā) of lava and/or coral.¹² Typically, such a loko kuapā fishpond had one sluice gate or mākahā. The wall was permeable to water, while the mākahā, or sluice gates were completely stationary and without any moving parts. They allowed the water to freely flow in and out of the pond so that water circulation and flushing could occur, yet the fish could be retained. The auwai-kai (sluices) or channels were present which connected the fishpond with the sea. Mature fish, when ready for harvest, would congregate in the auwai-kai on the pond side of the makaha during the incoming tide, and vice versa during the outgoing tide. Using this knowledge, the kia i loko (pond keeper) positioned himself at the makaha and caught the fish, using dipnets. In addition to the existence of this loko kuapā or shoreline type of fishpond that once could have existed here, it is likely that the upland taro patches had earlier been developed into "loko ia kalō" -- or taro patches used simultaneously to raise fish, especially mullet, and ōpae-'oeha'a (clawed, freshwater shrimp).

With the passage of time, as the sand accretion barrier at the mouth of the marine lagoon became wider and wider, it is possible that the loko kuapā fishpond

that may have existed here was eventually converted into the "loko wai" or inland freshwater type of fishpond. Thus, as the saltwater lagoon was gradually cut off from the sea by the evolving sand accretion barrier, the water quality changed from dominantly salty to brackish to predominantly fresh, and it became a collecting basin for all the spring and rain-fed fresh water running down from the surrounding mountain slopes in the Maunawili watershed. The increasing predominance of freshwater in the pond eventually led to the die off of the marine life and coral heads as the lagoon continued to fill in, and the biological community in the pond changed accordingly. To what extent the Hawaiians influenced these changes or had control over the types of sea life to be found in these ponds is not well understood for such a large interior freshwater pond. However, we do know that they did learn to master ways to augment the natural productivity of whatever edible species they found there. Desired fingerlings were caught outside and then stocked in the pond. Freshwater limu was also intentionally transplanted into the pond. Fertilization was both natural and artificial. The fish were fed taro, sweet potato, breadfruit, mussels, and seaweed. Religious beliefs governing the purity of freshwater did not allow the use of any type of animal waste for fertilizer.

Besides the use of scoop nets, the most efficient and practical method of harvesting the fishpond was the use of long seine and gill types of net which were used to take out a large quantity of fish. The large 450-acre Loko Wai type of fishpond that eventually developed at Kawai Nui Loko probably yielded a very rich harvest. *Ahole hole* (*Kuhlia sandvicensis*), several species of o'opu (goby), ama'ama (mullet), awa'awa (ten pounder), and awa (milkfish), were probably caught in this pond. Nearby Kawai Nui was another large productive fishpond, or Ka'elepulu. These ponds were connected with sophisticated canal systems. Before European contact and influence on this water flow system began, in the early part of the nineteenth century, the predominant drainage direction for water from the Kawai Nui pond was to the southeast, along Kawai Nui Stream, seasonally into Ka'elepulu fishpond, or out through a stream channel that enters the Kailua bay north of Alala Point in Lanikai. (See Figure 1.11)

The above description of the evolution of the 450 acre freshwater inland fishpond of Kawai Nui Loko is based on the hypotheses derived from available geological and archaeological evidence to date. It is ironic that there is no definitive documentation of fishpond construction techniques and dates here or elsewhere in the Hawaiian islands, yet the Hawaiians were known to have developed the most sophisticated aquaculture systems that existed among the peoples of the Pacific. It is believed to have been a labor intensive and time consuming process. The only known tools to have been used were ropes, calabashes, litters, and digging sticks. Legend has it that the fishponds were built by menehunes or dwarfs. It is commonly accepted that, as in the menehune legends, the rocks were actually transported by passing them along a human chain sometimes for many miles.

Another interesting legendary aspect of the fishpond at Kawai Nui Loko was the presence of Lepo-'ai-'ia or edible mud. Traditions state that Ka'ulu-a-kalana, a noted chief, brought the mud from Kahiki (foreign place) to O'ahu and placed it in the fishpond at Kawai Nui. The mud is described as thick and jelly-like, having the color of poi (mashed taro). In 1795, during his invasion of O'ahu, it is said that the warriors and servants of King Kamehameha the First ate the mud when poi was in short supply. King Kamehameha worked in Kawai Nui fishpond and the surrounding taro gardens with his own hands, thus encouraging the chiefs and people to maintain the productivity of the area.¹³

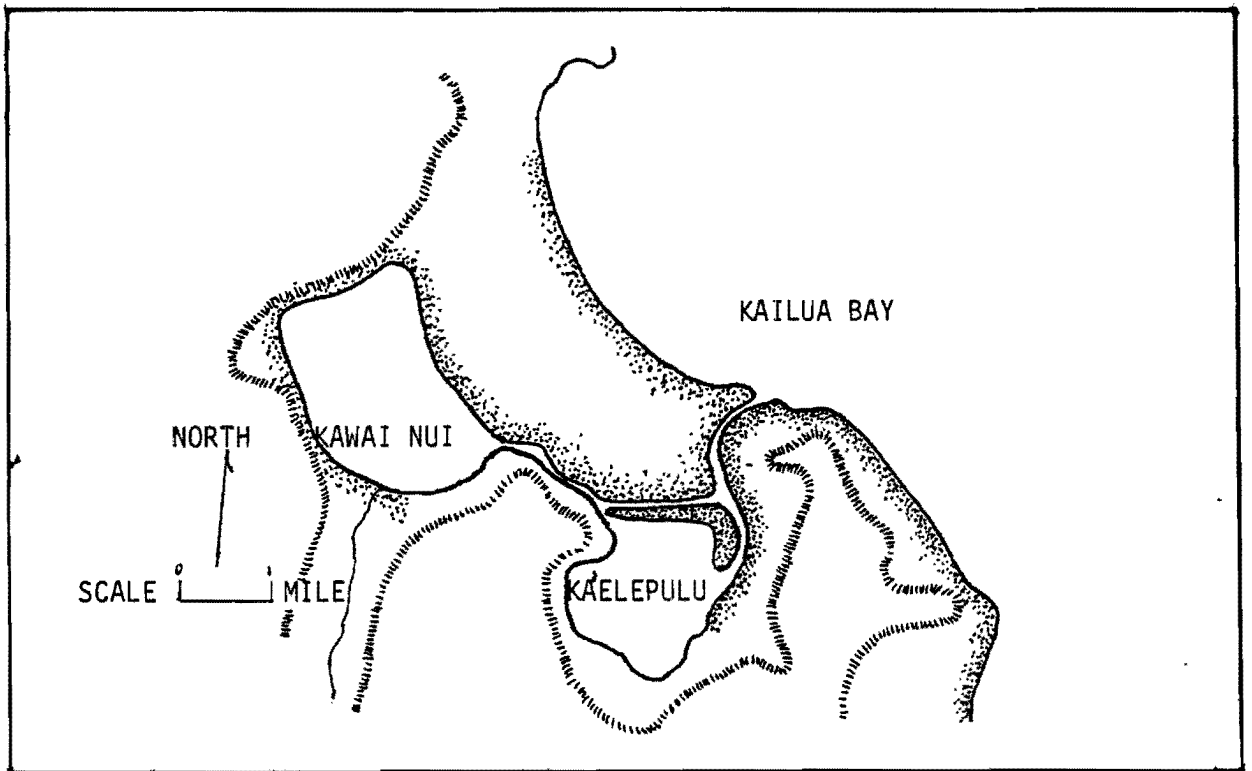


Figure 1.11 Diagram Showing Location of Kawai Nui and Ka'elepulu Ponds at Kailua Ahupua'a, and Interconnecting Drainage Pattern, before European Influence (Adapted from Summers, Catherine. Hawaiian Fishponds Honolulu: Bishop Museum, 1964, Figure 14, p. 21.) (Adapted by Donna Kamahele)

The continued productivity of the district was believed to be assured by the presence of a mo'o or guardian spirit of Kawai Nui, which manifested herself either in reptilian or beautiful woman-like forms, and whose presence in the pond was said to have been marked by the yellow hue imparted to the grasses and bullrushes there. Many freshwater fishponds were thought to have such a mo'o or guardian spirit. The mo'o at Kawai Nui was called Hau-wahine. She and her companion mo'o of Ka'elepulu looked after the welfare of the people by insuring a plentiful supply and variety of food to be harvested from the pond. If the chief's land agent oppressed the people of the area or became indifferent to their needs, the mo'o would take away the fish from the pond.¹⁴

Pollution in the form of sewage, rubbish, and metabolites accumulating in the water of the fishpond was considered to be an insult to the mo'o. Thus, the Hawaiians actively managed the fishpond by periodically clearing the open water of encroaching vegetation, thus paying respects to the residence of the mo'o goddess Hau-wahine. This religious-based respect had the additional side benefit of keeping the water in the fishpond open and clear, thus assuring a continuing supply of mullet and the other aquatic life in the pond upon which they depended for food. According to one description, the pond cleaning at Kawai Nui proceeded as follows:¹⁵ (See Figure 1.12)

The men, women, and children of Mauna wili, Kailua, and Waimanalo . . . went into the pond, and with their hands broke the limu loose, picking it up and twisting it under as it was gathered. . . breaking of the limu was continued until the pond was clean and the food of the fish clean, which for Kawai Nui required three days.

In addition to the respect thus paid to the residence of the Mo'o goddess, the Hawaiians displayed their religious-based respect for the natural environment by building and maintaining heiaus, or temples of worship, such as those which were built in many places along the periphery of Kawai Nui.

There were at least three major heiaus associated with the Kawai Nui area.¹⁶ One of these, Holomakani heiau, may have been a Ho'oulu'ai, or agricultural type of heiau, where the first fruits of the farmer were offered to insure further growth and prosperity of food crops in the area. It was located just beneath Pahukini heiau but has since been destroyed. Pahukini heiau, a walled-in structure, was thought to be the Luakini type or human sacrificial heiau, perhaps dedicated to the god Ku. Pahukini is located on a natural promontory, affording an excellent view of the entire Kawai Nui fishpond area, and out to the ocean. A distinctive large stone above the heiau may have been used in conjunction with the heiau activities. (See Figure 1.13 for location of Pahukini heiau)

The legendary Chief Olopana was said to have come from Kahiki (foreign land) and settled in this district. Olopana is said to have been responsible for the construction of both Holomakani and Pahukini heiaus in the Kawai Nui area, and his name is mentioned in a number of stories about the Kailua area. King Kamehameha the First was also involved with the heiau of this district. He is known to have rededicated a number of heiau on O'ahu to his use, including Keikipuipui Heiau on the dividing line between Kailua and Waimanalo.¹⁷ While there is agreement that Pahukini Heiau is one of five built by the great chiefs of antiquity, Olopana, confusion concerning its name may be linked to Kamehameha's



Figure 1.12 Artist's Rendition of Vegetation Clearing by Hawaiians in the Fishpond at Kawai Nui in Honor of Hauwahine, the Mo'o Guardian Goddess of the Pond, ca. 500 Years Before the Present (Artist: Donna Kamahale)

sojourn at Kailua.¹⁸ Pahukini may have been rededicated, with the name of Mookini, linking this heiau with the site of his own birth ceremony at Kohala, Hawaii, to honor the origins of his mother's people of Kailua, O'ahu and thus win the loyalty of his newly-conquered subjects in the Kailua district.

The third major significant heiau associated with the Kawai Nui area was Ulupō heiau, which may have been built as early as 700 to 800 A.D., and to have once fronted on the marine lagoon that still existed at Kawai Nui during the earliest phase of human occupancy in this area. Ulupō is a large heiau, measuring 140 feet in width and 30 feet in height. The construction of this heiau is attributed to the menhune and the stones that were used in the construction are said to have come from as far away as Wai'anae. The method of transporting these stones was done by passing them hand-to-hand in a human chain over the Koolau range or Pali. A spring exists on the northwest corner of the heiau, and this was used to wash the pigs or other offerings that would be dedicated to the gods at the heiau. A pathway leading up from this spring has been labeled the "menhune" pathway. Ulupō is believed to be dedicated to the first Hawaiian God, Kane, since one of the names referring to him is Kane Ulupō. Kane is the god of "sunlight, freshwater, and forests, to whom no human sacrifices were made".²⁰ (See Figure 1.13 for location of Ulupō heiau).

The elaborate fishpond/taro field complex, with its associated religious temple-like structures or heiaus, which the earliest Hawaiian occupants developed at Kawai Nui from approximately the fourth to the eighteenth century A.D. was part of a total human managed ecosystem within what came to be referred to as the Kailua Ahupua'a -- a pie-shaped division of land extending from the Ko'olau ramparts of Maunawili Valley, down through the Kawai Nui and Ka'elepulu fishponds, and out to the ocean at Kailua Bay. (See Figures 1.14 and 1.15) Under this late Hawaiian system of land division, the ahupua'a, running from the mountain peaks to the sea, was under the control of a high chief. The Kailua ahupua'a was one of eleven such areas comprising subdistricts of the Ko'olau Poko district on O'ahu. The ahupua'a concept is believed to be about 500 years old.²¹

A Hawaiian historian once defined an ahupua'a as the land-based unit around which all human activity and society was organized. Thus, he said:²²

The ahupua'a ran from the sea to the mountain, theoretically. That is to say the central idea of the Hawaiian division of land was emphatically central, or rather radial. Hawaiian life vibrated from uka, mountain, whence came wood, kapa, for clothing, olona, for fishline, ti-leaf for wrapping paper, ie for rattan lashing, wild birds for food, to the kai, whence came ia, fish, and all connected therewith. Mauka and makai are therefore fundamental ideas to the native of an island. (Emphasis added)

The central position of Kawai Nui fishpond in the Kailua ahupua'a and the agricultural/aquacultural productivity it was famous for, made it thus the very "piko" of the ahupua'a. The Hawaiians believe the piko, or navel, houses the soul.²³ The nutrient rich waters supported food for a large population, and gave rise to political power and the development of a sophisticated state-like government necessary for managing the irrigation systems and fishponds of the area. It is no small wonder that this highly productive area was once the capital of O'ahu and an

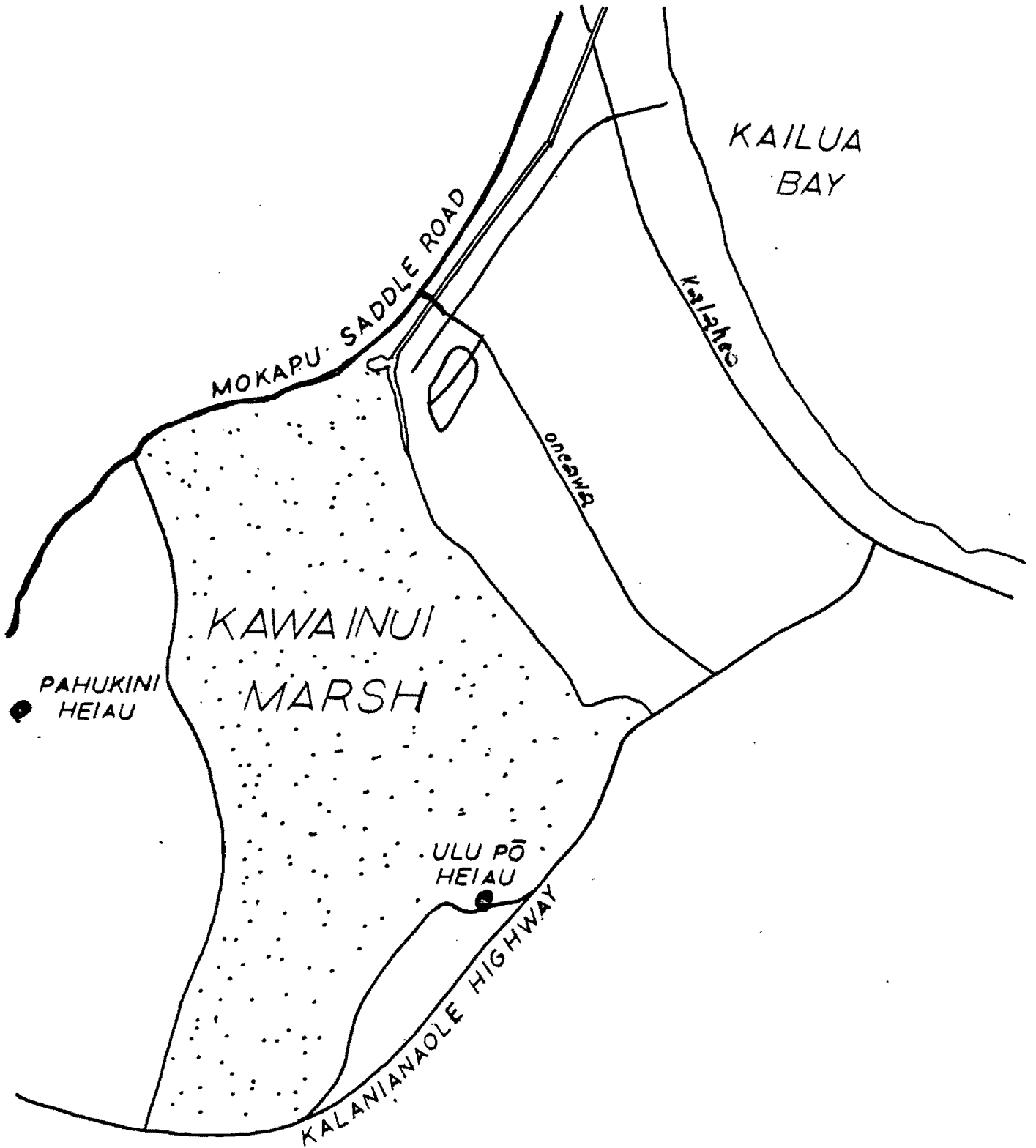


Figure 1.13 Simplified Map Showing Kawai Nui Marsh and Present Highway Leading into Kailua Town, Highlighting Location of Ulu Pō and Pahukini Heiaus
 (Adapted by Jennifer Tyau from U.S.G.S. Map, 1959, with scale 1 : 24,000)

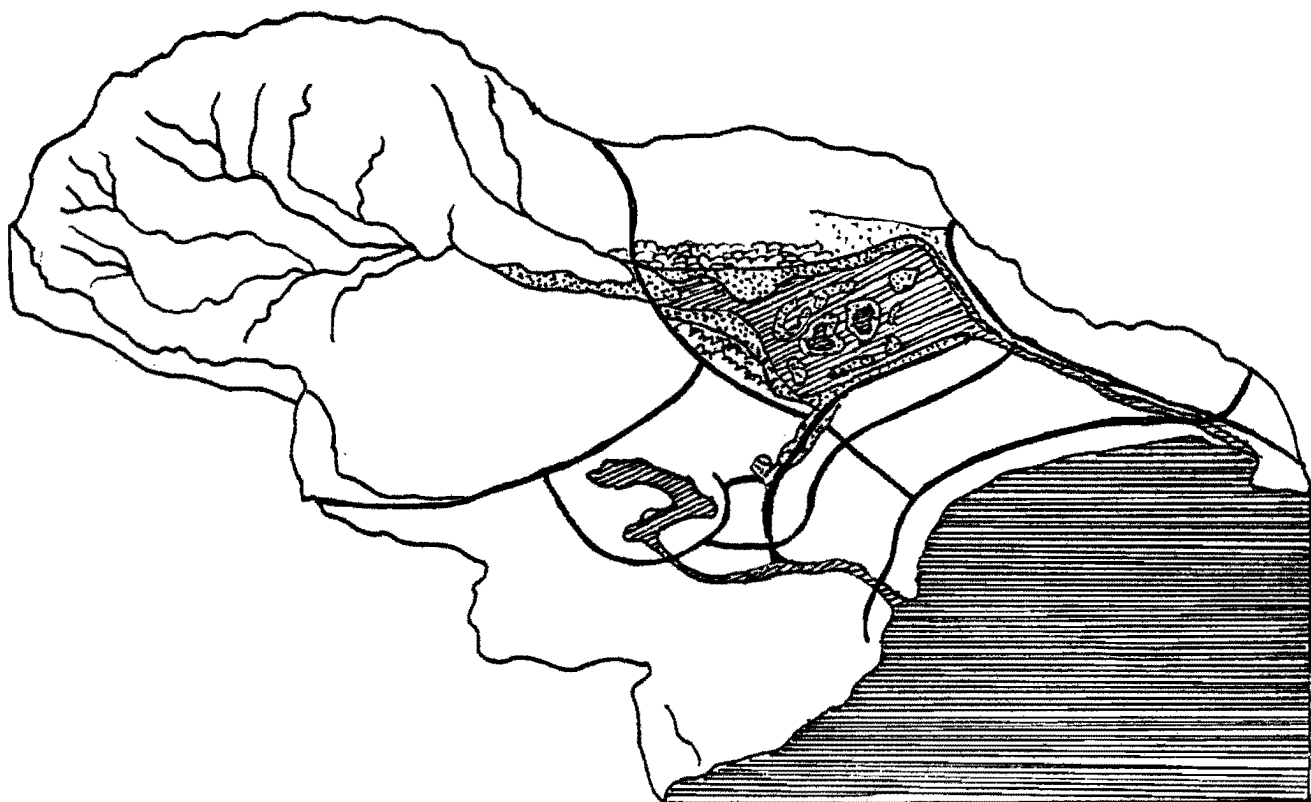


Figure 1.14 Schematic Diagram of the Kailua Ahupua'a, Showing Central Position of Kawai Nui and Ka'elepulu Fishponds (adapted from Directional Plan Diagram, ca. 1974 by Robert Herlinger, A.I.A.) Present Main Highway Arteries Also Shown.

area associated with a number of prominent ali'i or Hawaiian royalty. These attributes of the Kailua ahupua'a and the Kawai Nui area during the heyday of ancient Hawaiian culture in pre-contact times are summarized in the words of two Hawaiian historians as follows:²⁴

Kailua . . . presumably had been the seat of the high chiefs of Ko'olaupoko from very early times. The beach, the bay, and living conditions were and are very attractive. . .

Undoubtedly further reasons for attractiveness of Kailua as a place of residence for an ali'i nui with his large entourage were the great natural fishponds, Ka'elepulu and Kawai Nui and the complex of artificial salt-water ponds that are between Kailua and Kaneohe in the Mokapu area: Halekou, Nu'upia, Kaluapuhi.

Section 1.2 Land Use Changes at Kawai Nui from the beginning of the Post Contact Period (1778) to the early Twentieth Century (1920's)

The arrival of Captain Cook in 1778, followed closely by the missionaries, whalers, sugar barons, and the immigrant workers they recruited, brought sweeping social, economic and physical changes throughout the Hawaiian islands. Introduction of a foreign system of land tenure, based on private property ownership led to a restructuring of the Hawaiian's relationship to each other and to the land. These changes dramatically altered the environment at Kawai Nui and elsewhere. How these changes came about and how they affected Kawai Nui will be outlined in this section.

When Captain Cook first set foot upon Hawaiian shores in 1778, there was an estimated population of 300,000 living there which had evolved into a highly stratified society divided into three classes: the ali'i, or chiefs; the maka 'ainana, or commoners; and the kauwā, the slaves or outcasts.²⁵ The bulk of the 300,000 people fell into the maka 'ainana or commoner class. The structure of the word, maka 'ainana, is indicative of their position in society. "Āina", meaning "land", is derived from a word meaning "to eat". The word "maka 'ainana" actually refers to the land on which one is born and from which one derives one's sustenance. The maka 'ainana were the laboring masses -- who made their living from the soil or off the resources of the sea, as farmers, fishermen, gatherers and artisans.

Hawaii's ali'i were roughly divided into three levels of status: the paramount chiefs, or ali'i nui; the lesser chiefs including the konohiki; and the priests, or kā huna. The ali'i kept careful track of their geneologies and those that could trace their lineage back to the gods Kane, Kanaloa, Ku, and Lono, were the paramount chiefs. These geneologies were committed to memory through myths and legends, some of which were commemorated in chants and dances. These are the unique "library" of the Hawaiian race, incorporating their history and culture. "Mana" -- super-natural power -- flowed through these lineages. Special care was taken to see that the first born (male or female) of the ali'i class would be appropriately trained for leadership duties, as he/she was believed to possess the strongest possible force or "mana", with descent from the gods, which was often assured through ritual brother-sister mating.

The chiefs were stewards of the land on behalf of the gods, and imposed "kapus", or rules, in order to influence social behavior and enforce conservation of the resources. For instance, the catching of aku and 'opelu fish was restricted or "kapu" for these species in alternative six month intervals, which thus prevented overfishing of the nearby ocean.

Although the maka 'āinana "owned" no land, neither did anyone else, and they had rights to farm plots within the ahupua'a, the units of land and waters managed by the konohiki for the ali'i nui of the district. These commoners were free to wander over the whole ahupua'a, from mountain to sea, in order to gain their sustenance. They were also free to move to another district or island, if they chose. On the other hand, there was no such thing as secure title to the land, as we understand it today, over which one worked or wandered to gather food. The commoners were tenants at will and while they could be dispossessed at any time, this rarely happened. The konohiki chiefs were in a more vulnerable position. At the time of a change of rule or at their death, the responsibility for their holdings reverted to the paramount chief or ali'i nui of that district, who then assigned jurisdiction over the area to a new chief, not necessarily related to the dead one. This pattern affected the paramount chiefs' destiny as well. Whenever a new sovereign came into power in the district, jurisdiction over all the ahupua'a in his district was usually redistributed among the followers of the new sovereign.²⁶

When this highly stratified society was flourishing, before the advent of European influence, the ali'i had the authority to call on the maka 'āinana to construct large stone structures such as heiaus or fishponds. As indicated in the previous section, the maka 'āinana were also called upon to periodically clean the fishponds to prevent vegetation overgrowth. It took approximately three days for workers from Waimanalo, Maunawili, and Kailua to rid the Kawai Nui fishpond of such vegetation.²⁷

The ability to gather masses of maka 'āinana to perform such "public work projects" was short-lived soon after the arrival of the first Europeans. The Europeans were carriers of heretofore foreign diseases (eg. measles, smallpox, mumps, influenza, venereal diseases), which infected the vulnerable native Hawaiians in plague proportions, since they had no natural immunity to the imported germs which caused these plagues. The population of the native Hawaiians dropped drastically from the estimated 300,000 at the time of Captain Cook's first arrival to a mere 50,000 less than half a century later.²⁸ The ritualistic performance of fishpond clearing was no longer possible, and there were fewer and fewer Hawaiians to work the taro fields. Thus, the aquaculture/agricultural complex which existed at Kawai Nui and elsewhere in the islands fell into disuse while vegetation and silt encroached along the periphery at an accelerated rate.

While these indirect influences of European contact were working on the native Hawaiian population, and their environment, dramatically changing their relationship to each other and the land, more direct and deliberate influences were also at work. These influences began when Kamehameha the First, with the aid of European technology, united the island under one rule. On every island but Kauai, Hawaiian chiefs and priests had power over all the islands' resources, but the tenant farmers, or maka 'āinana, could reasonably expect to remain on the land which they were cultivating, despite changes in the ruling authority over the ahupua'a in which they resided.²⁹ Young Liholiho was only able to exercise his

influence over a minimum of land, and managed to divide only a few lands among his personal friends and followers prior to his untimely death in England in 1824.³⁰

Hawaiian society began to take on the trappings of a monarchy, in the European sense of the term. And, as European influence on island society grew, the Kamehameha family pressed for the principle of hereditary royal ownership of the land to be accepted. Wide-sweeping changes had been occurring in their world view due—in part -- to the European influences. The kingdom had been almost universally Christianized. Trade and diplomatic channels had been widened farther than ever before. The King and his chiefs realized that their new position vis-a-vis the world at large required a total restructuring of the government, including the system of land holdings.

By the time of Kamehameha the III, in the early 1800's, Europeans and Americans had begun to make the Hawaiian Islands their home and had begun to ask for land upon which to build not just houses and churches, but warehouses and stores and other such symbols of their rapidly growing ability to influence the economic destiny of the islands. The King had issued many land grants to these newcomers, in exchange for services rendered. However, once in their possession, the haoles treated the land they held in their own traditional way—leasing, selling, and accepting it in payments of debts, much in the same way as they would back home, in countries where private property ownership was an accepted value. Their influence in political circles grew as well. Thus, for example, in the late 1830's, the Hawaiian governing chiefs were forced to sign treaties with foreign nations, which sometimes allowed special land rights for foreigners living in Hawaii.

In these sometimes subtle and sometimes direct ways, the European and American foreigners persuaded their native Hawaiian hosts to accept changes which they advocated to protect their market economy interests in land-based enterprises which they believed to be for the benefit of everyone. Prompted by these influences, and also by a sincere desire to make it possible for his own people to acquire land and hold it secure, Kamehameha III, encouraged the drafting and promulgation of the Declaration of Rights in 1831 and the First Constitution in 1840, which formally transformed the kingdom from an absolute monarchy to a constitutional one, with a legislative assembly and the King as head of state. An important passage appearing in both the Bill of Rights and the First Constitution was intended to help secure individual rights to their land, for both natives and foreigners alike.³¹

Protection is hereby secured to the persons of all the people, together with their lands, building lots, and all their property, while they conform to the laws of the kingdom, and nothing whatsoever shall be taken from any individual except by express permission of the laws.

The concept of the kingdom, however, was still intact, because the land was still thought to belong ultimately to the King and no transfer of any kind could be made without his consent.

Subsequently, with industry, trade, and immigration forces continuing to grow, Kamehameha the III sustained considerable pressure to make it possible for people to acquire secure title to the land and to hold it in fee simple ownership. These pressures eventually led to The Great Mahele, or division of lands, which was

planned, arranged, and carried through by the legislature, with the consent and support of the King. Thus, in 1845, the legislature created a "Board of Commissioners to Quiet Land Titles", an organization remembered more commonly as the "Land Commission". The Commission was granted only the authority to determine the land rights existing at the time the Commission was created. It had no authority to create new land interests. Their analysis of vested land rights were that roughly one third of the lands was reserved for the King, one third for the chiefs, and one third for the tenants. In 1847, after much discussion by the Legislature Assembly and the Privy Council, the latter ruled that within the lands reserved for the Kings and chiefs, about two thirds of them were to be known as Government lands and the remaining one third were known as Crown lands, to be maintained as the King's own private estate, to be sold, leased, or mortgaged by him, at will. Full powers remained with the Land Commission as a court of record to investigate and adjudicate all claims to land by tenants who had to prove that they were eligible for the land they claimed, according to a set of criteria laid down by the Commission.

An elaborate government review process, with eligibility criteria, timetables, and deadlines for filing claims was implemented, which gave an advantage to those haoles who wanted to process their claims over the native maka 'āinana, to whom the concepts of individual land ownership and written rules were utterly alien and incomprehensible. According to one expert on the subject, it is important to understand these commoners' point of view in order to fully understand what happened next:³²

They did not understand the privileges and responsibilities of land ownership. They had been cared for by the chiefs and they expected to be cared for by the chiefs. In some cases, they were intimidated from putting in claims. In other cases, they were unwilling to seem to be taking land away from their alii. They were confused by the problems presented. Accustomed for generations to communal rights to forest and upland produce to fishing and to land, they could not imagine life on another basis. The whole idea of fee simple ownership was so new to them that they could not comprehend it and take advantage of it.

For reasons such as those cited above, many chiefs and commoners never filed claims on land to which they were entitled. It is no wonder that, of the four million acres that make up Hawaii, less than 30,000 were claimed by the common people.³³

By 1886, two thirds of the government land sold had gone to the haoles, and much of the land that the chiefs and commoners were awarded had come into haole hands, too. Even the royal lands began to slip away from the crown through leases and sale to private corporations.

By the mid-1800's, with the decline in native Hawaiian population numbers living off the land due to disease and being divested of their land claims, conditions became ripe for the take off of the pioneer sugar industry in Hawaii. Prior to the Great Mahele of 1848, European and American entrepreneurs had seen the potential in Hawaii for a sugar cane empire, but the conditions at that time were

not yet right. As long as they did not hold secure title to the land, these entrepreneurs were unwilling to take the risk of making the substantial capital investment that was required to make such an industry succeed. After the Great Mahele established a system which made it possible to process land claims and purchase claims of others, they set about on a deliberate program of consolidating control over lands suitable for growing sugar, or for supporting sugar (eg. wetland purchased for water diversion purposes to irrigate sugar land).

The above-described land tenure changes and the subsequent take off of the sugar industry in Hawaii had both a direct and indirect effect on the former fishpond/taro field complex at Kawai Nui. These effects will now be described. To begin with, the readers should recall from the previous section that the Kailua ahupua'a of which Kawai Nui was the heart, was reputed to be an area with a wealth of resources in pre-contact Hawaiian times. Large quantities of fresh spring and stream water were readily available throughout the Kailua watershed, along with high taro productivity, (both kula cultivation in the dryland areas and lo'i terraces in the wetland areas), and a rich harvest of aquatic life from the Kawai Nui Loko.³⁴ The attractiveness of this area, especially to members of the Hawaiian royalty (ali'i and konohiki), carried over into post-contact days, through the time of the Great Mahele. Thus, available records from the days of the Great Mahele indicate that when King Kamehameha the III and 245 of his chiefs divided the lands of the Hawaiian Kingdom, eleven of these chiefs, primarily Queen Kalama, Kamehemeha III's wife, received land within the area in and around Kawai Nui. It should also be noted that among the other remaining chiefs, who did not register their claims with the Land Commission at the time of the Great Mahele, forty-three of them held valid claims in the Kawai Nui area, which were of sufficient strength that the Commissioners recognized them anyway and awarded to them the parcels, of a much larger size than were awarded to ordinary farming commoners in the area, some of whom also obtained awards.

Thus, the size of the land parcels awarded to the chiefs (exclusive of Queen Kalama's ahupua'a award of 11,885 acres), ranged from 7.84 to 674.90 acres, with an average award of 92.908 acres. By contrast, of the kuleana awardees (land claims by commoners), only seven received more than five acres of land apiece, and the largest among them totaled 11.59 acres. The remaining thirty-six kuleana awardees within the Kailua ahupua'a received between 0.22 and 4.778 acres apiece and an average claim of only 1.932 acres.³⁵

Evidence from both recorded descriptions of land claimants, described to the Land Commissioners, at the time of the Great Mahele, and from archaeological investigations of the area in recent times, indicates that the rich productive character of the Kailua ahupua'a remained intact during this period. Dryland crops around the Marsh at the time of the Great Mahele included sweet potatoes, gourds, wauke (paper mulberry for making tapa), 'awa (kava or *Piper methysticum*), pia (arrowroot for starch), bananas, sugar cane, and tobacco. Coconut, hala, kukui, orange and lemon trees were mentioned as having been planted by the claimants. Kula agriculture thrived along the rise between Maunawili and Kahana Iki Streams at the point where they converged to enter the valley floor of the marsh and also along the surrounding slopes, particularly in the Kukanono and Pohakupu 'ilis.

As for the valley floor, much of the cultivatable portion of the marshland developing there at the time of the Great Mahele was comprised of irrigated terraced pondfields or lo'i, for the cultivation of taro. Several awardees mentioned

the existence of a stream or an 'auwai (irrigation or diversion canal) adjacent to their land parcels. Nearly all of the awardees mentioned lo'i on their lands.³⁶

As time went by, during the second half of the nineteenth century, the composition and numbers of land owners in the Kailua ahupua'a gradually changed, as did the types of land use and the overall agricultural productivity of the area. The land ownership changes which occurred to Queen Kalama's 'ili of Kawai Nui during this half century period in many ways mirrors land use changes in general both in the region and in the islands as a whole. Thus, Queen Kalama's claim to Kawai Nui 'ili remained intact, as did the fishpond, until her death, in 1870. Then this area encompassing much of the Kailua ahupua'a, was inherited by her stepfather and uncle. He promptly sold it in 1871 to a haole, Charles Coffin Harris, who had by that time consolidated claim to the ahupua'a of Kane'ohe as well as that of Kailua. Harris was an American lawyer who had moved to Hawaii and held many important positions in the Hawaiian government, in the service of various kings, until King Kalākaua appointed him as Chief Justice of the Supreme Court, an office which he held until the time of his death in 1881. One of his children, Nannie Roberta Harris, became sole heir to the Harris estate, including the Kailua ahupua'a at that time. She owned the Kailua ahupua'a until 1917 when she and her husband sold nearly all of their interest in both Kailua and Kane'ohe to Harold K.L. Castle. The lengthy document which legalized this transaction was evidence of the concentration of land ownership control of Kailua and Kane'ohe in 1917 that was enjoyed by Castle, and constituted a trend that was being experienced elsewhere in the islands at this time.³⁷

During this time period, as land in the Kailua ahupua'a became more and more concentrated in the hands of a few, primarily haole owners, the actual use of the land changed as well. According to available tax assessor's records, starting in 1859, a total of approximately one fourth of the 255 persons' assessed taxes in the ahupua'a of Kailua were recorded as having land in taro cultivation, either wet (lo'i) or dry ('aina kalo, or kula). By the mid-1860's, more and more land was assessed for the cattle it contained and there were indications that land was being leased in greater and greater numbers for rice cultivation to Chinese tenants.³⁸ This latter development is an indirect outgrowth of the new rise in sugar cane cultivation throughout the islands. In 1852, the sugar growers in Hawaii brought labor workers from the Orient to fill the labor gap created by the shrinking native Hawaiian population. The earliest of these immigrants were the Chinese who brought with them a fondness for rice and an industrious upwardly mobile nature. According to one historian, these characteristics combined to produce the following effect:³⁹

The most common Chinese response to plantation life was neither protest nor riot; it was to leave the plantation just as quickly as possible. The Chinese constituted 50 percent of the employees on the plantations in 1882; they were less than 10 percent by 1902. From nearly 6,000 Chinese plantation laborers in 1886, their numbers fell to less than 4,000 in 1902, a few less than 1,500 in 1922, and 706 in 1932. On the eve of statehood only 302 Americans of Chinese descent remained on Hawaii's sugar plantations. At first the Chinese, who traditionally valued land, calling it "living property", frequently tried rice farming. Some of the Chinese immigrants married Hawaiian women and settled down to taro planting to satisfy the appetites of poi-eating



Figure 1.16 Artist's Rendition of Chinese Farmer Harvesting Rice from Paddies Cultivated Along the Fringes of Kawai Nui, ca. Early 1900s (Artist: Donna Kamahale)

Polynesians. A few Chinese taro farmers prospered, but the taro industry was largely replaced by rice, partly because of the decreasing native population. Not much work was needed to put taro land into proper condition for rice growing. In some areas, the temperature, rainfall, and topography were perfect. The Chinese sought Hawaiians who would lease or sell land cheaply. In addition to the primary market for rice in Honolulu, there was a great demand from California, especially following the Reciprocity Treaty of 1876, which admitted rice as well as sugar to the United States duty free. Traditional cooperative farming practices plus Chinese zeal to succeed encouraged the growth of the industry. In 1899, there were 504 rice farms covering an area almost 10,000 acres and annually producing rice valued at more than \$1,500,000.

The Kailua ahupua'a, especially the Kawai Nui area, where taro lo'i once thrived, was one of these areas perfect for rice cultivation within relatively close proximity to the main market at Honolulu, and where Chinese rice farmers began to thrive in the fashion just described. By the early 1880's, judging from tax assessor's records, at least ten Chinese individuals and companies were listed as rice growers in the Kailua ahupua'a. Two rice mills were operating in Kailua in 1881, one each for Wong Lung Co. and Luk Sang & Yim Kwon. In that same year, a total of at least 279 acres were recorded as being under rice cultivation in Kailua, while at least 32 oxen and 23 mules were listed as belonging to the rice growers. The population of Kailua included over 100 Chinese workers for the rice growers. For the year 1881, the twelve rice growers mentioned above accounted for 55 percent⁴⁰ of the total value of real and personal property in the whole ahupua'a of Kailua. (See Figure 1.16)

The continuing natural productivity of Kawai Nui at this time, despite the switch from taro to rice cultivation, was vividly recorded in 1880, by George Bowser⁴¹, when he visited Kailua ahupua'a and wrote the following description of his trip:

Rice culture in this Kingdom has become an important industry. The large Chinese population to be found everywhere in the Islands provides a considerable home market, and at the same time the exportation has increased with great strides year by year. . . The culture of rice stands second in the rank of those industrial enterprises of the Kingdom which yield exportable produce. . .

. . . To my left, as I looked eastward, was the valley of the Kawai Nui, about one-fourth of which is already laid out in rice plantations. The remainder will be brought under cultivation during the coming season for the same purposes. Before me, still looking east, there is an uninterrupted view of the sea. In the bosom of the valley there is a large pond or lake celebrated for its mullet and ava. The latter fish grows here to four feet in length. Wild duck and the famous Hawaiian goose are also to be found here in abundance. . .

During the day I have fallen in with any quantity of plover. A good shot might have bagged his fifty brace in a very short time. These birds are plentiful all over this part of the country.

Leaving Mr. Kahulu's farm, I next visited the Kaelepulu Lake. This sheet of water is twelve miles from Honolulu. Innumerable ducks and geese frequent it, besides waterhens, herons, and other wild fowl. In its waters plenty of the fresh water fish of the country may always be found.

In summary, according to Bowser's statistical record, a total of 386 acres of cultivated land existed in Kailua in 1880. 325 of these acres were planted in rice, and other types of farming accounted for 61 acres of cultivated land. Chulan and Co. was listed as having 40 acres of rice in cultivation at "Kawainui Lake". Yet, despite this large-scale manipulation of the environment, Kawai Nui "lake" was still "celebrated for its mullet and ava", "wild duck, and the famous Hawaiian goose" still abounded, and "any quantity of plover" were still "plentiful all over this part of the country".

By the turn of the century, rice cultivation at Kawai Nui had taken over all but a small portion on the east end of the former fishpond and taro lo'i area. Study of the lease agreements between landowners and rice farmers during this period reveals much about how the Kawai Nui environment was being deliberately altered by these changing use patterns. Thus, for example, a lease agreement between landowner Charles C. Harris, and leasee Luk Sing (September 19, 1878), of a "certain fishpond . . . known as Kawainui", says it may be drained, "if he is able so to do, and may use any and all means to lower the water therein at his own expense. . . And it is also agreed that the party of the first party may at any and all times, conduct water through ditches or otherwise, through said premises to said pond, and use said pond as a pool for drainage from any other lands. . ." ⁴²

This lease agreement is indicative of the fact that the Kawai Nui area was still regarded as a fishpond at the turn of the century. It also is indicative of a shift in predominant attitude toward the notion that deliberate drainage or other manipulation of the fishpond water regime would be a desirable improvement of the environment in the area. The rice farmers constructed weirs on both Kawai Nui and Ka'elepulu streams to prevent saltwater incursions into their rice paddies ⁴³ and they deliberately altered the taro lo'i walls, enlarging them in order to accommodate water buffalo being used to assist in rice paddy cultivation, where the former fishpond/taro complex had been. ⁴⁴

Evidence that such changes were considered an "improvement" over the vestiges of Hawaiian-style agriculture/aquaculture in the area is indicated in the newspapers and literature of the time. Thus, for example, ⁴⁵ consider the following editorial comment from the Pacific Commercial Advertiser:

Rice cultivation is not only improving the waste and unsightly places of the Island, but actually beautifying the landscape to an extent that must be highly gratifying to any well-wisher of this country. It is wide of the mark to say that only the Chinese are benefited. Consider what an amount of rent, and even very high rents, larger than that

paid for sugar lands, has been and is now paid by Chinese for waste taro patches. . .

Consider also these remarks made by a Mr. Girvin in 1901:⁴⁶

It is generally admitted that the Island are much indebted to the Chinese, who through their industrious habits have redeemed land that for years had fallen into disuse and made it rent and tax producing property. As the natives diminished in numbers and taro lands dried up for lack of use, the Chinese leased them and turned them into rice patches.

There is also evidence, from the oral traditions that the native Hawaiian descendants of the first polynesian settlers in this area were not happy about these changes to their environment or to their methods of managing it. Recent research on a Hawaiian chant from the area indicates that when the Hawaiians saw their beautiful and rich Kawai Nui fishpond converted into rice fields (which they considered to be a "rubbish" food compared to taro), they felt a certain sadness. One interpretation of a chant said to have been composed in honor of the guardian mo'o, Hauwahine, of Kawai Nui fishpond, expresses that special poignant anguish felt by the native race toward changes in their land management system that was brought by these foreigners. The chant was originally recorded by Emerson, a missionary historian, and has been recently revived and freshly translated by Kihei and Mapuana DeSilva, directors of the Hālau Mōhala 'Ilima, a school of Hawaiian culture that frequently performs a hula whose movements reflect the meaning of this chant. (See Figure 117) Their version of the English translation appears below, and is more fully discussed in Chapter 2 of this guide.

Perhaps you are she, the leaf of love
 Perhaps this stirs my memory
 Remembering her presence
 She might still come
 But when she does, who will cry out?
 Your day is gone, your understanding of her.

The feeling is intense, desire gnaws from within
 I've been swallowed in the great ocean
 Great is my turmoil, my soul is in strife
 No man is unhurt in love
 You are the absent woman, I the estranged subject
 Our parting was difficult to bear;
 we are mere husks of our former selves.

Look at Kawainui, the fish container
 It is filled with 'opala food at Mokulana
 Limu clogs Makau-wahine
 You are the woman, he the man;
 Hauwahine the goddess, Kane the god.
 If she comes, who will wail?
 If she returns, who will acknowledge?



Figure 1.17 Artist's Rendition of Mapuana de Silva, Kumu Hula, and her students Recreating the lizard-like Movements of Hauwahine , the Mo'o Guardian Goddess of the Marsh (Artist: Donna Kamahele)

As indicated in Section 1.1 of this Chapter and in Section 2.3 of Chapter 2, Hauwahine is considered to be a guardian spirit of Kawai Nui fishpond and, as such, she looks after the people's welfare by insuring a plentiful supply and variety of food to be harvested from the pond. If the pond (her home) is mistreated in any way, such as by being polluted with undesirable vegetation, or animal fertilizer, it is recognized that she will abandon the pond and the prosperity of the people will decline, a condition which, prophetically, has come to pass. The composer of the above chant undoubtedly believed that this is what happened at Kawai Nui when the rice farmers moved in and began to radically alter the environment to grow "opala food", a possible reference to rice, to satisfy foreign appetites for food and profit. (See Chapter 2 for further discussion of possible interpretation of this chant and for a reprint in the original Hawaiian language version.)

While alterations from fishpond and taro lo'i to rice paddies continued at Kawai Nui under the influence of the rice-eating Chinese farmers in the area, Kawai Nui's ecosystem was being influenced by other change factors that were also an outgrowth of the sugar cane industry. Thus, in 1876, Chinese farmers began to cultivate sugar cane in nearby Waimanalo Valley.⁴⁷ It soon became apparent that, although the economic climate for sugar had become very favorable by this time, with the passage of the Reciprocity Treaty,⁴⁸ expansion of the sugar cane industry in this area was conditioned by the limited amount of water available for irrigation in the Waimanalo watershed. Hence in 1878, the Waimanalo Sugar Plantation was established and began diverting water from Maunawili Valley away from Kawai Nui to the irrigated Waimanalo canefields.⁴⁹ (See Figure 1.18)

By January 1881, close to 1,000 acres had been planted in sugarcane in Waimanalo and mill grinding operations were started (Austin 1953:2). Water was brought in from the upper reaches of Maunawili, ditch and tunnel construction being completed by 1878 (Takasaki et al. 1969:110 Fig. 18) Water development continued to expand and by 1900, the "flume and ditch system was 4½ miles long and diverted all of Maunawili Stream water into Waimanalo Valley" (Ibid.: 110-111). "Between 1922 and 1926, the Clark, Cooke, and Korean Tunnels were driven, and the Maunawili ditch system was extended." (Ibid: 111; Fig. 9). Dr. W. O. Clark, geologist for C. Brewer and Co., Ltd. in the early 1900's, supervised the construction of these additional tunnels and ditches in Maunawili Valley. "The supply ditch in Maunawili was extended to intercept all water available above the ditch elevation as far to the west as Omao Stream." (Austin. 1953:4). These water developments were covered by "leases or water licenses from the Kaneohe Ranch Co., to C. Brewer and Co., Ltd." (b9d) These developments delivered about 2 mgd of water to Waimanalo Valley," extending from "Omao Stream, at an altitude of 470 feet in Maunawili Valley, through a short tunnel under Aniani Nui Ridge" (Takasaki et. al. 1969:111).

In addition to upstream diversions, the former Kawai Nui fishpond proper was also eventually drained toward irrigating the canefields of Waimanalo. A November 2, 1900 report by a consulting Civil engineer recommended such a diversion project and that pumps be installed to direct water into a series of



Figure 1.18 Recent Photo of Flume and Ditch Diversion System
Constructed in the Upper Maunawili Valley in the Early 1900s
(Photo by William Stifel)

pipelines, ditches, and tunnels to implement this project. These recommendations were carried out in the early 1920's.⁵⁰

While the water resources of Kawai Nui were thus being used to serve the needs of the sugar industry and the rice-eating appetites of its laborers, another growing type of land use change in the area was that of ranching. By 1875, there were already "large herds of cattle and horses" in the Maunawili portion of the Kailua ahupua'a.⁵¹ Horses were also pastured in the area now known as the Lanikai subdivision of Kailua.⁵² Several other ranching enterprises, covering thousands of acres in the Kailua area, show up in the Tax Assessor's records of the late 1800's. By 1875, it can be estimated from these records that several thousand head of cattle and perhaps as many horses were being grazed in the entire Kailua ahupua'a.

A vivid indication of how much ranching was prospering in the Kawai Nui/Kailua area at this time is taken from George Bowser's travel accounts of 1880:⁵³

Between this fish-pond of Kawainui and the sea there is a level land about one mile and a quarter long by three-quarters of mile in width, covered with the most beautiful green grass I ever saw. To the right is a wide extend of plain, well grassed, where large herds of cattle and droves of horses roam at will. At the south end of the plain is a large grove of coconut palms. To the north is the open sea. . .

Leaving Mr. Kahulu's farm, I next visited the Kaelepulu Lake . . . The lake is completely surrounded by high mountains. Around its shores splendid pasturage is to be found. Large quantities of sheep might be bred here to great advantage. When I was there I only saw one small flock of about fifty in all grazing on the border of the lake.

Section 1.3 Land Use Changes at Kawai Nui from the 1920's to the Early 1970's

By the first decade of the twentieth century, rice cultivation — which had become the second most important industry during the latter half of the nineteenth century — was now declining rapidly. Rice growing had caught on in California and other states and the methods of cultivation there far excelled the "ancient, impractical methods" by which it was cultivated, milled, and marketed in Hawaii.⁵⁴ Evidence of this overall decline and its effect in the Kawai Nui area is provided by the contents of a deed from Wong Leong, one of the most prosperous rice farmers in Kailua, to Nannie R. Rice. He deeded over all his interests in land carefully accumulated over the years, along with all the infrastructure for milling the rice crop he formerly cultivated there:⁵⁵

And also the Rice Mill and other buildings and improvements situated on any part of the above described land and all the fixtures in said mill and other buildings, and also all mill sites, rice mill machinery, water rights and all rights, privileges and appurtenances to the aforesaid property or to said leaseholds, excepting and reserving, however, all crops

now growing on said land.

After the 1920's as the rice cultivation fell off, most of the rice paddy areas became pasture land and ranching became a more predominant enterprise in the entire Kailua ahupua'a. Diversified farming and horticulture operations also expanded into this niche created by the decline in rice farming. For example, in 1926, the Hawaiian Sugar Planter's Association (H.S.P.A.) opened a field lab in Kailua on land leased in an area located on "the abandoned rice paddies of stream bottom land". Kailua was desirable because the climate there favored "heavy tasseling", a desirable factor in cane breeding, cross pollination experiments.⁵⁶ Another desirable factor favoring H.S.P.A.'s choice of Kailua was the existence of a thick coconut grove, which provided a wind shelter for this delicate, cross-pollination work. The coconut grove had developed out of another earlier horticulture experiment. In 1906, Albert and Fred Waterhouse were walking over sand dunes along the approximately one mile wide by two and a half mile long accretion barrier between Kawai Nui and the sea, when they envisioned the idea of planting coconut trees there. In 1909, they set about making this idea a reality and leased 200 acres of it from J.B. Castle. They "leveled the sand dunes and smoothed out the sand hillocks", planted approximately 320 acres, with over 130,000 coconut trees, in the hopes of creating enough coconut oil from the copra for a good commercial enterprise. Many rows of ironwood trees were also planted as a windbreak and a fence had to be built to keep cattle out.⁵⁷

Further mauka, up into the Kailua ahupua'a, James Boyd and family bought land on which he practiced the hobby of collecting and caring for rare species of tropical plants and trees.⁵⁸ After the Boyd land was sold to W.G. Irwin, another large cultivation project was implemented -- the planting of 1,200 or more rubber trees, in the 1920's. The area of Maunawili was also famous for having the largest coffee plantation on O'ahu.⁵⁹

During the years between the late 1920's and the early 1940's, as the presence of the U.S. military in Hawaii grew, another use change affected the cultivation trends in the area. During World War II, the grove of rubber trees on the former Irwin estate "was tapped for badly needed rubber which was shipped to the mainland for processing".⁶⁰ The Army actively used the Kawai Nui area as a training ground during World War II on a lease agreement between Kaneohe Ranch Ltd. and the U.S. government.⁶¹

Coterminous with this increased military activity in the area (from early 1930's through the early 1940's), the population of Kailua town was increasing and the urbanization trend accelerated. Back in 1916, this trend had already begun, for example, when the Waterhouse's copra/coconut oil production failed, and they sold their "Coconut Grove" to A.H. Rice, who planned a residential subdivision in the area. In 1924, Earl H. Williams, of Liberty Investment Co., acquired 200 acres from Rice and began the lot subdivision process.⁶² Meanwhile, in 1924, the 2,500 acres comprising Maunawili had been sold to C. Brewer and Co., and the former Irwin mountain home, previously the scene of lively luaus and balls during the days of King Kalakaua and Queen Lili'uokalani's visits, now became a rest home for C. Brewer employees.⁶³

During this early period of urbanization in the Kailua area, the abundance of freshwater at spots such as Kawai Nui and Ka'elepulu, was no longer considered as precious a resource as the Hawaiians once did ("wai" - fresh water; "wai wai" -

wealth). Instead, the water abundance was considered to be a constraint on full development of the area's residential subdivision potential. The same environmental features which made this area a celebrated nesting haven for wild ducks and plover were now considered those that made it flood prone and mosquito ridden, and thus a public nuisance and a deterrent to development into residential, pasturage, or other uses. In fact, by the 1950's U.S. Geological Survey maps for the area covering most of the former Kawai Nui fishpond and the cultivated wetlands surrounding it had been designated the ecologically-erroneous, more pejorative label of "Kawainui Swamp".⁶⁴ (See Figure 1.19)

Also indicative of this negative attitude toward the natural wetland properties at Kawai Nui is the the drainage practice undertaken by Waimanalo Sugar Co. and later (after the Company liquidated), by the Kaneohe Ranch Co.. Thus, for example, as late as 1956, the Kaneohe Ranch had installed a vertical pump and began pumping with such energy that, four months later, the water table of the Marsh had dropped "almost four feet and made the once forbidding marsh a lush grazing land". On the value of this project, James Castle of Kaneohe Ranch said: "We want to eliminate the mosquito problem and we want to reclaim the area, if possible." The newspaper reporter who recorded the story of this project when it was launched said that "the reclamation project is too expensive, but some day it may be feasible. In the meantime, the land is choice grazing ground."⁶⁵ (As it turned out, this project was discontinued in 1965.)

Kaneohe Ranch had previously installed a weir in the early 1950's in order to create a total freshwater environment that would support grass for livestock feed. "The marsh was cut-off from Kawainui Stream, hence Kaelepulu Stream. Drainage was then to the north end of Kailua Bay, as it is now. . . rather than to the south end. . . as it had been before."⁶⁶ (Compare Figs. 1.15 & 1.19) The manipulation of the waters flowing into the marsh from the Ko'olaus and Maunawili Valley alternated between simple water storage and the actual out-pumping of water to the Waimanalo sugar plantation — for a price:⁶⁷

By the time that Kaneohe Ranch ceased selling irrigation water from Kawainui to Waimanalo sugar, a diversion ditch to Waimanalo had been constructed above the marsh. This ditch is still in operation and draws about 7,500 m³ per day of water which would be tributary to the marsh.

Today, the thousand acres sugar plantation at Waimanalo no longer exists but the water from Maunawili, which before historical diversion, went to Kawai Nui, still serves Waimanalo farmers.

Despite the constraints of expensive pumping and flood control, Kailua town in the period after World War II, began to experience steady displacement of agriculture by urbanization. In 1950, the population of 7,740 residents was a small town community. By 1960, however, the small residential area had increased by 231 percent reaching suburban proportions at 25,622 people.⁶⁸

Growth slowed in the next decade to 32 percent with the 1970 census population of 33,783. Outside downtown Kailua itself, residential growth in the last 20 years has focused at Enchanted Lake (or Kaelepulu fishpond) and the southeastern shore of Kawai Nui Marsh in the communities of Pohakupu, Maunawili and Maunawili Estate.

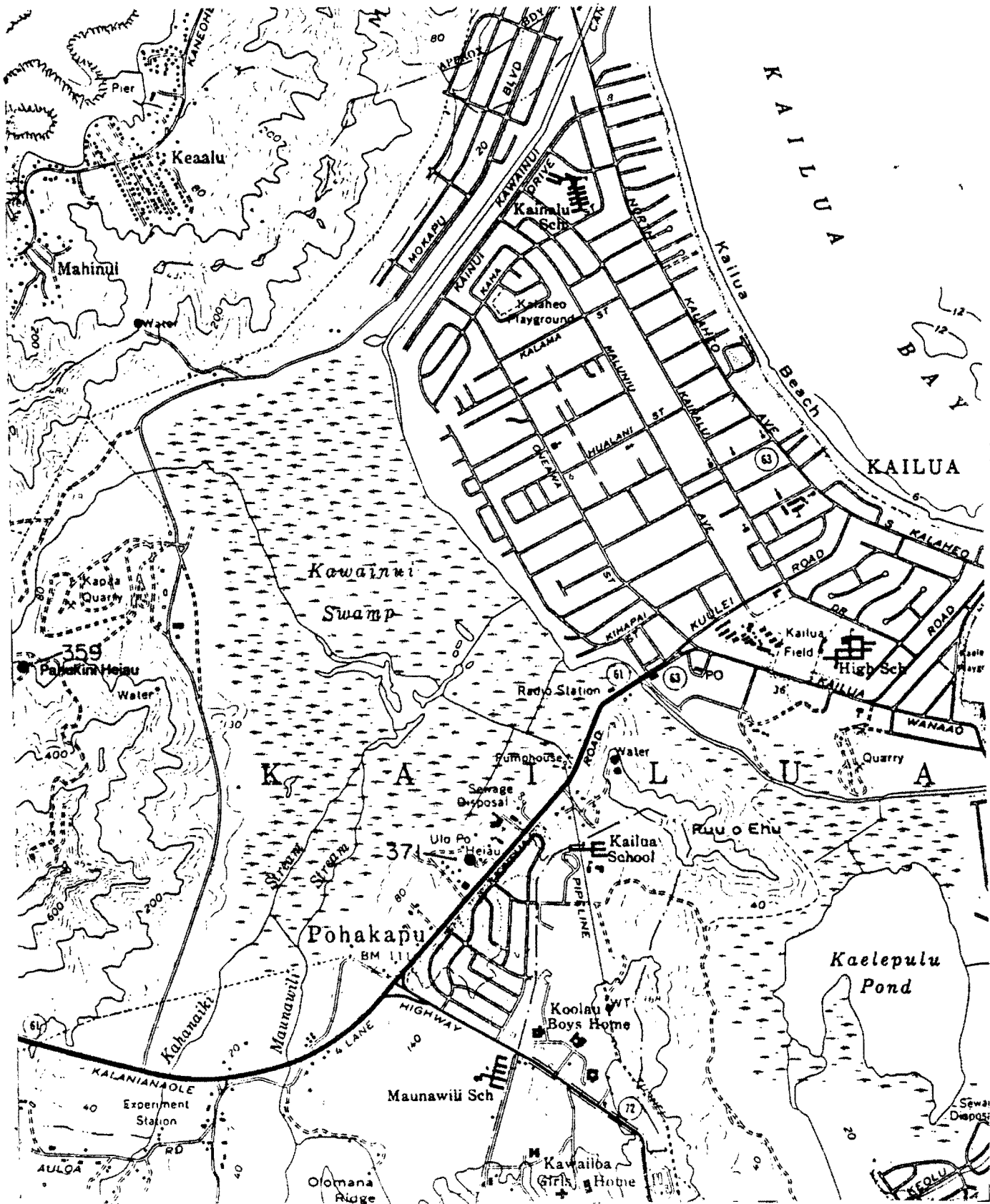


Figure 1.19 Portion of 1959 Map Showing Kawai Nui Marsh with Inaccurate Label of "Kawai Nui Swamp." Portion of U.S.G.S. Map (revised 1959), Scale 1: 24,000 Contour Interval 40 feet, Taken From Kelly, Marion and Jeffery Clark, Kawai Nui Marsh, O'ahu: Historical and Archaeological Studies (Honolulu: Bishop Museum, Department of Anthropology, 1980), Report 80-3, p. 26.

While the landscape of the areas thus became urbanized, the flooding problem in the area only became worse. "As urbanization takes place, roofs, paved streets, garages, and paved driveways collect rainwater. This water then moves to the lowest land, and without drains to carry it away, it ponds and remains until evaporation and a very slow lateral subsurface flow disposes of it."⁶⁹ Such a flooding problem especially plagued the Coconut Grove area of Kailua, immediately adjacent to the former fishpond at Kawai Nui. (See Figure 1.20) Kailua town as a whole suffered a severe flood in 1951 and 250 people were forced to evacuate their homes in the area. Even though the Oneawa Channel (Kawainui Canal) was constructed in 1950 to prevent the major flooding of the Kailua residential area situated on the edge of the marsh, five subsequent severe floods occurred in 1951, 1956, 1958, 1961, and 1963.⁷⁰ Finally, in 1966, the "permanent" stage of the Federal-State Kawainui Flood Control Project, first targeted for this area in the 1930's, was completed in 1966.⁷¹ This project entailed "dredging the debris and widening the Kawainui Canal, and building a 9-foot high levee to hold back storm water and widening the inner canal that runs approximately 6,500 feet long and 10 feet deep along the length of the levee."⁷² After this project, it was again hoped that flooding in the area would permanently cease. "However, from December 1968 through January 1969, as much as 8 inches of water covered a large area from Oneawa Street to Kihapai Street. . . The levee and⁷³ Canal had eliminated direct overflow from the swamp, and flooding still occurred:

By the earlier 1970's a hydrological study of the area revealed that the frequent flooding that still occurred in the Coconut Grove area was due to a shallow water table and the lack of a good storm drainage system.⁷⁴ (See Fig. 1.21) It was suggested that the installment of a sewer system would help the situation but "these changes will not be sufficient to eliminate the flooding problem unless the concentration of storm-water runoff in the low areas is reduced."⁷⁵ Nevertheless, this study concluded that "water from or in the swamp no longer contributes significantly to the flood problem."⁷⁶ Kawai Nui's value as a floodwater retention basin began to be acknowledged, while its former utility as an agriculturally and aquaculturally productive wetland and a celebrated haven for waterfowl continued to slip further and further into memory. Thus, in 1950, the marsh was designated an integral part of the Kawai Nui Flood Control Project authorized by Congress under Section 204 of the Flood Control Act of 1950. This designation meant that the City and County of Honolulu is expected to maintain a minimum flood storage area in the marsh of approximately 3,000 acre-feet of floodwater storage at a maximum ponding elevation of 6.6 feet above mean sea level. The levee located between the Coconut Grove area and the marsh was and still is considered part of the flood control project.

Other forces were also underway in the early 1950's along the slopes surrounding the northern, mauka, and southern edges of the marsh, which are also suggestive of changing attitudes toward the value of Kawai Nui. In 1949-1950, soil which was excavated from a water tank site above the area which is now Mokapu Saddle Road, along the northern edge of the marsh, was used to fill part of the wetland on the northwestern end. Kaneohe Ranch gave permission to Roy Weber to use this landfill area as an auto-wrecking business site. Later, when the Mokapu Saddle Road was built, excavated soil from this project was used as additional fill for the area occupied by Weber's business.⁷⁸ (See Figure 1.22)

Approximately 15,000 auto wrecks were stacked 5 high in the area about the year 1967, finally reaching a figure high

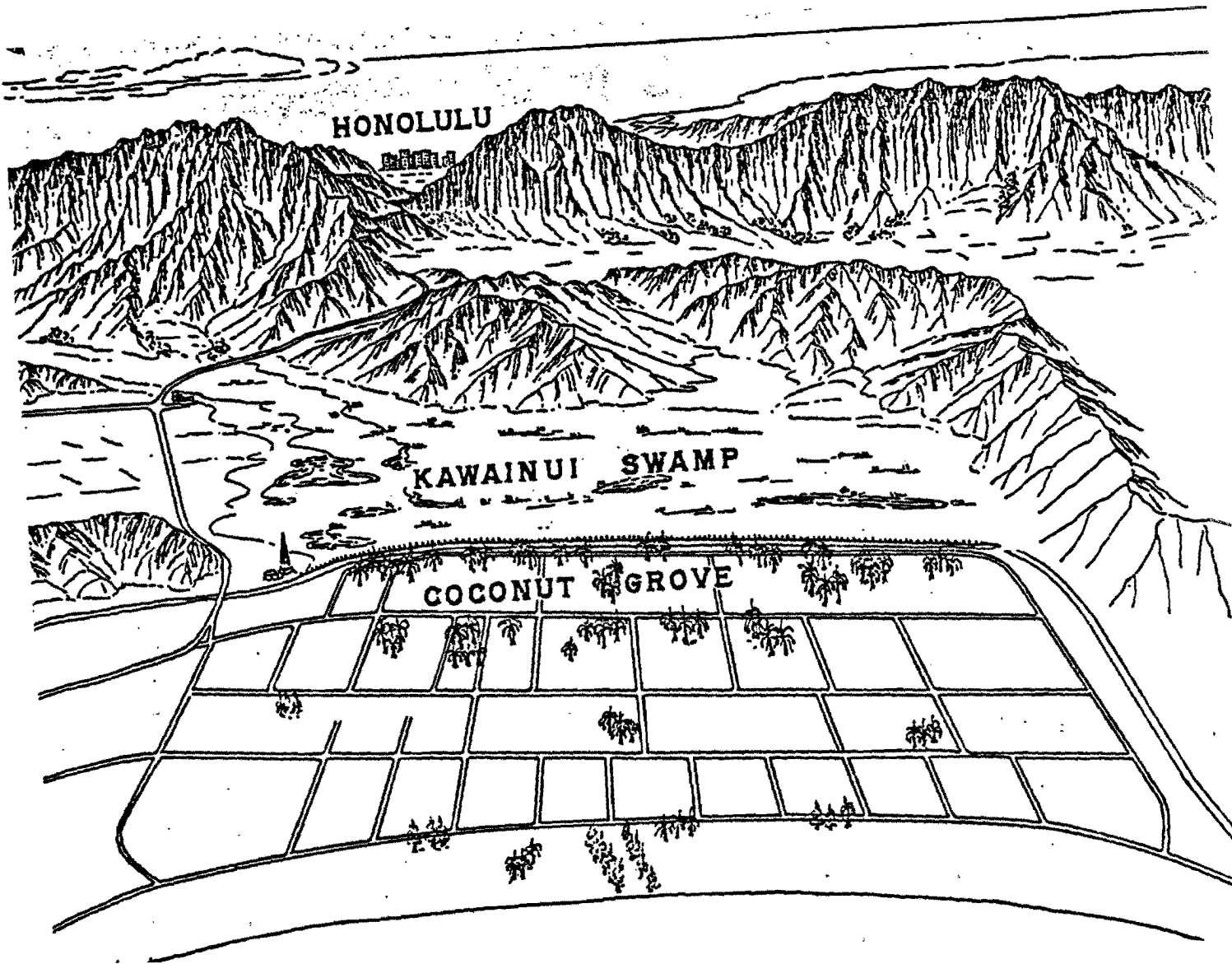


Figure 1.20 Diagram of Kailua, Showing Location of Coconut Grove Community Adjacent to Kawai Nui (Taken from: Report Cover, U.S. Geological Survey, Relation of Drainage Problems to High Ground-Water Levels, Coconut Grove Area, Oahu, Hawaii (Honolulu: Water Resources Division, Hawaii District, U.S.G.S., 1971))

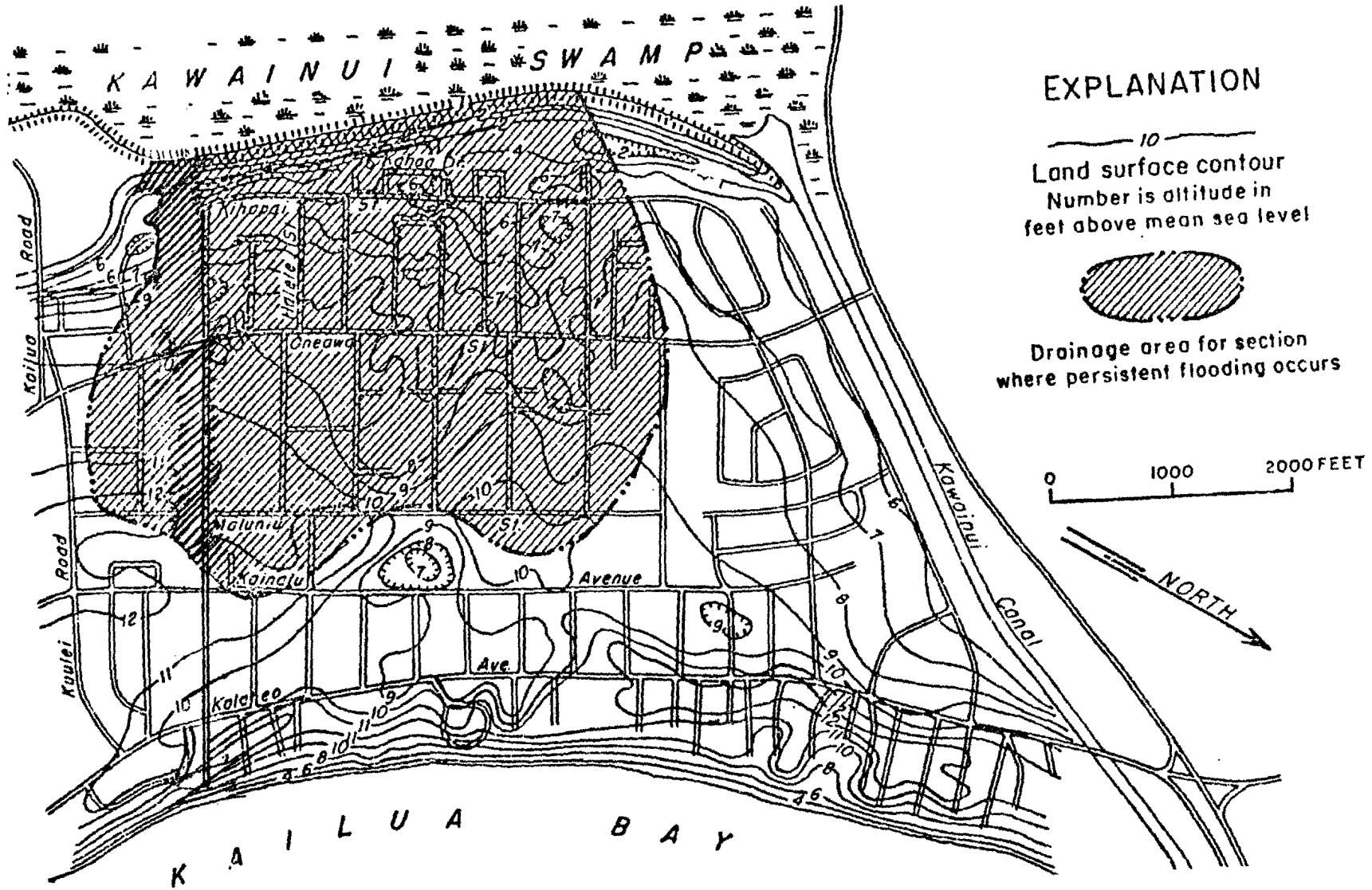


Figure 1.21 Land-Surface Contour Map of Coconut Grove Area of Kailua, showing Zone of Persistent Flooding (195) (Taken from: L.A. Swain and Huxell, C.J. Jr., Honolulu, Hawaii 1971, prepared in cooperation with the City and County of Honolulu).

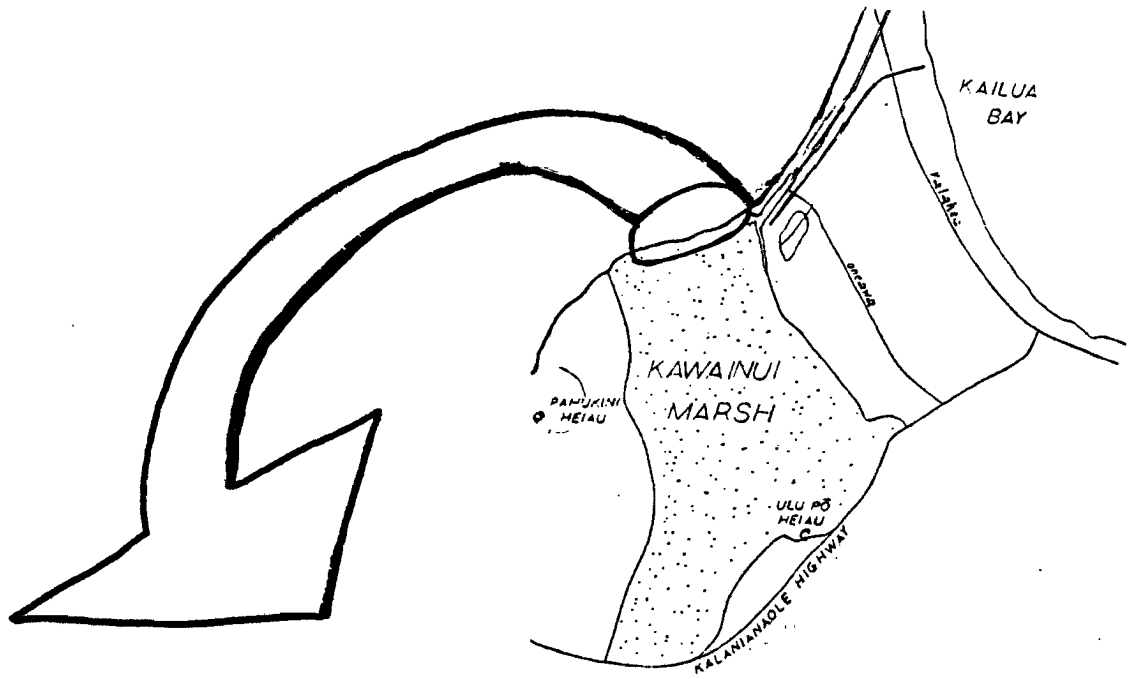


Figure 1.22 Recent Photo of Weber's Auto-Wrecking Operation at Kawai Nui
Photo by William Stifel (Note Quarry Operation in background and Koolau Mts.)

enough to make it economical to purchase the equipment for processing the wrecks for shipment.

Needless to say, the filled area used to store several decks of junked cars is not very stable in this marsh covered volcanic caldera area, where solid bedrock is not reached before 3 km depth below the surface. Hence, the area had to be built up consistently in order to prevent compactor equipment from "sinking into the ground".⁷⁹

While the Weber Enterprise was learning how to thus utilize the marshy area as an auto wreck "storage" or dump site, others were able to extract value out of the geological attributes on the marsh edge and surrounding slopes. Thus, in the 1950's the Honolulu Construction and Dredging Co. (H.C. & D) began to operate a rock crushing operation on approximately 76 acres of land along the mauka end of the marsh. Excess material from this crusher was piled up along the edge of the marsh for many years until the City and County of Honolulu leased the area as an open-burn refuse disposal site. This site was used until 1962 when the City's operation was relocated to a more upland area, adjacent to the Kapa'a Quarry, which has been engaging in the business of extracting large amounts of basaltic rock from this former volcanically active area for gravel and cement. These extractions were providing the necessary building material for the continuing urbanization of the area. (See Figure 1.23 for map of location of the original quarry waste stockpile and open-fire refuse area in the northwestern corner of Kawai Nui Marsh.)

The "quarried-out" areas taken over by the City and County of Honolulu began to be used as a sanitary landfill, and thus valuable as a repository for Honolulu's garbage — an "output" which was growing in volume proportionately with the urbanization and population growth processes. Today, the Kapa'a landfill area remains one of the largest garbage disposal sites of its kind on O'ahu. It receives about a thousand tons of garbage per day and is creating a man-made mountain of fill material as it continues to spread back into the valley on the mauka end of the marsh adjacent to the Kapa'a rock quarry.⁸⁰ As further evidence of the shift in values toward the Kawai Nui area as compared to pre-contact Hawaiian times, it is worthy of note that the combined quarry and landfill operations in the area have already destroyed all remnants of the former Holomakani heiau and are surrounding the still existing Pahukini heiau, (a site listed in the National Register of Historic Places) to such an extent that the once dramatic view it commanded of the fishpond/taro field complex in Kawai Nui below is now being shrouded by a growing mound of garbage.⁸¹ (See Figure 1.24)

This use of Kawai Nui as a "fill" and "dump" site was applauded by the predominant culture and political climate of the time, despite its negative impact on the cultural remnants of the early pre-contact Hawaiian civilization in the area, and on the wildlife remaining in the diminishing open water of the marsh. Such "reclamation" practices leading to the destruction of wetlands and their uses as historical sites and wildlife habitats have been occurring all over the United States and the world to the point that recent estimates by the U.S. Environmental Protection Agency say that about forty percent of the original wetland resources in the U.S. have now been filled in, and "reclaimed", for the sake of "higher" human uses.⁸²

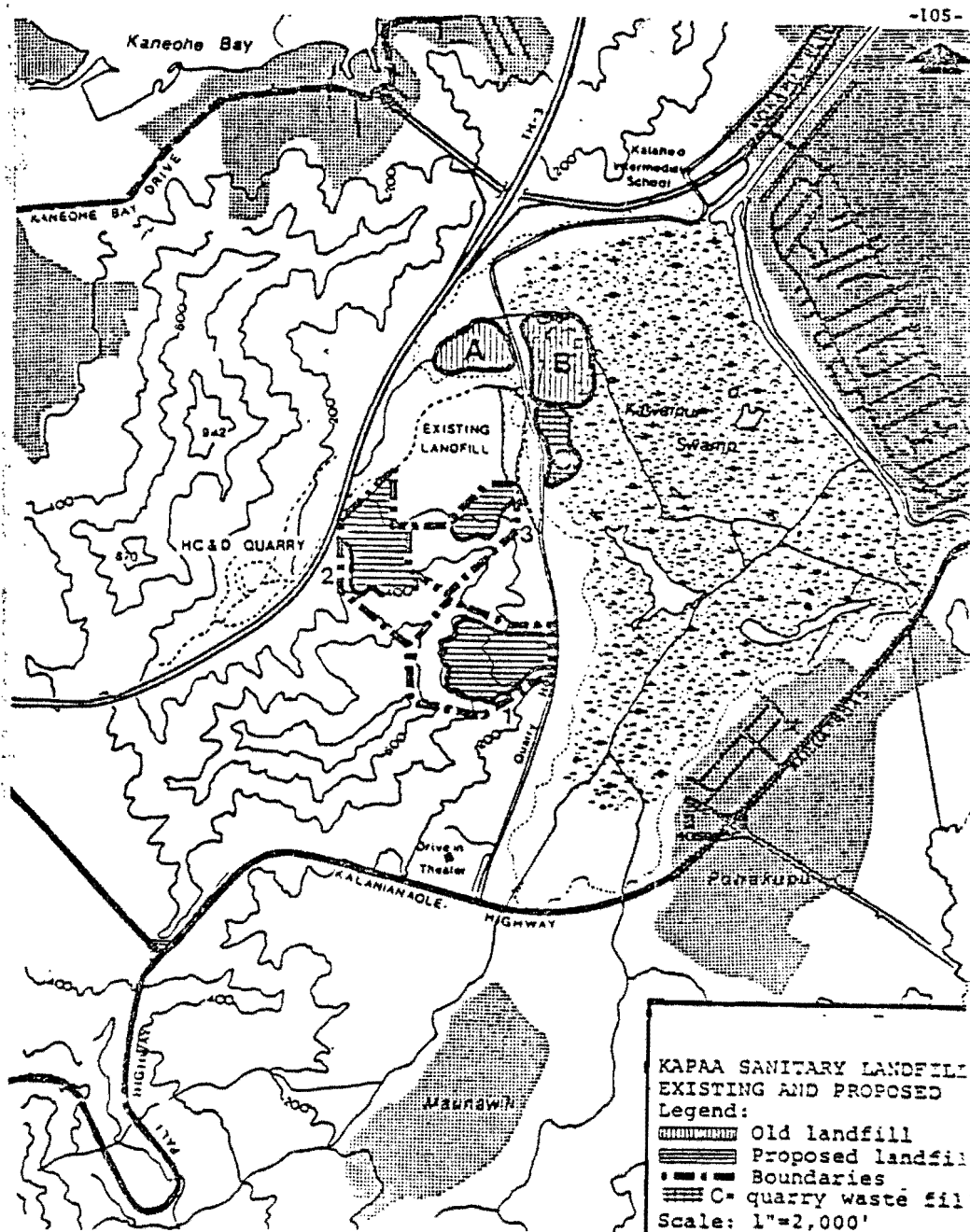


Fig. 31. Map of Kawaiui Marsh showing City & County refuse areas: A, landfill; B, landfill; C, open-fire refuse on old quarry waste stockpile. Areas 1, 2, & 3 show Kapa'a Sanitary Landfill expansion proposed in 1978. Map taken from E.I.S. for Kapa'a Sanitary Landfill expansion, July 1978.

Figure 1.23 Kapa'a Sanitary Landfill, Existing and Proposed Areas, as of 1978. (Taken from: Environmental Impact Statement for the Proposed Kapa'a Sanitary Landfill Expansion, Kailua, O'ahu prepared for Stanley S. Shimabukuro and Associates Inc., 1977)



Figure 1.24 View of Kawai Nui Marsh from atop Mountain of Garbage at Kapa'a Sanitary Landfill, Near Pahukini Heiau (Photo by William Stifel)

It has only been since the late 1960's and a growing, grass-roots alarm-represented in the resurgence of the national environmental movement that our society has come to critically reexamine such practices and admit that such disruptions of the natural environment are not devoid of long-term negative impacts on humans as well as on other forms of life ultimately affected.

While the Kawai Nui marsh, streams, and peripheral slopes were thus being channelized, extracted, and filled in to satisfy such uses as described above, other forces in the surrounding residential communities began to consolidate another viewpoint that recognized the value in preserving the disappearing cultural and wildlife heritage and open space in the Kailua ahupua'a as well as elsewhere in the islands. They began to vocally support the idea of developing a regional park at Kawai Nui to provide a valuable recreational oasis within the rapidly developing urbanization of the landscape.

One of the earliest supporters of a park concept for Kawai Nui was a descendant of one of the former large landholders in the area, Arthur Rice. In a 1949 interview with a reported, he is quoted as saying:⁸³

My dream is to see Kawainui swamp land filled in with the dirt from the tunnel (Pali) and the Kawainui swamp outlet at Kailua Park widened into a canal big enough for craft.

The whole area could be made into a natural game preserve and a beautiful park and playground for children.

As indicated by this quote, the value of the marsh as potential parkland is readily acknowledged, but its value is seen in the context of massive landscape alterations (through filling and channelizing), rather than through the enhancement of the already existing natural properties of the marsh.

By the early 1960's, the vision of a regional park at Kawai Nui had been developed to such an extent that the City Council of Honolulu included a proposed park at Kawai Nui in the Kailua General Plan (Ordinance 2408) which they adopted.⁸⁴ Coalescence of community support for the park concept was further developed when Centex-Trousdale Co., who purchased a 598.803 acre portion of the marsh from Harold K.L. Castle's children,⁸⁵ developed plans for a housing/water recreational park complex there.(See Figure 1.25) In order to proceed with their development, these project proponents needed permission from the State Land Use Commission to have redesignated as urban the marshland that they now owned and which was currently designated for preservation/open space/park use on state and city plans. An intense two year debate ensued which divided the affected community into opposing camps over the issues involved. Indicative of the polarity of opinion in the community toward the pros and cons of the Centex-Trousdale residential park concept vs. the government-supported regional park concept at Kawai Nui is a comparison of the following statements made by two rival opinions toward the project at a debate held among members of the Windward Chamber of Commerce:⁸⁶

Realtor S.W. (Tommy) Tompkins

"Our people want beach parks . . . not in-land areas and up valleys which would be nests for gangsters and which the

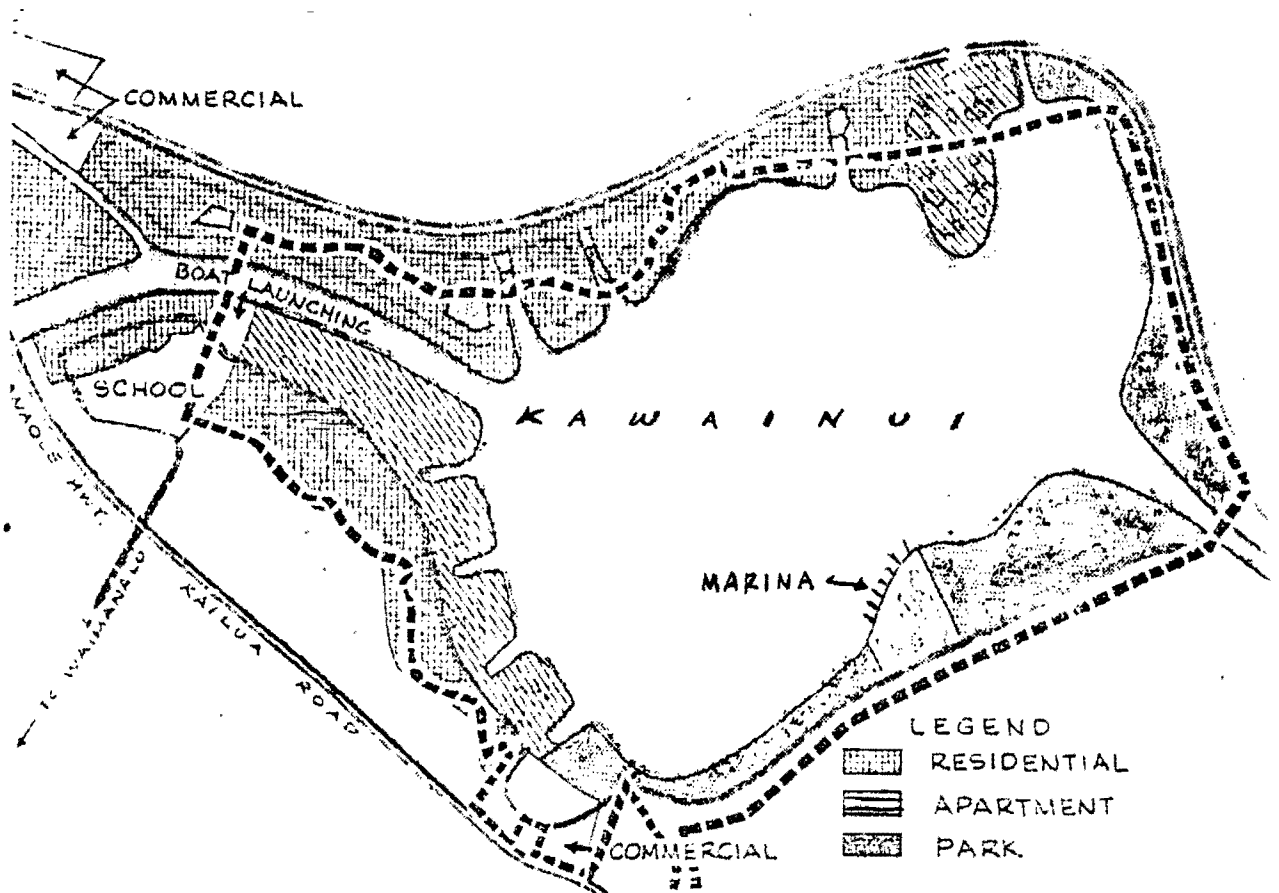


Figure 1.25 Map of Centex-Trousdale Corporation's Proposed Residential Park Complex at Kawai Nui (1963) (Taken From: Honolulu Advertiser 4/3/63)A-2.

police department would never be able to patrol sufficiently to make them safe."

Realtor Eileen Watkins

Referring to the rapid growth of Kailua's subdivision, she said that a "scenic eyesore" has been created in which subdivisions sprawled on either side of Pali Highway which "appear like scabies or other skin afflictions on an otherwise beautiful community skin."

Centex-Trousdale Corporation modified its proposal several times to accomodate public opinion, expanding the area set aside for public access in and around the housing portion of the residential park development proposal. However, the distrustful public was not convinced of the sincerity of this move and to the suggestion that the housing could be developed and the public could get its park too, as a "free" bargain deal. Such distrust is reflected in a Honolulu Star Bulletin article which appeared during this struggle, entitled "Not Such a Bargain" (April 4, 1963):

City Council members who expected to get a bargain in "free" park areas if they allowed Centex-Trousdale to develop Kawainui Swamp saw the light Tuesday.

The new Centex-Trousdale plan is no bargain. The City not only will have to pay for the 100 acres the developers set aside for park purposes (not all of it owned by Centex, incidentally), but would have to pay a portion of the costs of filling the land for the subdivision (and the park) under the improvement district statutes . . .

Mayor Blaisdell reminded the Council that the proposal to initiate a federally-aided flood control project at Kawainui got its start after the destructive 1951 flood which inundated parts of Kailua. . .

Flood control is still the main reason for the City's interest in Kawainui. Park development is incidental -- but desirable.

A concerned citizen wrote to the Honolulu Advertiser (April 8, 1963) saying:

Let's carefully review the facts. There are 732 acres at Kawainui. The total purchase price for the City is about \$1 million. The Federal Government has already authorized \$300,000 toward the purchase of the land for a Park Area, leaving only \$700,000 required to be put up by the City. This is a far cry from the millions needed to assist the subdivision plans.

Kawainui can be a perpetual enjoyment to all of Oahu. It is one of the few remaining green areas left on the doorsteps of Honolulu. Please support Mayor Blaisdell in his wish to preserve this vast area for the public use.

In 1964, after a two year intense battle for development rights to the central portion of Kawai Nui Marsh, Centex-Trousdale Construction Co. surrendered its claim and the City of Honolulu emerged victorious in its seven-year battle to acquire 749 acres of the Marsh for flood control and park purposes when, with federal assistance, they purchased the Centex-Trousdale properties for a total of \$1.2 million.⁸⁷ (See Figure 1.26)

The City moved forward in the late 1960's and early 1970's on further development of the Kawai Nui regional park plan and the necessary legal steps to be taken to consolidate their right to use the land in this manner. Thus, in 1964, the Kailua Detailed Land-Use Map (DLUM) — the zoning tool to be used to implement the General Plan for the area — was created and included the park proposal. A series of regional park development master plans were developed in 1966, 1969, and 1974 by the City and County Department of Parks, the responsible agency for the marsh.⁸⁸

The 1969 and 1974 plans called for the purchase of 250 additional acres in the southern portion of the marsh and on the marsh slopes controlled by private interests. The plans for a 1,000 acre, multi-purpose park proposed large-scale dredging and filling of the marsh would have provided a flood control ponding area, wildlife sanctuaries, a living laboratory for ecological studies, and multipurpose recreation facilities. Only a small, 3.5 acre parcel adjacent to Kapaa Quarry Road has been developed for model-airplane flying. In 1973 and 1975, the City and County sought the downzoning of the peripheral slope lands from Agriculture, Open Space and Residential zoning to Recreational (Park) use.

While these steps to realize the park plan were underway, private owners of the approximately 250 acres along the peripheral edges of the marsh continued to work on development proposals for their properties. The surfacing of these proposals during the last decade has further set back the realization of the regional park concept at Kawai Nui but has also occurred at a time when additional environmental laws, the maturation of the public's ecological awareness and political sophistication, and additional environmental research findings on the cultural, historical, and ecological significance of the area have added to the depth and complexity of the conflict and the realization of the tradeoffs involved.

The first of these setbacks occurred in 1974, when a real estate consultant to the Castle Estate cited in a study that Windward O'ahu was then growing at nearly twice the rate of the rest of O'ahu, and that its residents still made about 60 percent of its retail purchases outside the Windward area. Since the Windward area was expected to continue to grow rapidly in the '70s and 80's, along with their retail purchasing appetites, he recommended that the development of a shopping center in a more accessible location on Castle properties in the Marsh would be a worthwhile investment for the Estate. The Estate filed a letter of intent with the City Planning Department to develop a 63-acre shopping center on land next to the Kailua Drive-In on the southwest corner of the marsh property.⁸⁹ (See Figure 1.27) The City admitted that, if the shopping center was built as planned it would alter the nature of the park and flood-control plan that they had been developing over the years and would lead to the need for costly revision in the nature of the plan to accommodate the impact of the proposed shopping center.⁹⁰



Mayor Neal S. Blaisdell, left, and H. W. B. White, resident partner of Trousdale Construction Company display check for \$1,130,000 with which the City purchased Kawainui Swamp from the company. The decision to buy the property was made after a long controversy last year. It will be used initially for flood control and may eventually become a regional park. The check was handed to the company Friday in Mayor Blaisdell's office.—Star-Bulletin Photo.

Figure 1.26 Photo of Mayor Blaisdell Accepting Check for City and County of Honolulu to acquire much of Kawai Nui Marsh (1964) Headline Article

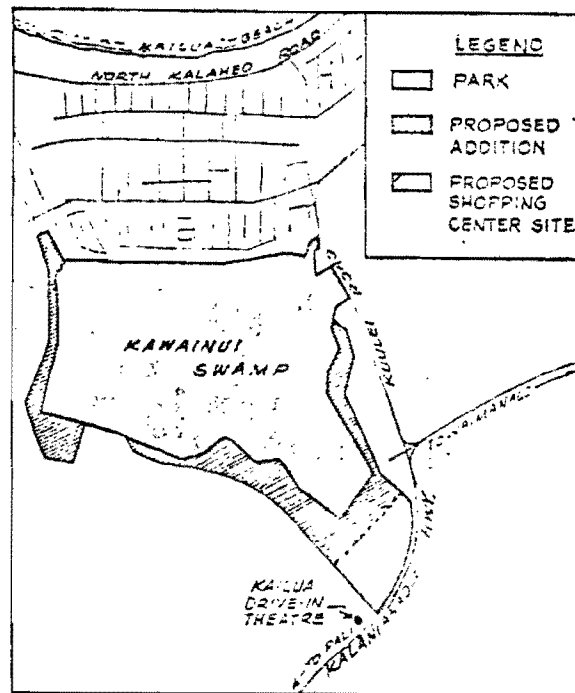


Figure 1.27 Map of Kawai Nui Showing City's Acquired Parcel/Park Area; Proposed Additional Parkland; and Proposed Shopping Center Site (1972)

By this time, the size and number of citizen and environmental organizations supporting park development at Kawai Nui had grown in both size and number, mirroring a national movement in this direction. Additional arguments for the development of a park here on the basis of ecological criteria, not heard as often during the mid-1960's debate, were added to the "standard" recreation/open space needs arguments. Thus, for example, a member of the Hawaii Audubon Society and professional wildlife biologist, Ron Walker, was quoted as saying he "ponders the wisdom of the plan" to construct a shopping center "straddling a relatively natural eco-system and watershed".⁹¹ Walker cited that Kawainui is the largest freshwater marsh left in Hawaii and the home to at least three species of birds protected by the newly-passed 1973 Endangered Species Law -- the Hawaiian Stilt, coot, and gallinule. In addition, state surveys in the area had recorded six species of migratory ducks there during the past ten years, including pintails, shovellers, baldpates, green-winged teal, scaups, and buffleheads. State efforts were also initiated to release another endangered species, the Koloa or Hawaiian duck, into the Marsh, to restore its numbers in this, one of its former habitats.⁹² It seems that this formerly "celebrated haven" for wild ducks during Boswer's travels in the Kailua area, at the turn of the century, were attributes that still existed in the area, but which had not been getting as much attention and publicity until lately, during the upsurge of public support for environmental concerns.

Another wildlife professional in Hawaii, Eugene Kridler, wildlife administrator for the federal Bureau of Sport Fisheries and Wildlife and Audubon Society member spoke out against the shopping center proposal in the context of the cumulative destructive effects of such developments as a national trend that was long overdue for a revision:⁹³

Other wetlands have disappeared before the onslaught of an urban society which demands more and more parking space for industrial areas, shopping centers, auto parking lots, highways, refuse dumps, subdivison, and hotels.

Too frequently decisions to destroy these marshes and ponds were made with primarily private economic gain for a few in mind and scant, if any, attention, was given to the impact that these projects might have on our environment, on the welfare of our unique form of wildlife found there, or if it really is in the public interest as a whole.

It is interesting to note that at the time of Captain Cook's arrival in Hawaii, there were 69 kinds of birds native to Hawaii.

Since then . . . 23 have become extinct and another 27 threatened with extinction. In no other place in the world is there such a tragic record.

Such public statements by recognized environmental experts about the endangered species at Kawai Nui and related values worthy of preserving added fuel to the emerging community concern over the issue of whether or not they really needed another shopping center, or would they be better served by an additional 250 acres of parkland, in this same area that the City was moving to acquire before the development proposal got underway.

On January 24, 1974, the Lani-Kailua branch of the Outdoor Circle -- the oldest environmental organization in the state (founded in 1912) -- sponsored a public meeting attended by a overflow crowd at which a coalition of community individuals and groups concerned about the shopping center's encroachment on the environmental and park values of the Kawai Nui area was formed, called the Ad Hoc Committee for Kawai Nui. Over the next six months, this grass roots groups worked diligently to consolidate community support in opposition to the shopping center concept, developed by Dillingham for the landholders. A small army of volunteers were solicited to distribute petitions requesting City acquisition of about 250 acres of privately-owned Kawai Nui lands, which resulted in the accumulation of over 10,000 signatures. It also resulted in the creation of the "Makana 'O Kawai Nui" (Kawai Nui: the Treasure) slide show dealing with the natural and cultural history of the area as well as its educational value shown in current usage by formal and informal educational groups.⁹⁴ As a result of this "campaigning" and mass public environmental education efforts, over 50 groups joined forces with the lead organization, The Outdoor Circle, in becoming a participating member of the Ad Hoc Committee for Kawai Nui, while numerous government officials and agencies officially endorsed the efforts and aims of the coalition.

This upwelling public endorsement of regional park development at Kawai Nui accomplished its goal of discouraging the Dillingham Land Corporation from implementing its shopping center scheme at the edge of the Marsh, a shopping center which would have provided about half the commercial space of the Ala Moana Center. Thus, in announcing its change in plans, the President of the Corporation stated: (See Figure 1.28)

While the results of the survey tend to confirm the need for better shopping facilities on the Windward side, the majority of the people at this time want to keep the swamp as it is or use it exclusively for a regional park.

While we have a responsibility to our employees and to our shareholders to pursue appropriate business opportunities, we must also consider the wishes of the communities in which we work so that we can continue to have the right to do business in them.

We believe that orderly, planned growth is in the long-range interest of the State and the Windward side of Oahu. In the case of the Kawainui Shopping Center, however, the majority of the people affected were opposed to the development so we are opposed.

'Once in a while, some good news.'

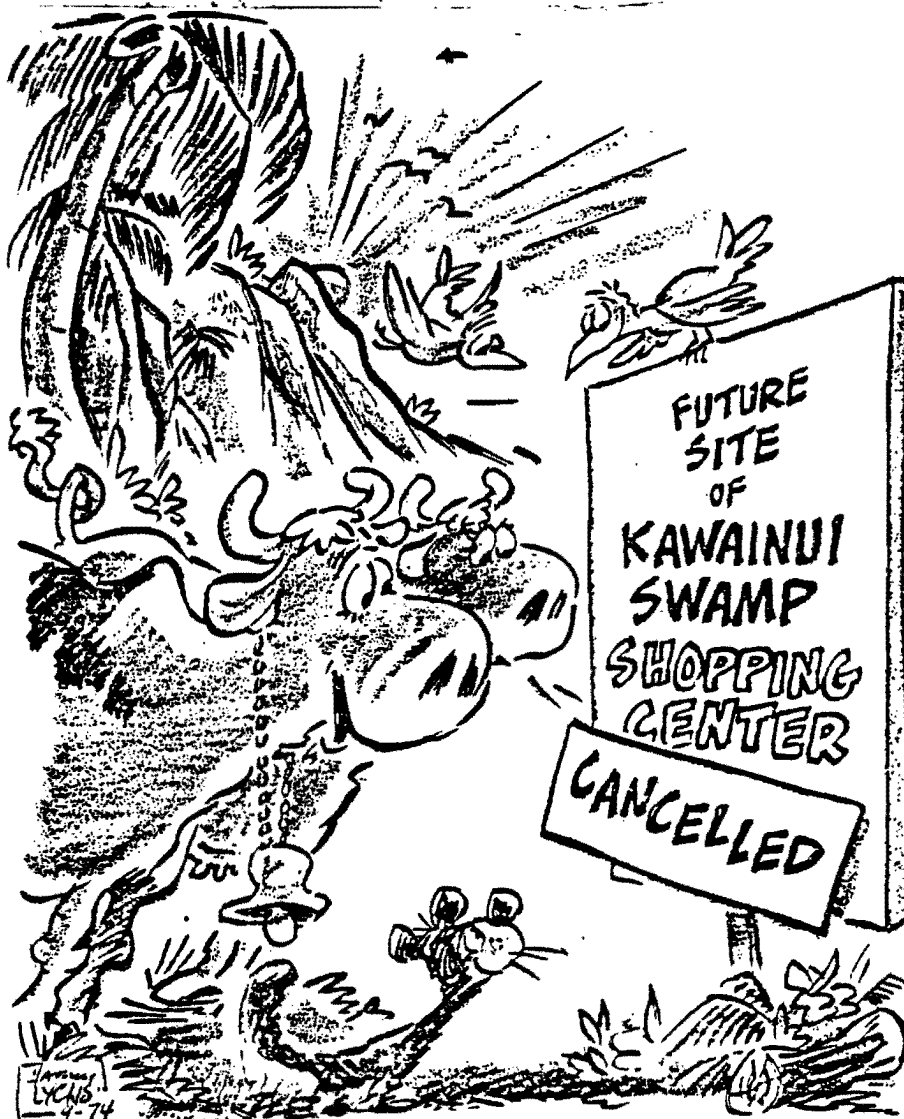


Figure 1.28 Newspaper Cartoon about the Cancellation of the Proposed Kawai Nui Shopping Center (1974) (Taken from: Honolulu Advertiser, September 19, 1974.

Section 1.4 Land Use Conflicts from the Early 1970's to the Early 1980's Over Future Disposition of Kawai Nui

Although the dispute over the shopping center proposal at Kawai Nui was won by park proponents, the end goal of implementing a regional park plan there was still a long way from being realized. In the process of resisting the Centex-Trousdale residential and Dillingham shopping center proposals, the citizens became more politically sophisticated in their search for long-range solutions to the development rights question.

The City's chief appraiser indicated in 1974 that acquisition of the proposed park area, including 88 acres of the now-defunct shopping center project site, would cost about \$11.5 million. This kind of money was not expected to be available for another 6 to 10 years of acquisition efforts. Citizen and government groups concentrated their efforts on achieving controls over the type of land use on the peripheral 250 acres not owned by the City. Thus, for example, in 1974, the City encouraged the Lani-Kailua Outdoor Circle to petition the State Land Use Commission (SLUC) in a Five-Year Boundary Review, to put lands in question into a Conservation designation. This action was taken, but through an apparent oversight, the SLUC failed to act on the Lani-Kailua Outdoor Circle petition.⁹⁶

In 1976, the State Department of Planning and Economic Development (DPED), requested the Ad Hoc Committee to assist that agency in developing their petition for redesignation of the approximately 250 acres along the edge of the marsh that was not owned by the City from Urban to Conservation, so that any proposed use of such acres would be in conformance with the City's park proposal for the rest of the marsh (approximately 750 acres) that they did own. The Lani-Kailua Outdoor Circle, sponsoring organization for the Ad Hoc Committee for Kawainui, extended full cooperation with this state-initiated effort and became a party to the action. Redesignation of the said properties from Urban to Conservation would further assure that the ecological and cultural integrity of the marsh would remain intact, and that piece-meal urban development along the marsh edges would be less likely to occur and to thus run interference on a regional park plan concept for the entire 1,000-acre marsh area.

The initial petition, covering approximately 250 acres, was denied, but after an appeal was filed, a decision was reached in 1979, to revise the earlier decision and approve the re-designation for 70 of the original 250 acres requested in the petition, at the southern end of the marsh in the wetlands. The decision on the remaining acreage covered by the petition, at date of this writing, is still under appeal.

Meanwhile, the initiation of the State's partially-successful petition to "down-zone" the marsh peripheral lands prompted the Harold Kainalu Long Castle Trust et al. (Kaneohe Ranch) and Henry Wong -- principal owners of those affected acres -- to initiate their own 230 acre Kawainui Residential Subdivision proposal for the same lands covered by the State's petition. (See Fig. 1.29) From the land-owner's point of view, such action on their part was necessitated by the petition, because -- if the petition succeeded in redesignating their land from "Urban" to "Conservation", the land's appraised value would decline and they would not realize the profit from these properties to which they believed they were entitled and which they expected to make if the lands were developed for an urban-type use, or

sold to the City at the higher, urban valuation.⁹⁸

While this struggle was occurring over the use-designation of the peripheral areas around the marsh, the coalition of citizens were also at work evaluating the nature of the city's park proposal. Professional scientists and planners had volunteered their services to more critically evaluate the City's park plan and to further clarify the most appropriate park concept for the site. (See Figure 1.29)

Working with these specialists, the Ad Hoc Committee became aware of certain environmentally-destructive aspects of the City's regional park plan and the need for more baseline studies of the existing environment in the marsh (water flow, flora and fauna, water quality, vegetation growth, archaeological surveys, etc.) before a park plan with minimal environmental impact on the marsh could be carefully conceived and carried out. For example, in October 1974, the City Department of Public Works issued an environmental impact assessment that would implement a park concept using the marsh to accommodate 25 years of landfill (garbage) through resculpturing the landscape and water courses to fit the model of such mainland municipal parks as the Boston Fens.⁹⁹

Citizens feared for the habitat necessary to maintain the wildlife during the proposed park development period. When the marsh was being filled in and "reshaped" to suit the image of what the park there "should" look like, according to the plan, where would the wildlife go during this "temporary" 25-year disruption of their habitat? One informed citizen expressed concern that the city's park plan would make the following impact on the environment of the marsh during its implementation phases:¹⁰⁰

The plan would move the required flood storage from the makai elevations into the mauka elevations. This would be no small task; it would mean removing the sloping wooded areas below the Kukanono subdivision, along a portion of the Quarry Road, and along the Pali Highway. This would lower the existing elevations so that a new flood plain could be created. Near the center of the newly raw plain, artificial ponds would be gouged out and, to make certain the waters stayed there, a weir (or dam) would extend across the upper portion of the Marsh. This one structure is estimated to cost \$5,000,000 because of the tricky subsoils, with slippage and slide certainty.

Maunawili and Kahanaiki Streams would be channeled into concrete culverts leading into the upper silting basin.

Following the reconstruction of the upper portion of the Marsh, attention would shift to the lower portion, where extensive dredging for settling ponds, waterways and the area makai of Ulu Po Heiau would also be gouged out.

As you may know, Kawainui is affected by tidal action, its waters rising and falling with the sea. This is why Kawainui was included by name in the Shoreline Protection Bill. It is an estuary (or "nursery") of the sea into which fingerling mullet, papio, and aholehole come to grow to maturity

before returning to the sea. It was the largest of the inland Hawaiian fishponds, for this reason. Notwithstanding, in the City's plan, a "control device" would be placed in the Kawainui mouth of the Canal, which would prevent salt water from entering the Marsh; Nor would the fish.

Now Kawainui would be dead as an estuary, and the Kawainui Canal reduced to the same dismal fate as the Ala Wai canal, behind Waikiki except when flood waters were high enough to flush its stagnant waters into the Bay. Its mauka portions defoliated, flattened, its streams in concrete she would lie ravaged and stripped of life, her raw, gaping wounds filling with muddied waters from the brooding Pali.

The drying, stinking, rotting lower portion of the Marsh would now be prepared to received the "sanitary" landfill. Dikes would be built, with the hope they would hold the compacted, weighted landfill, and not slide out. For 20 to 30 years, as long as it took to fill an almost bottomless 100-acre area, the now dead ecosystem would receive the City and County of Honolulu wastes. (Because recycling is, at last, becoming a reality even in Hawaii, it could take even longer before the area would be filled.) Finally, imported topsoil would be added, followed by expensive landscaping and planting.

Only then would a "park" be possible: a sterile artificially contrived monument to a Disposable Culture's value system, where once a tropic marshland drowsily stretched its green loveliness from mountain to sea. The man-made travesty in the Kawainui Basin would exceed that allowed at Salt Lake.

Instead of a great, enhanced natural view plain of lake, marshlands and lowland forests greeting residents and visitors from the Pali lookouts - a completely plastic conventional city park.

After careful reevaluation of the City's park plan concept, volunteer experts and the citizens of the Ad Hoc Committee began to clarify their own goals and vision for a future park development alternative at Kawai Nui that they would support; one that would preserve the best of the environmental features already present in this largest freshwater marsh in the islands and would encourage human uses in the form of "soft" recreational technologies such as canoeing and hiking rather than "hard" technologies such as motorboating and marina development. Rather than a standard municipal park "where a nine-year old boy could bounce a ball", the citizens envisioned a "tropic marshland park like none other in the world."¹⁰¹ In clarifying their vision of a regional park plan, they were striving to shape in cooperation with the City, a model park which would utilize the natural and cultural features already present in the area rather than work against them.

Representatives of the Ad Hoc Committee for Kawai Nui committed individual and organization efforts to an unprecedented educational campaign

directed to elected and agency officials, as well as the general public, to increase awareness of the variety of Kawai Nui resources meriting public protection, restoration, and enhancement.

Just as too few of the Hawaiian community were aware of how the original native Hawaiian pioneers utilized this environment as an extensive fishpond/taro cultivation complex capable of supporting a large population, and which had a wealth of sacred and royal tradition, so was the larger community (environmentalists, as well) unaware that the cultivation of taro not only served to benefit the humans as a food source, but also benefited the endemic waterbirds of Hawai'i by providing nesting, eating, and loafing sites, and provided an adjunct to the estuary of great value to a variety of aquatic animals. These elements, of course, were included in the work of a key community-based volunteer professional architect/planner, Robert A. Herlinger, A.I.A. Herlinger translated scientific expertise and community concerns into a series of citizen-directed plans and designs for the Kawai Nui resource, based on the best available information obtained through archival research accomplished by a number of volunteers, and through hundreds of his own interviews.

For example, while interviewing a wildlife biologist, he might say -- "If I gave you a blank check and there were no constraints whatsoever, what would it take to shape this environment at Kawai Nui to be a better habitat for producing more of the endangered waterbirds of Hawaii, such as the Hawaiian Stilt, Gallinule, Coot, or Koloa Duck -- all of which are found at Kawai Nui but in reduced numbers? "If I were an endangered native Hawaii stilt, for example, what type of vegetation cover and water area would I be attracted to for setting up my nest site?" By such brainstorming, Herlinger would get the wildlife biologist to sketch out the requirements of the stiltbird and would proceed to integrate those requirements into the "citizens' directional plan" for the marsh/park that was rapidly emerging.¹⁰²

In 1975, the Committee held numerous meetings with the City and County of Honolulu, and several audiences with the then Mayor Fasi, during which they urged the responsible parties to set aside funds to do appropriate environmental studies prior to funding their regional park plan so that it would not have the destructive environmental impacts mentioned earlier. The Committee presented their Directional Park Plan to the Mayor and his aides to encourage further action in this area. This presentation did not cause the City to endorse the citizens' version of the park plan but, the Mayor did promise to "put the best man and best efforts" into the park project.¹⁰³

Meanwhile, the citizens successfully lobbied the State legislature through Representatives Ajifu and Evans, for a \$100,000 grant-in-aid appropriation to the City to commission the environmental baseline studies that they urged as necessary to achieve an appropriate park plan. The City Departments of Parks and Recreation and Public Works solicited an environmental study proposal from the University of Hawaii Water Resources Center. The citizen's Ad Hoc Committee for Kawai Nui was fully involved in the study formulation, but the final study proposal that emerged was so different from what they expected that they could not endorse it, feeling that it represented too much of an "engineering exercise -- restructuring of the marshlands, rather than an unbiased analysis of the ecosystem."¹⁰⁴ The citizens successfully lobbied the State not to release the study monies appropriated through the City to the University of Hawaii Water Resources

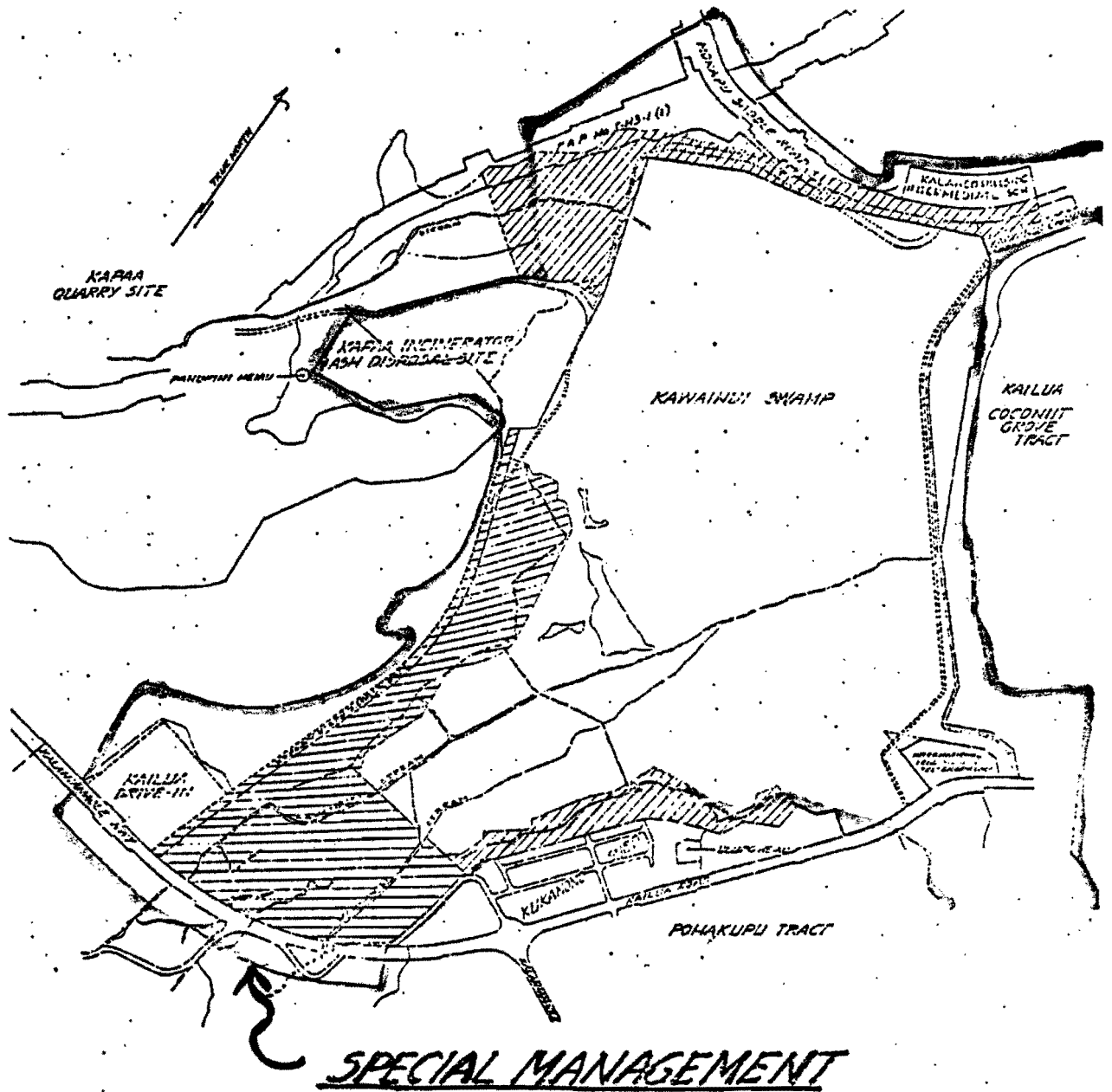
Research Center, and -- instead -- to transfer the funds to the State Department of Land and Natural Resources (DLNR) hoping they would effect a study proposal instead. Momentum at the state level in support of the citizen's efforts was sustained by a Resolution passed in 1976, by the State legislature, requesting a feasibility study of the historical/archaeological values of Kawai Nui, and a determination of its eligibility to the state and national historic registers. While DLNR never developed an environmental baseline study proposal, that department did send forward a review of the site's qualifications for historic site designation, stating that the area did indeed qualify. However, the DLNR neglected to fill out the necessary forms to request the proper agencies to grant the formal designations, despite the Legislative Resolution endorsed in 1976.¹⁰⁵ The City dropped Kawai Nui park planning at the same time.

After several years of thus moving towards their goal of developing an ecologically-sound regional park plan concept and pushing for interim measures such as zoning controls to prevent piecemeal development along the fringes of the marsh, the Ad Hoc Committee and supportive government agencies discovered new tools at their disposal in the form of more national level landmark environmental legislation designed to protect the natural resource values of areas such as Kawai Nui from urban encroachment. Thus, in 1975, a court-decision led to the extension of the U.S. Army Corps of Engineers permit program mandated under Section 404 of the Clean Water Act to cover "wetlands" such as Kawai Nui.¹⁰⁶ According to this program, any developer who wished to secure approval for a project which would significantly effect the chemical/biological integrity of wetlands in the United States (by willful discharges of dredged or fill material that could permanently destroy or alter the character of these resources), would have to apply for a permit from the U.S. Army Corps of Engineers. During the permit application review process, any application which looked as if it would have a significant environmental impact would be subject to the additional scrutiny of an environmental assessment review process, perhaps leading to a full-fledged Environmental Impact Statement and widespread citizen review and comment.

Another law, the National Coastal Zone Management Act, and its State counterpart, the Shoreline Protection Act in Hawaii, also applied to Kawai Nui. The CZM legislative initiatives placed the Kawai Nui Marsh in the category of a coastal zone environment requiring "special management" to protect its unique natural and cultural resource values from irreversible and unnecessary encroachment by urban or industrial development. A "special management area permit"¹⁰⁷ application review would be required for development projects in such zones before a decision was made about whether they would be allowed to proceed. (See Fig. 130) Another aspect of the CZM initiative was that the State could apply for federal funds to initiate special planning processes for protected areas covered by coastal zone regulations.¹⁰⁸

The availability of CZM funds encouraged citizens -- again led by the Outdoor Circle/Ad Hoc Committee for Kawai Nui -- to pressure for use of these funds on the long-awaited environmental baseline studies necessary to come up with an ecologically sound park development project.

The new attention to wetland and cultural preservation provided by the CZM law and the wetland protection provisions of the Section 404 of the Clean Water Act provided additional legal basis for citizen opposition to the 230 acre Castle/Wong Kawai Nui Residential Subdivision proposal around the marsh



LEGEND


 *Approximate location of areas within the City and County of Honolulu Special Management area.*

Figure 1.30 Map of Kawai Nui, Showing Boundaries of the Special Management Area (SMA) into which it fits, for Coastal Zone Management Purposes.

periphery.

By the late 1970's sufficient momentum was generated by these concurrent forces for the following significant events to occur:

1. Public hearings held on the Castle/Wong proposal to ring the marsh with a 704-home residential development on the 230 acres of slopes in question yielded overwhelming opposition to the proposal, especially on the basis of the cumulative adverse impacts such development would have on the natural and cultural/historical values of the marsh and on the park plan option;¹⁰⁹ (See Figure 1.31)
2. The State DPED acquired an \$80,000 grant from the CZM which would initiate an advisory committee that would direct the gathering of data from multiple disciplinary sources toward the preparation of a comprehensive resource management plan for Kawai Nui Marsh that would guide future use decisions and planning in the marsh environment.¹¹⁰
3. The City and County of Honolulu submitted a proposal to construct a \$1.9 million sewer project that would eliminate the discharge of four wastewater treatment plants into the marsh, thus improving the water quality of the marsh, nearby streams, and Kailua Bay for which it was required to develop an EIS.¹¹¹ (See Figure 1.32)
4. In 1979, the Office of the National Register of Historic Places declared Kawai Nui to be eligible for listing therein.¹¹²
5. Studies funded by the developers as a requirement of the City's Department of Land Utilization resulted in the discovery of the oldest known agricultural site of the first Hawaiian settlers on the southern slopes of the marsh; and Dr. John C. Kraft, a visiting Sea Grant Scholar, proved that Kawai Nui was a bay or saltwater lagoon when first settled.¹¹³

The interaction of these events and their impacts (present and potential) on realization of the regional park plan at Kawai Nui will now be discussed.

During the residential development proposal hearings and EIS review, mentioned in (1) above, media attention concentrated on the widely contrasting perceptions between the project proponent's viewpoint of the marsh's natural and cultural values and park development potential vs. those of the citizens in the Ad Hoc Committee. Thus, for example, consider these contrasting viewpoints between project proponent/landowner Henry Wong, and Muriel Seto, officer in the Congress of Hawaiian People, an organization participating in the Ad Hoc Committee for Kawai Nui.¹¹⁴

Henry Wong

I raise a question as to food production in the swamp. I don't think there are lo'i (taro patches) in the swamp. In the 49 years with Kaneohe Ranch that I ran cattle in there, I never saw taro patches . . .

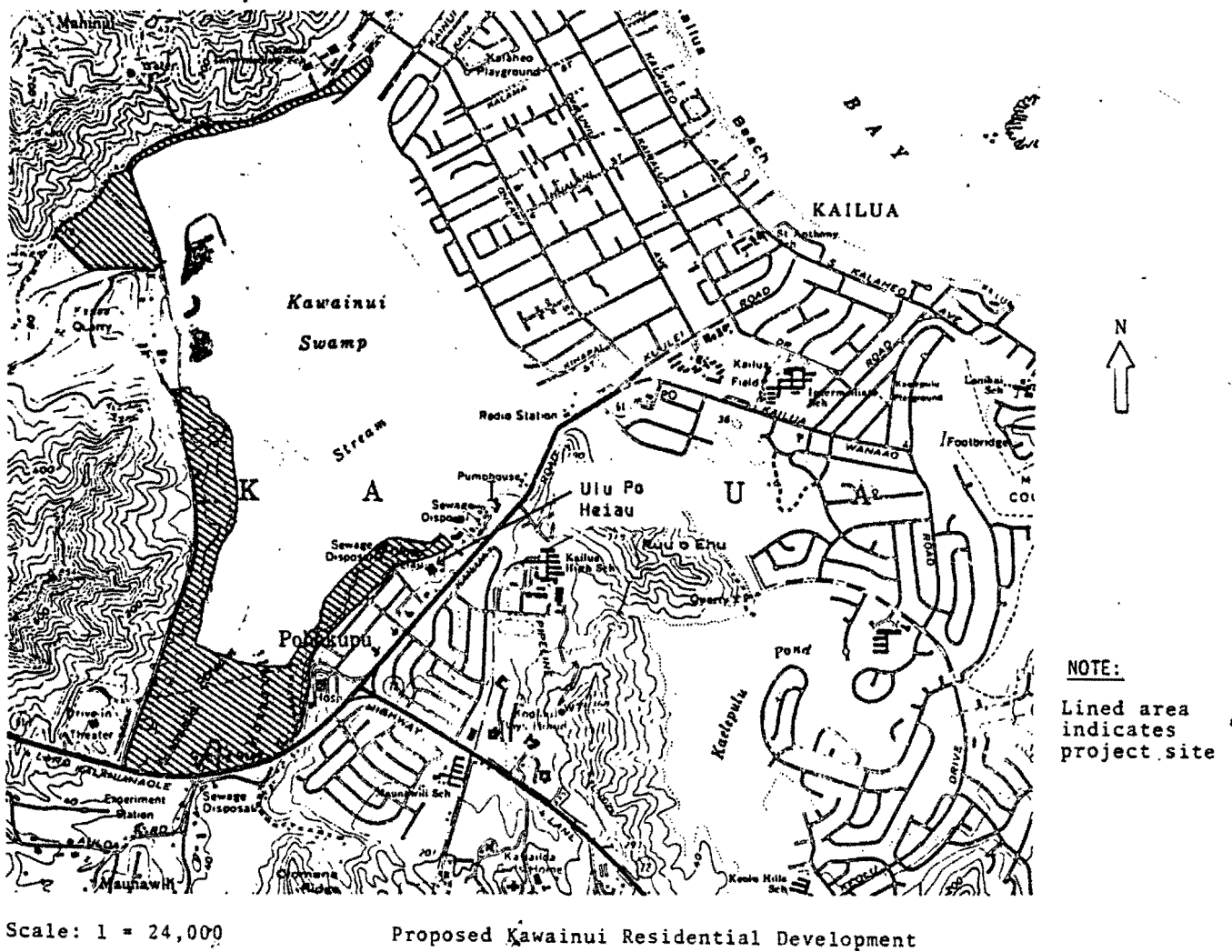


Figure 1.31 Map of Proposed 704-Home Residential Development on 230 Acres bordering Kawai Nui Marsh (1977) (Taken from: Environmental Impact Statement for project, prepared by Community Planning Inc., 1977)

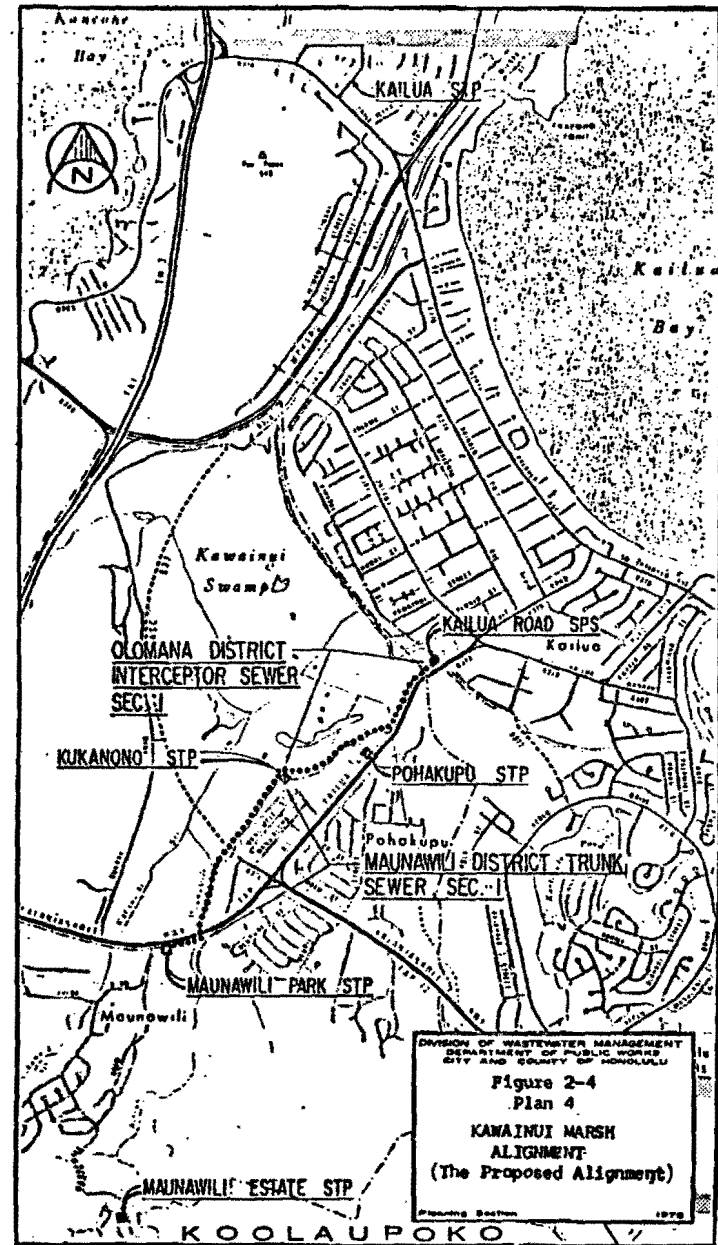
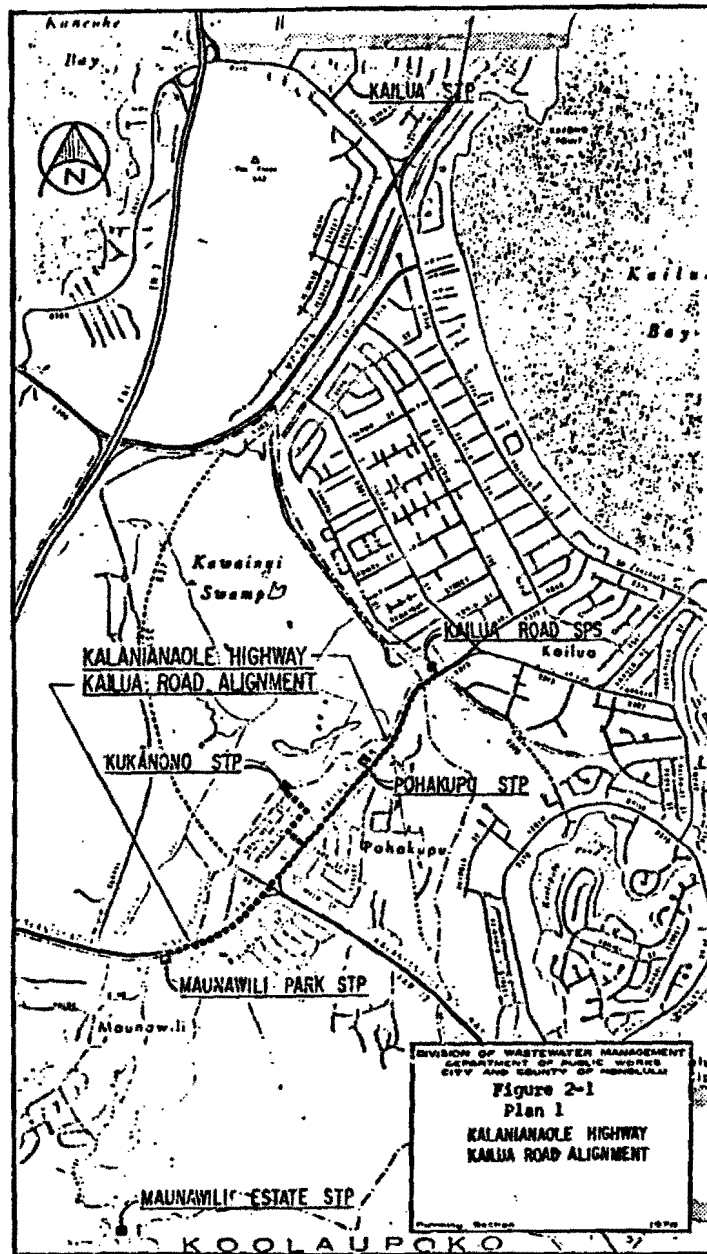


Figure 1.32 Map of Proposed Sewer Project, showing City and County of Honolulu's Preferred Alternative Alignment Adjacent to Kawai Nui Marsh vs. Alternative Supported by a Majority of Citizen's Groups, along the Kalaniana'ole Highway, Outside of the Marsh. (Taken from: U.S. Army Corps of Engineers, EIS, 1981)

They're really out of their minds if they think they can grow taro in there today. The cost of building the kuanaus (taro patch walls) would be prohibitive. Getting fresh water would be prohibitive. You cannot use the water in the swamp because effluent goes in there. Taro has to have fresh, clean water.

Muriel Seto

Seto was interviewed as saying a report by the Army Corps of Engineers dated August 1978 describes old lo'i in the swamp with walls dating back to 1692-1788. She said Wong's property on the fringe of the swamp is part of an old Hawaiian agricultural complex and that 32 stone structures have been found there. Seto agreed with Wong that taro could not be grown in the swamp today because of effluent discharges there, but added that Wong knows as well as she that a new sewer interceptor is planned to drain off that effluent. She also said "A taro grower in Waianae has assured us that by the time the interceptor is built and the taro patches are ready, the water in Kawainui will be pure enough to grow taro there."

It became apparent to all that, more than ever before, the conflicting perceptions as to the natural and cultural values of the marsh would not be meshed until more definitive, scientifically-based data about the existing environment and archeological features in the marsh were available. Interestingly, the overwhelming evidence showing Kawainui as an important Hawaiian agricultural complex and its potential as a wildlife sanctuary are among reasons stated by U.S. Senator Daniel Inouye (D-Hawaii) to the Department of Interior in support of a request that Kawainui be made a national park or a national wildlife sanctuary.¹¹⁵

In February 1980, in the face of overwhelming community opposition, the absence of definitive data on environmental impacts, and on the advice of City Council, the Hawaiian Papaya Co. and Associates, project proponents and representatives of the Wong-Castle interests, withdrew their permit application for the housing project surrounding the marsh. However, they promised to return with their application once the problems had been resolved and arguments over impacts settled.

Meanwhile, the City was told by the State DPED/CZM program that the long awaited marsh studies would be getting underway, funded by the \$80,000 grant from the National Office of Coastal Zone Management (as indicated in (2) above). The study initiation and integration process would be coordinated by a technical and policy advisory committee of private and public sector representatives who had vested interest and/or jurisdiction over various aspects of the marsh's environment -- including the landowners, the various city, state, and federal agencies with jurisdiction, and the citizen's organizations interested in the development of a park project there.¹¹⁶ These advisory committee members were assembled to decide priorities on study needs, coordinate the studies by contracted researchers, and take study results into account toward development of a comprehensive resource management plan, for the marsh. The citizen representatives presumed that since all those representing the various interests sat on the committee, efforts would be

taken by DPED to ensure that all development proposals for the marsh environment would be held in limbo until the committee completed its work and came up with a plan — a process which was expected to take about three years.¹¹⁷

At time of this writing, mid-1982, the DPED-coordinated advisory committee work is almost completed, and the resource management plan for Kawai Nui marsh is due for review by the Governor. However, the Ad Hoc Committee's representative on the DPED/CZM committee, i.e. the Outdoor Circle, and that of the Hawaiians cultural concerns, i.e. the Congress of the Hawaiian People, have become disenchanted with the decision-making process used by the DPED committee. Mechanisms for protecting the resources during the planning process were never implemented by DPED; the alternative of park development was not given as full consideration as other development proposals; and several participants on the advisory committee had "jumped the gun" and pushed forward with project proposals and approvals of proposals, during the management planning process. These actions were counterproductive to the rationale for having a comprehensive resource management plan in the first place. Thus, the following development proposals have moved forward, despite the fact that they would have significant adverse impacts on the natural and cultural resource values associated with the marsh, and on the marsh park development option:

1. The City's preferred alternative of routing the interceptor sewer line through the marsh, instead of along an alternative route such as the already-disturbed environment along the Kalaniana'ole Highway, has gained momentum, despite a significant amount of opposition to this route. The basis of the opposition is that it would cut through the remains of at least 45 taro lo'i and erase prehistoric cultural evidences of cultural significance in the project area, as well as severely reduce the potential for restoring some of the taro lo'i as one of the uses proposed in the citizen-supported Directional Park Plan. A newly-constituted citizen watchdog public interest organization, Hawaii's Thousand Friends, has pointed out that legal liabilities may exist for the U.S. Army Corps of Engineers, if they accept the City's preferred alternative route for the sewerline and issue a Section 404 permit for the marsh alignment. A majority of members on the DPED/CZM technical and policy committee have voted to approve the highway rather than the marsh alignment for the sewerline.¹¹⁸ Their vote has been communicated to the U.S. Army Corps, through its representative on the Committee, as a factor to be considered in the permit decision still pending. Numerous government representatives, citizens, scientists, and environmental organization have recommended against the marsh alignment.¹¹⁹
2. The Wong/Castle subdivision proposal has been reinitiated. Instead of coming in for the required Special Management Permit for building over 700 homes around three sides of the marsh, they have reinstated their request for a permit in increments. Thus, for example, Hawaiian Papaya Co. and Associates resubmitted the first increment of their proposal in the form of a request for a permit to build 153 single-family homes on the southern slopes of the marsh near Castle Hospital. Despite an overwhelming negative sentiment expressed by citizens, public agency representatives and numerous interest groups at their requisite hearing on this proposal, an environmental impact statement for this revised project was never prepared, and the city granted the

permit, with some conditions attached, in an attempt to appease the concerns of the protesting groups. At time of this writing, some of these conditions have been partially met, but disagreement among experts remains as to whether those conditions will adequately mitigate adverse impacts on the natural and cultural values of the marsh protected under a variety of laws.

A coalition of citizens' groups has already initiated a court complaint challenging the basis of the City's decision to grant the SMA for this project. While this complaint is working its way through the courts, the project proponents have submitted the next increment of their project for City consideration, encompassing the Mokapu portion of the marsh slopes.¹²⁰

In tandem to all these developments, the Ad Hoc Committee for Kawai Nui has continued to exist, enlarge its membership, conduct successful fund-raising events to pay legal fees and to sustain the efforts of community based professional architect/planner Herlinger to continue to work on the directional park plan for Kawai Nui.¹²¹

The sentiment of the Ad Hoc Committee for Kawainui, now representing over 50 community groups and thousands of individuals who seek restoration and enhancement of Kawai Nui as a natural and cultural heritage center for the education and enjoyment of future generations, has been eloquently summarized by one of its most active members, and concurrent participant in the DPED/CZM advisory committee planning efforts for Kawai Nui, Muriel B. Seto, in the published commentary reprinted as Figure 1.33

Regardless of the outcome of the current conflict over the most appropriate land uses to be allowed at Kawai Nui marsh, any student of this process will be impressed with this continuing dynamic as a classic example of the impact generated by the rise of environmental and cultural concerns as issues in American politics.

By Muriel B. Seto
Historics Site Chairman
The Congress of the Hawaiian People

For more than 20 years, both the landowners and the people of Oahu have expected Kawainui lands to be publicly acquired. Therefore, the resident position is historically "pro-resource," not "anti-development."

Park supporters prove consistent in opposing alternatives which are damaging to park development, including the latest subdivision scheme to be considered by City Council tomorrow at 7:00 p.m. at Honolulu Hale.

THE FIRST INCREMENTAL city and county purchase of 750 acres of marshland for open space and park purposes was widely applauded in 1963. Acquisition of another 250 acres of privately owned peripheral dry lands has been expected since the Blaisdell administration and supported by 20,000 signatures on petitions.

There is no other place like it. Hawaii's largest remaining freshwater marshland has the classic park elements of size, highway access, wooded slopes, estuarine waters, unique native and migratory wildlife, and almost 2,000 years of man shaping and being shaped by the resources.

Recent discovery of the oldest known sites of human habitation in the Hawaiian Islands confirms Kawainui's significance, the names and voices of those first deified Polynesian settlers traditionally revered in mele and chants. These are sacred lands, the cradle of the Hawaiian people nestled at Ko'ulau crater, birthplace of Oahu. Preservation of this ancestral homeland is essential to the Hawaiian renaissance on this, our most populous island.

THREE ANCIENT Hawaiian temples representing different cultural periods grace opposite sides of the former wetland taro gardens and 450-acre fishpond. Two of the heiau are listed on the National Register of Historic Places. One, Ulu Po Heiau, is 500 years older than the Rheims Cathedral and has become part of the state park system.

Another, Pahukini Heiau, sits damaged amid the state's largest sanitary landfill.

Such contrasting examples of resource management for two equally noted national historic sites testify to seven years of governmental abdication of responsibility, duplicity, and neglect. While talking "park" with the community, government has also allowed four sewage treatment plants to drain into Kawainui; denied responsibility for the resulting proliferation of exotic vegetation in the marsh, put a garbage dump in the wetlands and, when stopped by federal constraints, reconstructed Kapa'a Pu'u in such a way as to denigrate Chief Olopana's Pahukini Heiau.

The government has further demonstrated its own perverted view of the marsh's true resource values by violating the intent of the Highway Beautification Act of 1965 by allowing an auto graveyard in the marsh, below the federally funded H-3 spur, resulting in runoff of heavy metals and oil into the marsh.

To add insult to injury, the city's earlier park plans for Kawainui ignored ecological dynamics and masked the intent to justify 25 more years of landfill in the Marsh.

COASTAL ZONE and environmental laws require that negative impacts be judged in cumulative fashion. What about the cumulative significance of such governmental abuse and neglect?

By comparison, the citizen's perception of the marsh's cumulative values is embodied in a directional plan. Lacking a governmental agency parent does not render the citizen's plan illegitimate. Indeed, broad community support of it has prodded public inquiry resulting in:

Figure 1.33 Save Kawainui, An Invited Commentary to the Honolulu Advertiser by M.B.Seto, April 6, 1981, A-7.

- The landowner's limited survey by the Bishop Museum in 1980, leading to the discovery of the oldest known sites in Hawaii.

- Archaeological exploration by the Corps of Engineers confirming 250 acres of walled taro gardens.

- The Kawainui Archaeological District being declared eligible for listing on the National Register of Historic Places, to include the fishpond, walled taro gardens, dryland agricultural complexes of sites "whose components may lack individual distinction."

- Core samples by world-famed geologist, Dr. John C. Kraft, which have completely altered our understanding of Kawainui's progression from saltwater lagoon to freshwater fishpond following Hawaiian colonization.

- Inclusion of Kawainui in Hawaii's coastal zone management program.

- The establishment of the Kawainui Marsh Technical and Policy Advisory Committee (KMPAC), whose task is to guide the state in forming a Kawainui Marsh Management Plan.

FOR MORE THAN A YEAR, Hawaiian and environmental community groups, agency representatives (city, state, and federal), and the landowners themselves have been affiliated in KMPAC, with the presumption that all participants were sincerely committed to the goals of the committee. Baseline studies necessary to the timely completion of the plan are now in progress, with an \$80,000 federal CZM grant and some \$20,000-worth of related Army Corps of Engineers support. Instead, the landowners are upstaging the timetable of the planning process by submitting application for part of a larger proposal, which they pulled back in 1979, partly as a result of the need for such definitive studies and plan.

Even worse, they have tried to justify their action with an out-dated 1977 Environmental Impact Statement which addresses neither the significance of the new cultural findings, nor the environmental impacts of its one new element — a 6,000-foot long berm.

In spite of a Feb. 19 public hearing at which copious negative documentation was reiterated, the Department of Land Utilization (DLU) has recommended approval of this permit to City Council. In its Director's Summary, the DLU has omitted critical information such as the scientific findings of Dr. Kraft; has failed to transmit the state chief planner and lieutenant governor requests for a moratorium pending completion of the work of the KMPAC, whose existence it has all but ignored; has distorted and altered the content of testimonies in its summary of the hearing, and has abrogated its responsibilities to uphold Hawaii's Coastal Zone Management laws regarding acceptance, processing, and evaluation of Special Management Area permits.

MORE THAN 50 community groups and thousands of individuals seek restoration and enhancement of Kawainui as a natural and cultural heritage center for the education and enjoyment of future generations. Will the City Council reach for statesmanship by validating the community's historic expectations and vision of itself? If so, it will respond through acquisition of these controversial lands by trade or purchase to complete park plans that were initiated over two decades ago.

FOOTNOTES FOR CHAPTER I

Section 1.1

1. Furumoto, A.S., N.J. Thompson, and G.P. Wollard. "The Structure of Koolau Volcano from Seismic Refraction Studies", Pacific Science, Vol. XIX, No. 3, July 1965, Fig. 5 and related text on page 310. For related article, see Adams, W.M., and A.S. Furumoto, "A Seismic Refraction Study of the Koolau Volcanic Plug", *ibid*, pp. 296-305.
2. For a description of the geological origins of O'ahu Island from Waianae and Ko'olau Volcanoes, see text and diagrams in Stearns, Harold. Geologic Map and Guide of the Island of Oahu, Hawaii, (Territory of Hawaii: U.S. Dept of Interior, and Geological Survey, August 1939), Bulletin No. 2 especially pp. 8-9, and Plates 3-6.
3. For more extensive discussion of the origin of the Pali cliffs along the Ko'olau range on the island of O'ahu, see Macdonald, Gordon and A.T. Abbott, Volcanoes in the Sea (Honolulu: University of Hawaii Press, 1970), pp. 362-366.
4. Takasaki, K.J., G.T. Hirashima, and E.R. Lubke, Water Resources of Windward O'ahu (Washington D.C.: U.S. Gov't Printing Office, 1969), Geological Survey Water Supply Paper No. 1894,) p. 63.
5. For a summary report on results of several recent research projects at Kawai Nui which have included core borings into the marsh floor, see "Geology and Geomorphology Section of Allen-Wheeler, Jane. Archeological Excavations in Kawainui Marsh, Island of O'ahu (Honolulu: Department of Anthropology, Bishop Museum), prepared for State of Hawaii Department of Planning and Economic Development, November 1981.
6. This evidence is discussed, separately and together, in the Allen-Wheeler report, *ibid.* as well as in Clark, Jeffrey T. Phase I Archaeological Survey of Castle Estate Lands Around the Kawainui Marsh, Kailua, O'ahu (Honolulu, Department of Anthropology, Bishop Museum, prepared for Trustees of Castle Estate, April 1980; Kelly, Marion and J.T. Clark, Kawainui Marsh, O'ahu: Historical and Archaeological Studies (Honolulu: Department of Anthropology, Bishop Museum), Report 80-3; and Kraft, John C., Visiting Sea Grant Scholar, from University of Delaware, Department of Geology, publication forthcoming, based on core samples and related analyses from 1980-1982.
7. See Summers, Catherine, Hawaiian Fishponds (Honolulu: Bishop Museum, 1964) Special Publication No. 52, for basis of estimated 450 acre water area at Kawai Nui. See also, Kikuchi, William K. "Prehistoric Hawaiian Fishponds" in Science, 23 July 1976, Vol. 193, No. 4250, pp. 295-299 and Chapter 4 of this guide for more information on Hawaiian fishponds in general and the "loko wai" type pond found at Kawai Nui.

8. Handy, E.S. Craighill, and E.G. Handy. Native Planters in Old Hawaii; Their Life, Lore and Environment (Honolulu: Bishop Museum Press, 1972), Bulletin No. 23, p.80
9. Ibid., pp. 42-43, 45, 76.
10. Ibid, pp. 57-58.
11. Kikuchi, op. cit., note 7, p. 296.
12. For diagrams and discussions of the various types of Hawaiian fishponds, their characteristic physical and biological features, see Chapter 4 of this guide.
13. Kelly, Marion and J.T. Clark, op. cit., note 6, pp. 9-10. For more detailed discussion of the legends and chants associated with Kawai Nui, see Chapter 2 of this guide, and the references cited therein.
14. Kelly, Marion and J.T. Clark, op. cit., note 6, p.7 and Chapter of this guide.
15. Keko'owai (1922) quoted in Summers, Catherine C. Hawaiian Fishponds (Honolulu: Bishop Museum Press, 1964), Special Publication No. 52, p. 22.
16. For more detailed discussion of these heiaus, consult the following references: Kelly, Marion and J.T. Clark, op. cit., note 6, pp. 3-4, and references cited therein. also, since both Pahukini and Ulupō Heiaus are on the National Register of Historic Places, the description of these heiaus' eligibility on the nomination forms is also useful. For Ulupō, consult the USDI/National Park Service nomination form compiled by B. Jean Martin, archaeologist with the Hawaii Register of Historic Places, 465 South King Street, Honolulu, as of September 23, 1971. For Pahukini heiau consult the same type of form, prepared by Jennifer Hunt Watts, also with the Hawaii Register of Historic Places as of September 23, 1971.
17. Sterling, E. and C.C. Summers. Sites of O'ahu (Honolulu: Departments of Anthropology and Education, Bishop Museum, 1978), p. 242.
18. Ibid., p. 218.
19. See diagrams and discussion of Kamehameha the First and his geneology, in Fornander, Abraham. An Account of the Polynesian Race, Its Origins and Migrations, (Tokyo: Charles E. Tuttle and Co., 1969), pp. 129-131 in Vol. II; and Appendix IX of Volume I, p. 204, showing Comparative Geneology of Nunalu and Ulu.
20. Pukui, Mary K. and S.H. Elbert, Hawaiian Dictionary (Honolulu: University of Hawaii Press, 1973), p. 387.
21. Sterling and Summers, op. cit., note 17, p. xii.
22. Lyons, Curtis J. (1875) as quoted in Kelly, Marion and Barry Nakamura. Historical Study of Kawainui Marsh Area, Island of O'ahu (Honolulu: Department of Anthropology, Bishop Museum, November, 1981), prepared for State of Hawaii, Department of Planning and Economic Development, p. 12.

23. This analogy of the Kawai Nui area to that of the "piko" or "navel" of the ahupua'a was borrowed from a presentation by Muriel B. Seto, Historic Sites Chairperson of the Congress of Hawaiian People at a Life of the Land sponsored Workshop on Kawai Nui Marsh, held on February 20, 1982, and supported by a grant from the Hawaii Committee for the Humanities.
24. Handy and Handy, op. cit., note 8, p. 457.

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25. Handy, E.S.C. "Government and Society", Chapter 3 in Ancient Hawaiian Civilization (Tokyo: Charles E. Tuttle Co., 1973), revised edition, pp. 35-36.
26. Wise, John H. "The History of Land Ownership in Hawaii", Chapter 7 in *ibid.*, pp. 83-86.
27. Summers, C., op. cit., note 7.
28. Fuchs, Lawrence. Hawaii Pono: A Social History (New York: Harcourt, Brace, and World, Inc., 1961), p. 4.
29. Wise, John, op.cit., note 25, p. 86.
30. Chinen, John. The Great Mahele, (Honolulu: University of Hawaii Press, 1974), p. 6.
31. Hutchinson, Ira. How the Hawaiian Land Boundaries and Titles Came into Being, a paper presented to Western Regional Land Appraisers Conference (undated), p.2.
32. Wise, John., op. cit., note 25, pp. 87-88.
33. Fuchs, Lawrence, op.cit., note 28, p. 16.
34. See discussion in Section 1.1 of this Chapter. See also Kelly, Marion and J.T. Clark, op.cit., note 6, p.15.
35. Kelly, Marion and Barry Nakamura, Historical Study of Kawainui Marsh Area, Island of O'ahu, (Honolulu: Dept. of Anthropology, Bishop Museum, November, 1981), a report prepared for the State of Hawaii Department of Planning and Economic Development (DPED), pp. 23-25.
36. *Ibid.*, p. 26.
37. *Ibid.*, pp. 117-120.
38. *Ibid.*, pp. 36-45.
39. Fuchs, Lawrence, op. cit., note 28, p. 90.
40. Kelly, Marion and Barry Nakamura, op. cit., note 35, p. 43.

41. Bowser, George (1880) quoted in Kelly, Marion and Barry Nakamura, op. cit., note 35, p. 46.
42. Liber 57:426-428, quoted in Kelly, Marion and B. Nakamura, op. cit., note 35, p. 60.
43. McAllister (1973) cited in Smith, Linda Lea. Development of Emergent Vegetation in a Tropical Marsh, a thesis submitted for Master of Science in Botanical Sciences (Honolulu: University of Hawaii at Manoa, May 1978), p. 25.
44. Personal conversation, Marion Kelly, Anthropology Department, Bishop Museum, Honolulu, 1982.
45. Editorial Comment on December 21, 1982, in the Pacific Commercial Advertiser, and quoted in Kelly, M. and B. Nakamura, op. cit., note 35, pp. 51-52.
46. Girvin (1901) quoted in Taylor (1929:6) and cited by Kelly, M. and B. Nakamura, op. cit., note 35, p. 52.
47. Takasaki et al., 1969:110 in Kelly, M. and B. Nakamura, op. cit., note 35, p. 73.
48. The Reciprocity Treaty of 1976 between the U.S. and Hawaiian Kingdom, allowed sugar, the most important commodity of Hawaii, along with other commodities such as rice, to be imported to the U.S. duty-free. This legal development encouraged a boom in the sugar industry in subsequent years. (See Kelly, M. and B. Nakamura, op. cit., note 35, p. 52)
49. Kelly, Marion and B. Nakamura, op. cit., note 35, p. 76.
50. Ibid., pp. 76-77.
51. As reported in Tax Assessor's Records of 1875 and discussed in Ibid., p. 67.
52. Ibid.
53. Bowser, George, quoted in Kelly, Marion and B. Nakamura, Ibid., p. 41.

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54. Neal 1965:71, cited in Kelly, Marion and B. Nakamura, op. cit., note 35, p. 63.
55. Quoted in Kelly, M. and B. Nakamura, Ibid., p. 64.
56. Manglesdorf 1951:135, quoted in Ibid., p. 100.
57. This story is taken from a newspaper story in the Honolulu Star Bulletin, Sept. 12, 1931, as cited in Kelly, M. and B. Nakamura, Ibid, p. 99.
58. Clarke 1949:12, cited in Kelly, M. and B. Nakamura, Ibid, p. 67.

59. Ibid.
60. Ibid., p. 67.
61. Ibid.
62. Kelly, M. and B. Nakamura, op. cit., note 35, p. 99.
63. Clarke 1949:13 in Ibid., p. 67.
64. Kelly, Marion and J.T. Clark, op. cit., note 6, p. 24 and Figure 13, p. 26.
65. This story is as reported in Kelly, Marion and Barry Nakamura, op. cit., note 35, p. 81.
66. Smith, Linda L., op. cit., note 43, p. 61.
67. Ibid, p. 61.
68. U.S. Dept. of Interior, Fish and Wildlife Service, Kawainui Marsh, (Honolulu: U.S. Fish and Wildlife Service, Division of Refuges and Wildlife Resources, August 1981), pp. 9-10.
69. Kelly, Marion and B. Nakamura, op. cit., note 35, p. 96.
70. See discussion of floods and flood control measures in Kelly, M. and B. Nakamura, op. cit., note 35, pp. 84-93.
71. For more background, see Kelly, M. and B. Nakamura, op. cit., note 35, 84 and Swain and Huxel (1971) as quoted in Ibid., p. 93.
72. Swain and Huxel 1971:1; Fig. 29, as quoted in *ibid*, p. 93.
73. Ibid.
74. Ibid., p. 96.
75. Ibid.
76. Swain and Huxel, 1971:16, in *ibid.*, p. 93.
77. U.S. Army Corps of Engineers, Honolulu District. Final Environmental Impact Statement, U.S. Department of the Army Permit Application for Olomana - Maunawili Sewer Projects, Kawainui Marsh, Oahu, Hawaii. (Honolulu: U.S. Army Engineer District, August 1981), p. 14
78. Kelly, Marion and B. Nakamura, op. cit., note 35, pp. 101-102.
79. Lee, Michael. "Investigation and Inspection of the Kailua Autowrecker, Inc. Yard on the Edge of Kawainui Marsh, Kapa'a, Oahu, Hi., A Memo for the Record" (Honolulu: U.S. Army Engineer District, March 8, 1976), as quoted in Kelly, M. and B. Nakamura, op. cit., note 35, p. 102.

80. Rate of garbage accumulation at Kapa'a sanitary landfill obtained from Doyle, Frank J., Chief, Division of Refuse Collection and Disposal, City and County of Honolulu, in presentation delivered at "Workshop on Kawainui Marsh", part of A Conference on Environmental Protection and Inflation, (February 20, 1982), sponsored by LIFE OF THE LAND and made possible by a grant from the HAWAII COMMITTEE FOR THE HUMANITIES. Data obtained from published Proceedings of conference, p. 111.
81. For insight into Hawaiian reaction to this shift in values toward the Marsh from pre-contact days of native Hawaiian sacredness association to modern day utilitarian attitude toward its usefulness as a dumping ground, see Kupau, Ella mae. "Dumping on Sacred Isle Soil", Honolulu Star Bulletin, (Aug, 23, 1978).
82. Horwitz, Elinor L. Our Nation's Wetlands, An Interagency Task Force Report, coordinated by Environmental Protection Agency (Wash. D.C. U.S. Government Printing Office, 1978), p. 1.
- This estimate of 40% irreversible U.S. wetland loss is a conservative one since it is based on data from the 48 continental states. For more information on the basis by which this estimate was derived, see Greenwalt, Lynn A., Director, U.S. Fish and Wildlife Service, speech delivered at the National Wildlife Federation annual conference, Louisville Kentucky, March 20, 1976, Department of Interior News Release, p. 2. Statistics on wetland losses appear in Chapters IV and VI, regarding discussion of wetlands.
83. Rice, Arthur as quoted in interview by Shepard, Moana Peterson, "Arthur Rice recalls His Early Kailua, O'ahu, Days," Honolulu Advertiser, June 19, 1949:6, cited in Kelly, M. and B. Nakamura., op. cit., note 36, p. 99.
84. U.S. Army Corps of Engineers, Honolulu District, op. cit., note 77, p. 13.
85. Kelly, M. and B. Nakamura, op. cit., note 36, p. 121.
86. Quoted in "Chamber Minority Refuses to Act on Kawainui Swamp Issue", in Pali Press, Vol. VI, No. 9, February 27, 1963. p. 1.
87. See "Million Plus Paid For Kawainui", Honolulu Advertiser, May 2, 1964.
88. U.S. Army Corps of Engineers, Honolulu District, op. cit., note 77, p. 13.
89. Hostetler, H. "Park Setback Seen Kawainui Center OKd" Honolulu Advertiser, December 1, 1972, B-1.
90. Costa, Carol. "'Let's make a deal?' Castle official, City must agree" in Sun Press, April 17, 1974, p. A-1.
91. Quoted in Pali Press, "Shopping Center Not for the Birds", December 20, 1972.
92. Bowan, Pierre "Saving the Koloa Maoli", in Honolulu Star Bulletin (December ?, 1974)
93. Quoted in Pali Press, op. cit., note 91.

94. For background on this petitioning effort and slide show development, see: "Kawainui Plans to be Aired", Sun Press, January 8, 1974; Bendet, Peggy. "A Park or a Parking Lot?" Honolulu Star Bulletin, Jan. 23, 1974, E-1, "Kawainui Discussion, Jan. 24" Honolulu Advertiser, Jan. 9, 1974; "Ad Hoc Committee to discuss the Kawainui Swamp", Sun Press, Feb 20-25, 1974; Bowman, Pierre "The Swamp is a Wonderful Marsh", Honolulu Star Bulletin, June 4, 1974, B-12.; Wolf, Peter, "Sen. Inouye Supports City Kawainui Plan", Sun Press, August 21, 1974.
95. Quoted in Tune, Jerry "No Shopping Center for Kawainui", Honolulu Star Bulletin, Sept. 18, 1974. p. 1.

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96. Information from Muriel B. Seto, citizen active in Lani-Kailua Outdoor Circle petitioning effort at the time.
97. Whitten, Harry. "70 Acres in Kawainui Get Conservation OK" Honolulu Star Bulletin, June 27, 1979, A-3.
98. For more insight into the landowner/developer point of view, see comments of Gordon Wong in LIFE OF THE LAND, Conference proceedings op. cit., note 80, pp. 115-120.
99. "Marsh Landfill Draws Fire", The WindWORD, Vol 1, No. 6, October 24, 1974, p. 1.
100. Seto, Muriel B. Chairman, Ad Hoc Committee for Kawainui, "Committee Opposes City Park, "a guest editorial in The Windward Sun Press, Oct. 1-7, 1975, A-5.
101. Seto, Muriel B. as quoted in Whitten, Harry. "The Potential for Kawainui", Honolulu Star Bulletin, September ?, 1974.
102. Information about process by which Robert Herlinger, A.I.A., proceeded to develop the citizen's Directional Park Plan for Kawai Nui as reported here, was obtained by personal interviews and observations (1981-1982). See also, for example, interview with Herlinger, reported by Wolf, Peter. "Kawainui Marsh Issue Heats Up" The Windward Sun Press, April 2, 1975.
103. Information obtained from notes of meetings maintained by Muriel B. Seto (1982).
104. Personal communication with Muriel B. Seto.
105. "Kawainui Swamp Resolution Adopted, "The Windward Sun Press, April 14, 1976; "Kawainui Swamp Study", Honolulu Star Bulletin, April 14, 1976. C-10.
106. "Feds. increase jurisdiction over wetlands, " Honolulu Star Bulletin, October 24, 1975.

107. SMA permit applications on O'ahu, in special management areas such as Kawai Nui Marsh, would be reviewed according to procedures, and criteria spelled out in the City and County of Honolulu Ordinance 4529, as amended, which regulates development within the coastal zone.
108. Section 306 (administration grants) of the National Coastal Zone Management Act of 1972 allows for State application for such federal grant monies.
109. Bone, Robert W. "Testimony Opposes Kawainui Project", Honolulu Advertiser (Wednesday, November 21, 1979), p. A-6.
110. See "OCZM Earmarks Funds for Kawainui Studies", in Hawaii Coastal Zone News (Honolulu: State of Hawaii, Department of Planning and Economic Development, November 1980), Vol. 5, No. 7, p. 1.
111. Murphy, Jerry. "Sewer Plan Endangers Historic Sites, Data", Windward Sun Press, September 24, 1980, Vol. XX, No. 36, p.1.
112. Murphy, Jerry. "Kailua's Kawainui Marsh Given OK for Registry Nominations" Windward Sun Press, Aug. 1 - Aug. 7, 1979; See also Kelly, Marion. "Kawainui Fishpond" in Historic Hawaii News, January 1980.
113. Whitten, Harry. "Early Kawainui Settlements Indicated", Honolulu Star Bulletin, Thursday, May 22, 1980, p. A-3; Kraft, John C. Letter to the Editor, "Geologist Pleas for Preservation of Kawainui", Windward Sun Press, Sept. 16, 1981, B-4.
114. As reported in Krauss, Bob. "The Kawainui Facts Could Swamp You", Honolulu Advertiser, Tuesday, February 5, 1980, p. A-3.
115. See quote from U.S. Senator Dan Inouye, in newspaper article "State Planners Set Terms of Kawainui Marsh Study" in Honolulu Star Bulletin, January 20, 1980.
116. See note 110.
117. Personal conversations with citizen group representatives Sandra Braun (for Lani-Kailua Outdoor Circle) and Muriel B. Seto (for Congress of the Hawaiian People) on the DPED - coordinated Technical and Policy Advisory Committee, working toward development of a resource management plan for Kawainui Marsh.
118. On September 14, 1982, in a letter to the City and County of Honolulu, the U.S. Army Corps of Engineers, Lt. Col. Kenneth Sprague issued a denial of a permit for the City's preferred sewer alignment through the marsh "in light of the overall public interest, the documents, and evidence,...as well as the stated views of agencies and the public."
119. As reported in Murphy, Jerry. "Pact Puts Conditions on Sewer Installation at Kawainui Marsh", Windward Sun Press, December 23, 1981, p. A-1. See also "Appendix D, Letters of Comments and Response" in U.S. Army Engineers Honolulu District, op. cit., note 77.

120. For background on the developments discussed in the text at this point, see Hartwell, Jay. "Most of 150 at Hearing Oppose Swamp Project" Honolulu Advertiser, Feb. 20, 1981, A-13. "Kawainui Marsh Proposal Draws Fire at Hearing", Honolulu Star Bulletin, Feb. 20, 1981; Murphy, Jerry. "Critics Blast Marsh Plan" Windward Sun Press, Feb. 25, 1981; Matsunaga, Mark. "Council Ok's Permit for Project on Edge of Kawainui Marsh", Honolulu Advertiser, April 11, 1981; and "Lawsuit Filed in Attempt to Halt Kawainui Project", Honolulu Advertiser, May 12, 1981, A-7.
121. Thus, for example, as recently as April 1982 over 1,000 people were attracted to a fund-raising event, "Malama Kawainui", put on by more than 70 civic organizations working to "Save the Marsh". See "Supporters Gather at Kawainui Marsh", Honolulu Advertiser, April 26, 1982, p. A-3.

Chapter 2. KAWAI NUI MARSH: ITS EVOLUTION AND SIGNIFICANCE AS SEEN FROM A HAWAIIAN CULTURAL PERSPECTIVE

Section 2.1 Introduction

Within all cultural traditions, there exists a fine line between fact and fiction. An examination of Hawaiian tradition bears no exception to this rule. History is a prism reflecting varied colors, depending on whose light shines on which facet.

Each culture retains its notable events, wisdom, and heroes of a previous age within its library, thus commemorating and perpetuating its history. The Hawaiian library was committed to the trained and disciplined minds of succeeding generations of expert chanters as a sacred trust. These were the physicians and astronomers, the temple priests and prophets - and most especially were the geneologists and hula masters entrusted with the chronicle of the past.

Arriving missionaries came from a world where their history was enclosed in books. They brought with them their own library in the written word, also religious in concept and, therefore, in conflict with the roots of Hawaiian culture. Literal-minded people, they were poorly schooled to comprehend the Hawaiian vision of reality present in age-old myths and legends, and were dismayed by "heathen" notions even while learning the language for the purpose of teaching natives to read and write. Themselves dependent on their written records, they marvelled at Hawaiian ability to quickly and correctly memorize whole chapters of scripture, all the while denying that it was possible to accurately retain traditions in this way. The notion that dance could encompass elements of historical truth was incomprehensible to missionaries who believed the dance to be wicked, and a pagan tradition to be suppressed.

There is a nice irony that, since Western contact, Hawaiian history has been preserved through both written literature and oral tradition. Credit is due those who taught Hawaiians to write, and whose students left behind them a wealth of material, much of which has still not been translated into English; and to Kalākaua, last king of Hawai'i, who may have rescued chant and dance from extinction. Gratitude is also due those die-hard masters in the hinterlands who refused to believe their work was disreputable and remained practitioners of the forbidden arts, continuing to teach a chosen few. And, finally, these days of "renaissance" owe much to those westerners of the last century who collected stories, chants, mele, etc.; and to the keenly observant visitors who recorded their impressions of these Islands and their people, as they found them.

The "accuracy" of the existing body of tradition is sometimes called into question, perhaps unfairly. A chant, for example, may be the story of a legend, the conversation between two lovers, or a proclamation to the gods. In any case, it is of historical significance. Its contents gives us an idea of what was important to Hawaiians before Western influence. Legends reveal clues to us about what were the lifestyles, values, mores, beliefs, traditions, and sources of entertainment for the Hawaiian people of long ago. Some legends have been altered to conform to biblical traditions introduced to Hawaiians in historic times, while others are so ambiguous with ancient allegories that the present-day mind may not comprehend

their full meaning. Thus, it is imperative to remember that some Hawaiian legends preserved in oral tradition and written literature are altered to suit the perspective — biblical, geneological, political, or otherwise -- of the one who performed the translation. However, they do represent a source of clues to a sometimes mysterious past and can be studied for purposes of education, enjoyment, and archaeological research.

Compared to Kawai Nui, few other areas have as many landforms named for legendary persons, or myths spanning nearly 2,000 years of Hawaiian habitation. Now, one of the oldest known agricultural sites in Hawai'i has been found on the former shores of Kawai Nui, in the vicinity of the fabled Makalei tree²; and it appears that the landform, itself, has evolved from a saltwater to freshwater body within the Hawaiian period of residency in the area.³ Just as Bible stories of the Middle East and the classic mythology of Greece have led archaeologists to new discoveries illuminating those ancient peoples, so may fresh understandings of Hawaiian literature lead archaeologists to new understandings of the evolutionary Hawaiians at ancient Kawai Nui.

There are numerous legends and chants that make reference to the Kailua Ahupua'a. However, rather than list them all, a representative few will be discussed to emphasize the importance of Kailua. Kailua, and specifically the Kawai Nui area is known for numerous outstanding features and figures of cultural and historical significance. In order for the reader to get a "feel" for the Hawaiian folklore from which these features and figures have been identified, the next section will explain the legends behind how they became associated with Kailua and Kawai Nui in the first place.

Section 2.2 The Legends

Any land far from the Hawaiian Islands was referred to as "Kahiki". Within this distant area there existed many beautiful places from which the Hawaiian was said to come. Some of these places — Pola Pola, Nu'umealani, Uluka'a, Kapa'ahu, and Moa-'ula-nui-akea, for example -- are names of actual islands and island districts to the south. Others like Kanahunamoku, Kuaihelani, Hapakuela, Kealohilani, and Mokumanamana refer to god-lands with mysterious and often unstable characteristics. Kanahunamoku, for example, was described as a floating spirit world or dream land that appeared, disappeared, and moved in response to the commands of its controlling god. These were the homes of the Hawaiian ancestors. Traveling to and from them was common in ancient times.⁴ (See Fig.2.1)

Mo'oinanea (self-reliant dragon) was a demigoddess with greater power than Ku, Kane, Kanaloa or Lono (the four major gods of the Hawaiian Islands). She lived in Kuaihelani and was responsible for caring for the children of the gods. She took one child, an exceptional little girl named "Hina", to live with Ku and later bear his children.

Meanwhile, Kane and Kanaloa who lived in Waolani, Nu'uauu, on the Island of O'ahu, built a home for the first child of Hina. She had a boy named "Kahanaiakeakua". Anuenue, Kane and Kanaloa's rainbow sister, went to fetch the boy and bring him to O'ahu to Waolani. There he would be cared for by menehune and e'epa. The menehune are small gnomes, and the e'epa chosen were the ugliest, deformed ones so that there was little chance of the boy falling in love with any of them.

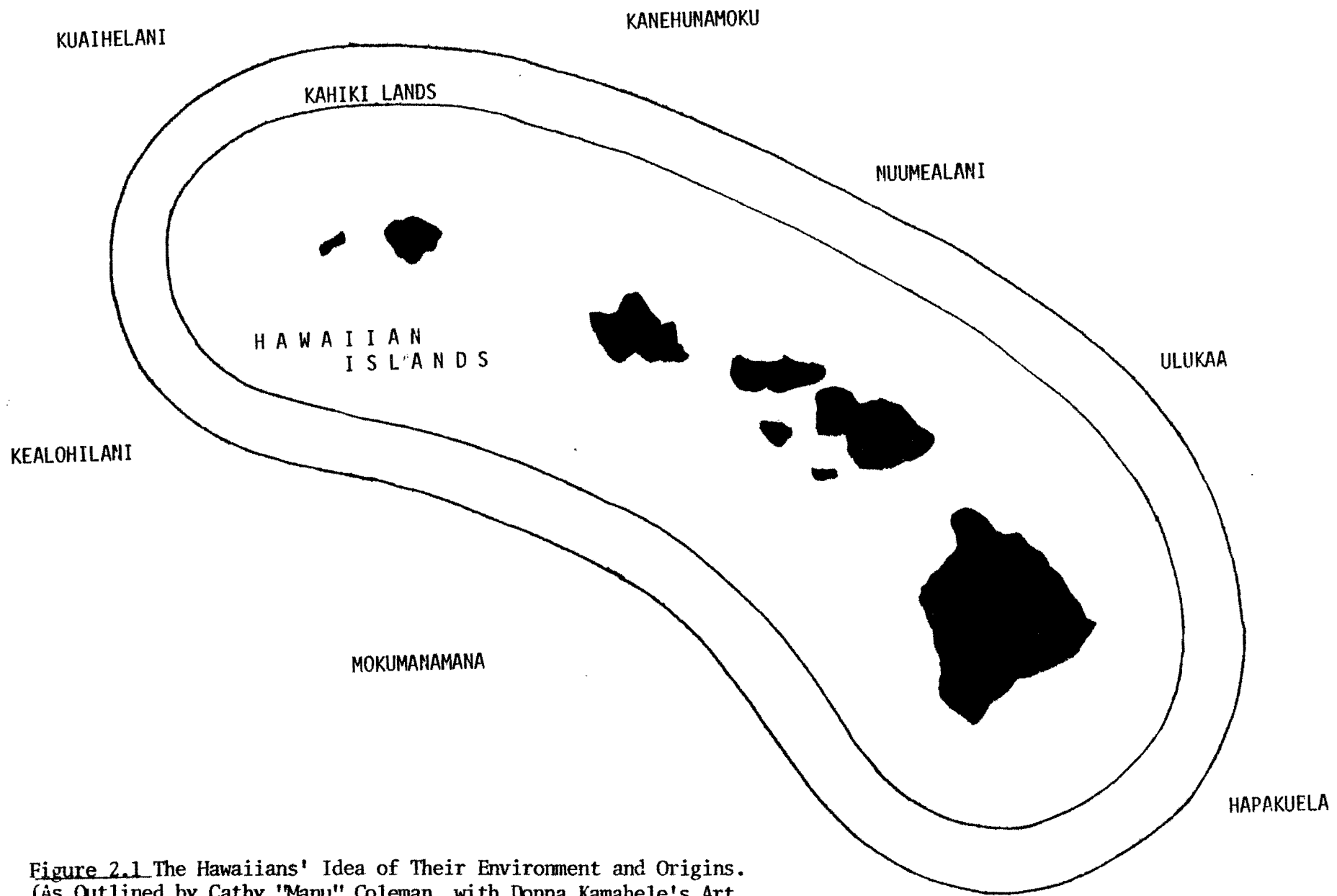


Figure 2.1 The Hawaiians' Idea of Their Environment and Origins.
(As Outlined by Cathy "Manu" Coleman, with Donna Kamahele's Art Assistance)

The next child of Hina and Ku was a beautiful girl named Paliula. Kane sent two of his daughters to fetch this child. They rode the great bird 'Iwa to the sacred land of Kuaihelani, found the child, and took her to the mo'o keeper Waka on the Island of Hawai'i. Waka asked Mo'oinanea to send two magical trees from the land of Nu'umealani. The first, Kalalaikawai, was a food tree with powers of attracting a wealth of vegetable food. The second, Makalei, was responsible for attracting great swarms of fish. Mo'oinanea gave these trees to 'Iwa, and they were brought to Waka at his home near Hilo.

When Paliula and Kahanai grew older, they were brought together to be married in Hilo, and they lived in a nearby district in a fantastic home built of yellow mamo feathers. This district was subsequently named Paliula, in honor of the girl. Before this marriage, Hina and Ku had another daughter so beautiful and special that she was born from Hina's head when Hina was sleeping. Her name was Keaomelemele and she was brought up in the shining land of Kealohilani. Soon after Keaomelemele's birth, Ku and Hina separated. Ku married Hi'ilei, and Hina married Olopana. This was common of gods. Hina, especially, was noted for marrying many gods and giving birth to many children. Ku and Hi'ilei had a red-skinned boy named Kaumailiula who went to live in Kealohilani with his half-sister Keaomelemele. When these two were old enough to be married, Mo'oinanea asked Ku, Hi'ilei, Hina, and Olopana to prepare their magic ships for a final voyage. Mo'oinanea felt that they would all now settle in our islands.⁵ (See Figure 2.2)

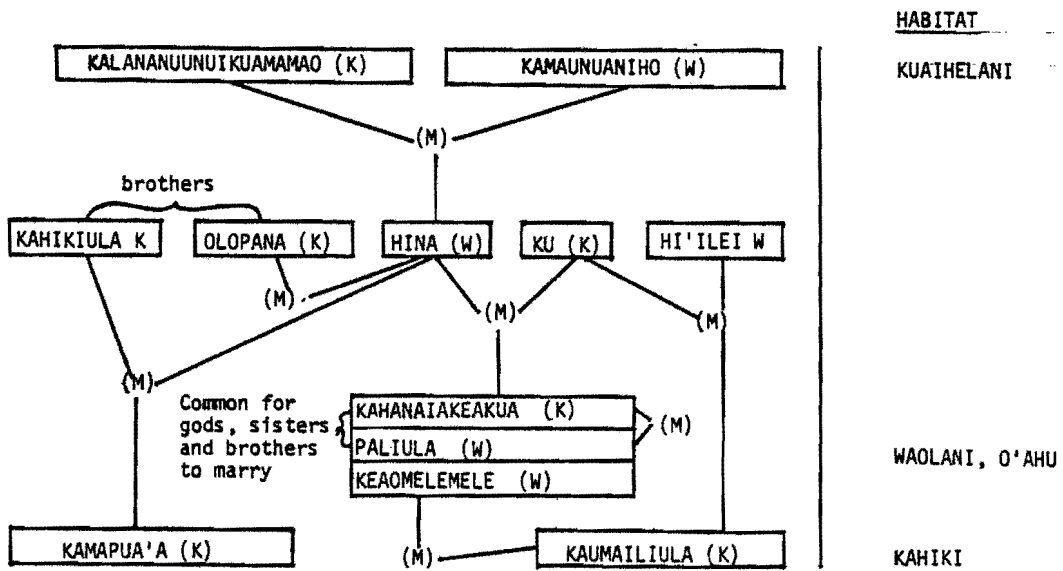
Section 2.3 The Significance of Kailua Ahupua'a

Mo'oinanea brought all the dragons with her, and they landed in He'eia, on the windward side of O'ahu.⁶ The dragons were spirit servants of the gods. Some had reputations as the most terrible kupua — demons -- of the ghost lands. Others were just and benevolent; when properly treated, they brought prosperity to the people of their districts. Kawai Nui became the home of one of the gentler dragons, the mo'o Hauwahine. In celebration of the marriage of Kaumailiula and Keaomelemele, Waka brought the two trees from the Big Island. The food tree entered Waolani without incident, but as the Makalei rose at the foot of the Pali, the menehune and e'epa of Nu'uaniu, thinking that this was a mightily kupua come from Kahiki to destroy them, raised a great shout which broke the kapu of silence and sent the Makalei tumbling into Kawai Nui. This is one of the legends of how the Makalei tree came to Kailua.

Chief Olopana and his wife Hina settled in Ko'olaupoko and established many heiau there. Pahukini and Holomakani, constructed on the rim of Kawai Nui, were two of the five heiau credited to this chief. Hina and Kahikiula (Olopana's brother) sired the notorious pig-man Kamapua'a. Kawa'ewa'e Heiau near Kailua is the site at which Kamapua'a, against all odds, tricked and killed his uncle, Olopana.⁸

The Kailua ahupua'a supported one of the largest populations of old Hawai'i. Taro and fish were raised in great abundance, and the area was a favorite among chiefs. One legend asserts that Kane, Ku, and Lono made the first man, Kanehulihonua, out of soil — and the first woman, Keakahuilani, from his shadow — at Mōkapu.

The navigator chiefs Paumakua and Kaulu-a-kalana were based in the Kailua area. The former is said to have sailed to the ends of the world, to have returned



LEGEND

(K) - KANE; MALE

(M) - MARRIED

(W) - WAHINE; FEMALE

HAWAIIAN ISLANDS

FOUR MAJOR GODS

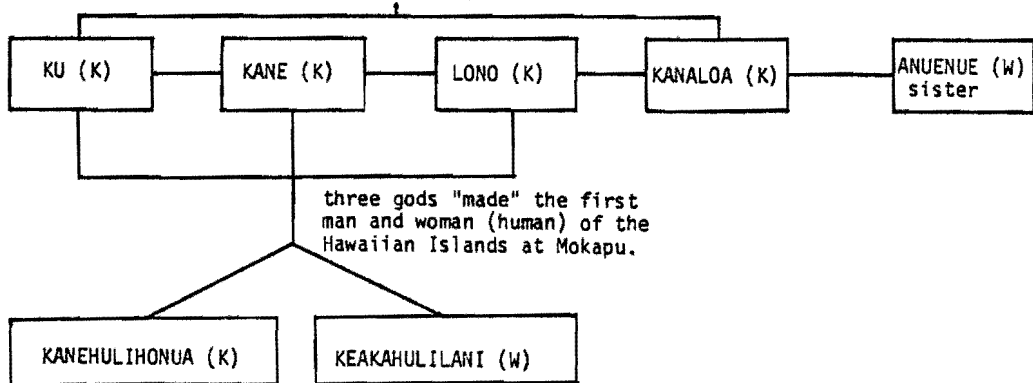


Figure 2.2 The Geneological Documentation of the Settlement of Kailua Ahupua'a, Ko'olaupoko, O'ahu by the Gods and People (As Outlined by Cathy 'Manu' Coleman, to Illuminate the Text)

with two white priests whose lines extend to historical times, and to have introduced circumcision to the Hawaiians. The latter is credited with sailing to the pillars of Kahiki and with bringing to Kawai Nui the edible mud, lepo ai 'ia.⁹

Kakuhihewa, a legendary 16th century high chief, ruled O'ahu from Pamoā, his expansive government house on the plain of Alele in central Kailua. His great-grandson, the famous Kualii, renamed this royal complex Kalanihele. In both reigns, the site was recognized as a veritable Paris of the Hawaiian chain.¹¹ The adjoining district of Waiaua (between Ulu po and Kailua town). was home to chiefs of such high lineage that they out-ranked chiefs of any other area. When an outsider desired entrance to Waiaua, he had to prove his lineage by jumping over the crossed arms of Waiaua's royalty. Only then could he set foot on this sacred land.¹²

Kailua was one of the first places to which the menehune were assigned. They were brought here by an ancestor of Paumakua's who stretched out his arms to kahiki, thus making a bridge for their safe passage.¹³ Menehune were credited with constructing the heiau of Ulupō -- the most prominent of Kawai Nui's temples.¹⁴ The little people were responsible for linking Waimea, Kaua'i, with Kailua. Menehune building a dam and waterway in Waimea Canyon rejoiced at their work. So great was their jubilation that the birds of Kawai Nui heard them and flew upward in excitement.¹⁵ It was also said that drums beaten at Ulupō could be heard in distant Waimea.

Another legend speaks of Olomana, a special guardian attendant of Haumea and the konohiki -- overseer -- of the Kailua fishponds. When he became overbearing, Olomana was killed by a Kaua'i warrior named Palila. The konohiki was cut in half; his head flew towards Kaneohe, becoing Mahinui Ridge; his decapitated torso became Olomana, the peak overlooking Kawai Nui.¹⁶ (See Fig.2.3)

As mentioned earlier, the people of Kailua were fortunate to have their own mo'o: Hauwahine. Hauwahine protected⁷ the health and welfare of Kailua's residents and assured an abundance of fish. She took several forms. Most often she appeared as a long, black, terrifying dragon. In this form she was so massive that she was described as moving through Kawai Nui like the hull of a canoe. At others times, as indicated in a legend from the Pele cycle, Hauwahine took on human form. While passing through Kailua, Pele's younger sister Hi'iaka and Hi'iaka's companion Wahine-oma'o, saw two beautiful women bathing in the stream that connected Kawainui and Ka'elepulu. Hi'iaka informed Wahine-oma'o that these two were really mo'o. To prove her point, Hi'iaka began to chant:

Kailua is like hair tousled by the Malanae wind
The leaves of the 'uki are flattened down
You are startled as though by the voice of a bird
You think they are human
But they are not
That is Hauwahine and her companion
The supernatural women of peaceful Kailua

The women suddenly disappeared into the waters, and Wahine-oma'o was convinced of their kupua nature. Hi'iaka explained that one of the mo'o was Hauwahine, and that the other was her companion who belonged to the hala grove on the level place close to the pond of Ka'elepulu. Hauwahine's presence, Hi'iaka concluded, was known when the plant-life of Kawai Nui changed from green to yellow.¹⁸

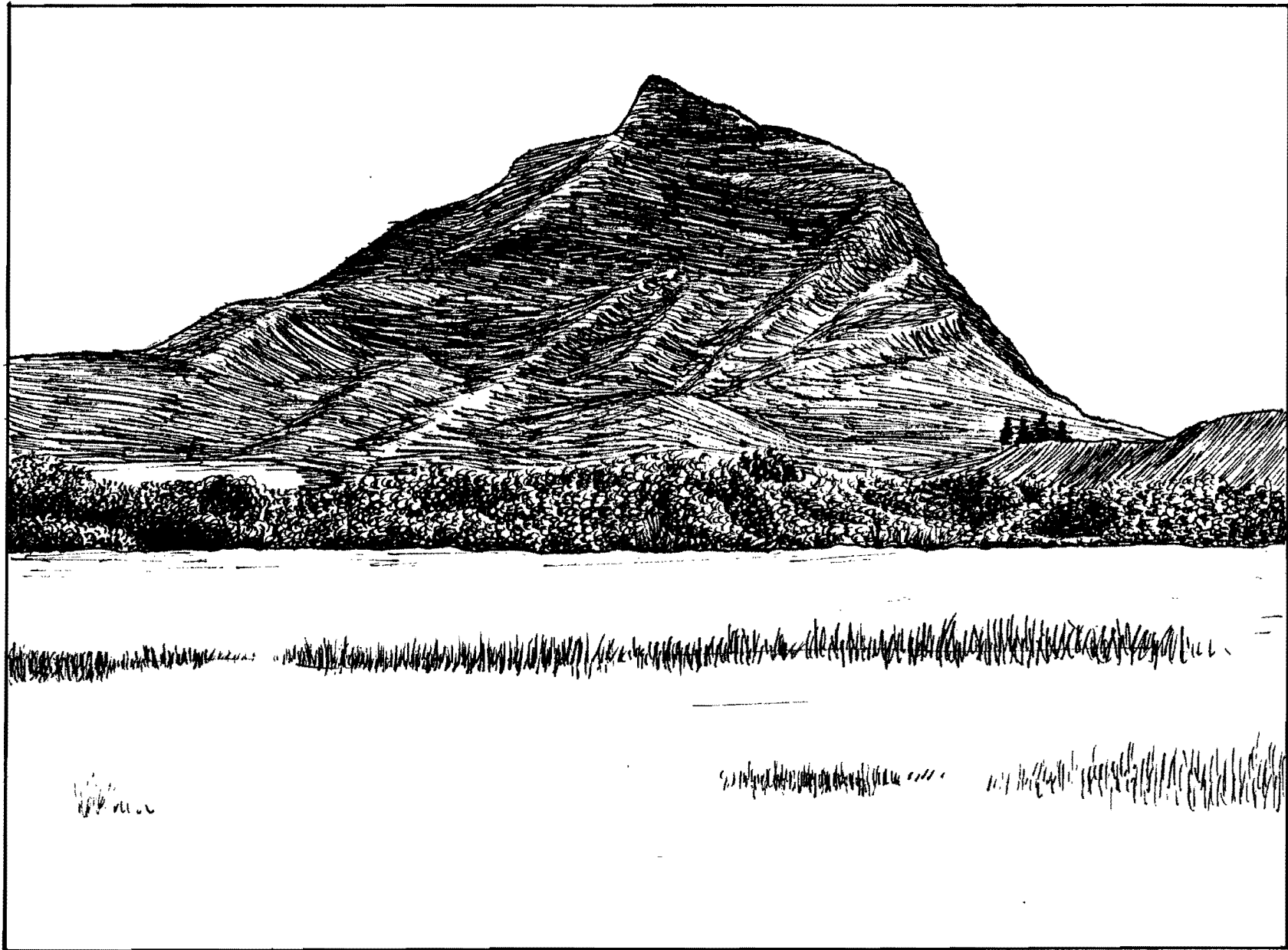


Figure 2.3 Mt. Olomana Overlooking Kawai Nui Marsh (Artist: Donna Kamahele)

Kawai Nui was the only area in Hawaii known to contain lepo ai 'ia. Lepo ai 'ia was an edible mud brought from the pillars of Kahiki by Kaulu-a-kalana when the Islands were first inhabited by the southern gods and goddesses. It was a thick, poi-colored, haupia-like substance found in the depths of Kawai Nui. A kapu was imposed during the gathering of the sacred mud. No one was allowed to speak while diving for it. If the kapu was broken, ordinary mud would rise to engulf the diver. Kamehameha I and his warriors were served lepo ai 'ia when Kailua experienced a taro shortage.¹⁹

Kailua also possessed the Makalei, a famous fish-attracting tree. Some legends give the southeast corner of Kawai Nui as the fixed location of Makalei. Other legends move the Makalei — in branch form — from place to place in the Kailua district.²⁰ One such legend describes Haumea's punishment of Pakui, a pondkeeper under Olomana's rule. When Pakui allocated Kawai Nui's fish to Kailua's people, he disregarded Kahinihiniula, a red-headed boy of Haumea's family line. In her rage, the goddess removed the Makalei to a mountain stream in Maunawili so only Kahini and his grandmother, Neula, could benefit from its fish-attracting powers. The Makalei was returned to Kawai Nui only after Pakui discovered the boy and his grandmother and atoned for his oversight.²¹ These and other legends are referred to in poems that were composed long ago and that have survived the years in both a handful of increasingly popular chant anthologies and in a largely untranslated and unindexed scattering of Hawaiian language newspapers. Additionally, the Hawaiian renaissance of the past decade and a surge of interest in the cultural significance of Kailua have inspired the composition of new Hawaiian chants for the area. Several chants that are relevant to Kawai Nui are reproduced and translated in the following section.

Section 2.4 The Chants

It is difficult to place chants in chronological order, other than the date of written publication or by the date of certain words.

This section includes only a handful of chants out of the many that exist dealing with Kailua and Kawai Nui. At the end of this section there is an index of chants for those who wish to pursue further study of this subject.

For those who are not familiar with Hawaiian chants, or how they are studied, it is important to note that most Hawaiian songs and chants have at least two meanings: the literal and the kaona or inner meaning. The literal meaning is like the body and the kaona, inner meaning is like the spirit.

It will also be helpful to have a background of some names and places that are commonly referred to and that have importance. Below are some of those words.

HAUWAHINE:	mo'o goddess and guardian of Kawai Nui
NEULA:	female demi-god of Maunawili, mother or grandmother of Hinihiniula
AHIKI:	overseer of Kawai Nui; also a peak of Olomana

OLOMANA:	chief; guardian mountain of Ko'olaupoko
PAKU'I:	peak of Olomana
KAWAINUI:	largest freshwater fishpond; marsh
ONEAWA:	Kailua beach
MAHINUI:	a mountain on northern rim of Kawai Nui
KAIWA:	Lanikai ridge
ULUMAWAO:	mountain flanking Kawai Nui, O'ahu husband of Pele
MOKULUA:	twin islands off Lanikai
AKAKA:	fishing ground off Kailua
ULUPO:	heiau situated on border of Kawai Nui; a manifestation of the primary god, Kane.
ULU MANO:	a strong Puna/Ka'u wind
MALANAI:	sea wind of Kailua
MAKALEI:	fish attracting tree
LEPO AI IA:	edible mud
MOKULANA:	real translation is not easily obtained or understood, but it is interesting to note that out of all the chants researched so far, it is only used about three times. Maybe with further research, it will be found more often.

Some background information concerning mo'o in general, and Hauwahine, in particular, may be helpful, and for the Makalei tree as well.

Mo'o worship was brought to Hawaii. Mo'o are the gods of the royal Oropa'a family of Tahiti. The ancestor that brought the mo'o was the leader of them all, Mo'oinanea. Mo'oinanea, as indicated earlier, was a demigoddess with remarkable powers. The mo'o gods are often keepers of fishponds. They provide an abundance of food for the people, and keep this supply in abundance if no wrong doing is done to or by the people. It seems that these mo'o guardians of fishponds are often female. They are described as being six to fifteen feet long and black in color. They are able to change their body forms, but are not often seen. The presence of mo'o is known when the trees, grasses, and weeds begin yellowing in color. It has been said that people have disappeared for days and then have come back with a loss of wits and delirious, saying they had been with a mo'o goddess.²²

Hauwahine is the mo'o guardian of Kawai Nui. She is also sometimes referred to as the mo'o guardian of Ka'elepulu pond as well. Old timers of Kailua claim that

Hauwahine never left Kawai Nui to go elsewhere. She is a symbol of the wealth of Kawai Nui fishpond, and is the spirit caretaker of the pond and Kailua's people. She took away the food supply²³ from the pond following wrong doing, or if the pond was not properly maintained.

The Makalei tree is another symbol of wealth for Kawai Nui. As stated earlier, in the Legend Section of this chapter, the Makalei is the legendary fish-attracting tree. Its presence was one reason why Kawai Nui was blessed with multitudes of fish.

Hauwahine and the Makalei are thus both symbols of the wealth of Kawai Nui. Some chants about Hauwahine and the Makalei are printed below:²⁴

HO'OPUKA E KA LĀ KAI O MOKULUA

(Kihei de Silva, 1981)

Ho'opuka e ka lā kai o Mokulua	<i>The sun enters at the sea of Mokulua</i>
I puka ka 'ike a ka 'iwa i Akaka	<i>So too does the vision of Ka'iwa at Akaka</i>
Ma 'Oneawa ua pae Ka-lau-o-ke-kahuli	<i>the tree of changing leaves has come ashore at 'Oneawa</i>
Ma Waiāuia ua lālā Makalei	<i>At Waiāuia, the Makalei spreads</i>
Ko'iawe ka līhau pili mai Kawainui	<i>(and) the līhau rain moves close to Kawainui</i>
Ua kanikani kō Hauwahine kua	<i>Rain falls musically on Hauwahines back</i>
Ehene kani'ahē ka mo'o ho'opua i ka la'i	<i>Laughing softly in delight is the mo'o resting in the calm</i>
Pua'i mai nā lau hā'ama	<i>The yellowing leaves emerge</i>
Mai lalo mai nā lau 'omao	<i>from beneath the green</i>
He hālonā ia no Hauwahine	<i>This is a sign of Hauwahine</i>
E nā mamo o Haumea	<i>O children of Haumea</i>
Ua like me ka Malanae-haehae	<i>You are like the sea wind Malanae-haehae</i>
E lū ana i ka pua 'ilima, e ku'i ana, a pa'a 'ia	<i>Scattering 'ilima blossoms, stringing them, carrying them</i>
E lei ana ia ka wai Kawainui	<i>To wreath the waters of Kawainui</i>
E nā mamo o Haumea	<i>O children of Haumea</i>
O Kawainui; ia wai Kawainui	<i>Kawainui, whose is Kawainui?</i>
Ia Hauwahine no	<i>It is Hauwahine's</i>

The place names in this chant are all of the Kailua area. Mokulua, Akaka, Kawainui, Waiuia, Oneawa, Kailua. Hauwahine and the Makalei are also in the chant. The chant seems to be showing the procession of how the Ka-lau-o-ke-kahuli tree came to 'Oneawa, and where the Makalei became rooted. In the second verse, the presence of Hauwahine is made known. In the third verse a deeper symbolism is taking place.

The whole chant is like a peaceful day unfolding. The sun emerging, an 'iwa (frigate bird) soaring above, a light rain falling, Hauwahine resting, and 'ilima blossoms floating on the water — all events of a calm day. There is a kaona taking place and as said earlier it is realized in the ending of the third verse. The question: Whose is Kawainui?, The answer: Hauwahine's. The chant is showing there is a rich history associated with Kailua and Kawai Nui.

The sun emerging is not just the sun but a whole new perspective and understanding. The tree of changing leaves has come ashore. Could this be the changing views and attitudes that have come? "The lihau rain moves close to Kawainui!" Could this be that changing attitudes are coming again to Kawai Nui?; changes toward the realization of what it once was and what could be done with it? "The yellowing leaves emerge — could this be the importance of Hauwahine and what she symbolizes; of the culture that is emerging? It is the children of Haumea who will finally have this understanding, who will bring about much more than a new day, but a new understanding as well.

'O'OE NO PAHA IA

(title assigned)

'O'oe no paha ia, e ka lau o ke aloha	<i>Perhaps you are she, the leaf of love</i>
'Oia no paha ia ke kau mai nei ka hali'a	<i>Perhaps this stirs my memory</i>
Ke hali'a-li 'a mai nei ka maka	<i>Remembering her presence</i>
Mana'o hiki mai no paha au ane'i	<i>She might still come</i>
Hiki mai no la ia, na wai e uwē aku?	<i>But when she does, who will cry out?</i>
Ua pau kau lā, kau 'ike iaia.	<i>Your day is gone, your understanding of her</i>
Ka manawa 'oi e ai ka mana'o iloko	<i>The feeling is intense, desire gnaws from within</i>
Ua lu'u iho nei au i ke kai nui	<i>I've been swallowed in the great ocean</i>
Nui ka 'uki'uki, paio ka na'au	<i>Great is my turmoil, my soul is in strife</i>
A'ohe kanaka 'eha 'ole i ke aloha	<i>No man is unhurt in love</i>
A wahine 'e 'oe, kanaka 'e au	<i>You are the absent woman, I the estranged subject</i>
He mau 'alu'alu ka ha'i e lawe	<i>Our parting was difficult to bear; we are mere husks of our former selves</i>
'Ike aku i ke kula i'a o Kawainui	<i>Look at Kawainui, the fish container</i>
Nui ka 'ōpala 'ai o Mokulana	<i>It is filled with 'opala-food at Mokulana</i>
Lana ka limu pae hewa o Makau wahine	<i>Limu clogs Makau-Wahine</i>
ʻO ka wahine no 'oe, 'o ke kane no ia	<i>You are the woman, he the man; Hauwahine the goddess, Kane the god</i>
Hiki mai no la ia, na wai e uwē aku?	<i>If she comes, who will wail?</i>
Ho'i mai no la ia, a ia wai e uwē aku?	<i>If she returns who will acknowledge?</i>
(from: Emerson, <u>Unwritten Literature of Hawaii</u> , 1909, p. 82)	

This chant at a first reading appears as a love story. A sad love story where the love of someone is lost. In the first section, the speaker is remembering his love. In the second section, he is feeling anger and turmoil. In the last section, he is describing Kawai Nui, perhaps comparing the decaying state of the fishpond to his feelings of love or toward himself.

The last two lines of the first and last sections, as well as the whole last section itself, are clues that there is a kaona to this chant. The speaker is remembering someone, and her presence. He does not actually state or describe a bodily person but a presence. The last two lines of this section also give a clue to who is this presence. They imply Hauwahine, not as obvious at first as when you look deeper into the chant.

The second section describes the feeling this speaker is experiencing. He is uneasy and troubled. His love for Hauwahine may not be a physical love but a love for what she stands for and how she was linked to Kawai Nui. He knows with her gone, the pond will decay. This section has an undertone of anger at how there is a loss of a dying culture. He realizes no one knows the old ways, and that no one wants to respect the old traditions anymore.

The third section is like the final piece to the story of a lost respect for the traditions of a culture. Kawai Nui is full of 'opala ai, edible rubbish. This is probably a reference to rice. The rice cultivation is taking over and the pond's purpose or use as a main fish supply is being forgotten, thus it has become neglected. It is becoming overgrown with 'opala. The last two lines sum it up. "Hiki mai no la ia, na wai e uwe aku?" If she comes who will wail? "Ho'i mai no la ia, a ia wai e uwe aku?" If she returns who will acknowledge?

If Hauwahine returns, who will know her, who will remember her? The speaker, through these questions, is expressing his concern, anger, and sense of loss for the old traditions. Hauwahine left the pond because of its neglect so it is slowly decaying. If the pond is restored, will anyone remember how to recognize the signs of Hauwahine? The chant is much more than a love story; it is about someone who sees much more than a fishpond disappearing.

A PO ULUPŌ

(Kihei de Silva, 1981)

A pō Ulupō i ka aulia manu	<i>Ulupo is blackened in the flight of birds</i>
'O ka 'upena 'apo'apo i ka lā	<i>a net snares the sun</i>
'O ka lawai'a lu'u i kō Kawainui keke	<i>A fisherman plunges in mud</i>
'O ka leleo kē, pala i ka walha	<i>The voice: a (filth) coated mouth</i>
Lilo ka lawai'a, lalo i ka wai	<i>The fisherman is lost, taken under</i>
Nalo ka la'au lālā Makalei	<i>The tree is gone, branching Makalei.</i>
<u>kahea:</u> a'ole paha.	<i>Perhap not</i>
Pā hane (la) ka makawao o ka hūnalo	<i>Hinalo fragrance blows faintly</i>
Me he leo hinihini kani mai iluna	<i>like a tree shell singing from above</i>
'O Kailua me he hinihini-ula	<i>Kailua is like mountain moss,</i>
Huluhulu puehu i ka Malanai	<i>ruffled feathers in the tradewind.</i>
Ka mo'opuna 'ehu'ehu a ka mo'o Neula	<i>The red headed child of mo'o Neula</i>
Kō maunawili pua nona Makalei	<i>perhaps Makalei is for this child.</i>
<u>kahea:</u> pela paha.	<i>perhaps so</i>

'O ka lā hāweo, he kī'eke 'ilima ma Ka'iwa	<i>The sun glows, a basket of 'ilima at Ka'iwa</i>
Makani Ulu-Mano, he hānai kui-lima ma Pu'u Pua'i	<i>The wind Ulu-Mano; a needle joining hands at Pu'u Pua'i</i>
Pua'i mai (la) ka hulu weo mai loko mai (la) ka hapapa 'ele'ele	<i>A glow appears from within the black crust</i>
Eia nā wāhine apo pua nā wāhine hele malu o ka lālā ola	<i>Here are the women who encircle flowers, The women who walk in the shade of living branches</i>
Ho'olālā na pualei a'o Makalei <u>kahea</u> : ae, a pau ka mehameha a Ahiki	<i>The children of Makalei branch out yes, the loneliness of Ahiki is over.</i>

This chant may seem to be describing a day's events taking place, as does the chant HO'OPUKA. It follows a kind of succession. The first section is dealing with a broken kapu. There is an area of Kawai Nui where there is said to be lepo ai 'ia, edible mud, which — in times of famine — divers would bring up to eat. When a diver dove down to retrieve the lepo ai 'ia, no one was allowed to speak. If someone did, the diver would be swallowed up by the mud. This is what is happening in the first section. "A po Ulupo i ka aulia manu" Ulupo is blackened in the flight of birds, which is a sign that something has happened. A diver has been lost and the Makalei has been stolen. The kahea, perhaps not, indicates there is more to the branch being stolen than what is said.

The second section at first seems to be a description of the Kailua area. The last three lines hint at something else. The ruffled feathers indicate that some angry feelings may be going around. Then the red headed child of mo'o Neula which is Kahinihiniula, is linked with Makalei. Could it be the kahinihiniula took the Makalei? In the legend section there is a story about Kahinihiniula and the Makalei. This chant may be linked to this legend.

The last section is one of calmness or harmony. This would suggest that all has been put back to right. The last two lines would suggest that the tree was put back and that everything is as it once was.

The following chants and translations are followed by only a brief review. The first four are the ones that are the most obvious in talking about the Kawai Nui/Kailua area. The others are not as obvious but still have importance in the Kawai Nui/Kailua tradition.

KI'EKI'E ILUNA KE KU O AHIKI

(title assigned)

Kiekiē iluna ke ku o Ahiki	<i>Lofty is the peak of Ahiki</i>
Holo ana ke aka ilalo o Kawainui,	<i>Its image sails below on Kawainui</i>
Nana a'e be, oki ke alo o ka pali,	<i>Look out there, the pali's face i wonderous</i>
He maika'i 'oko'a no mailuna lalo e	<i>A smooth, sheer cliff from top to bottom there</i>

Ilaila no māua me ka Malanai,	<i>There we two are in the Malanai wind</i>
E wehe aku ana i ka poli o ke 'uki	<i>Opened are the leaves of the uki,</i>
'Ūwī pū me ka neki o Mokulana	<i>Joined beautifully with the bullrushes at Mokulana</i>
Me ka ía ho'opā'ili kanaka i ka wai e laila	<i>And the fish attracting skins of the people in the water there</i>
A he waiwai no ko ka hale o ku'u aloha	<i>A treasure for the house of my love</i>
N'ou ka hewa i ke kipa'ole ana mai	<i>Mine is the fault for the lack of visitors</i>
Oe anei e	<i>Are you here? Is it you?</i>
(from: <u>Ka Nupepa Kuokoa</u> , 2-10, 1922; Translation: Kihei de Silva)	

This chant at first is a description chant, describing a breathtaking view. The wealth of the speaker's surroundings is the treasure for his love. The last two lines take on a different tone. The speaker is blaming himself for lack of visitors, which seems to be the reason that his loved one has left. The chant has a sexual kaona. The first two lines describe the shadow of Ahiki falling on Kawai Nui. The description of Ahiki as a smooth, sheer cliff from top to bottom gives emphasis to the maleness of Ahiki. "There we two are" would be the speaker speaking of him and his love as he is comparing them to the Ahiki/Kawai Nui relationship. Below Ahiki, Kawai Nui is spread out with uki grasses and bullrushes. The reflection of Ahiki is joined beautifully with the bullrushes. This love relationship has gone wrong, so this chant could be one of remembrance of what he once had.

'O KAILUA I KE OHO O KA MALANAI

(title assigned)

O Kailua i ke oho o ka Malanai	<i>Kailua in the leaf of the Malanai wind. The wind tousles the hair/growth of Kailua</i>
Moe e ka lau i ke 'uki,	<i>Asleep on the leaves of the 'uki, flattened are the leaves of 'uki</i>
Pūiwa i ka leo o ka manu,	<i>Startled by the voice of the bird</i>
E kuhi ana 'oe he wahi.	<i>You suppose that she is a woman</i>
'Āole--a	<i>No</i>
'O Hauwahine ma no kēlā,	<i>That is Hauwahine and her companion</i>
'O nā wahine o Kailua i ka la'i	<i>The women of Kailua in the calm</i>
(from: <u>Ka Hoku o Hawaii</u> 12-15, 1925; Translation: Kihei de Silva)	

This chant is one which Hi'iaka chants to her companion to say that the two women they come upon are not women, but really mo'o. This story is found in the earlier Legend Section of this chapter.

KE AMO 'IA A'E LA KA WA'A MA KAI E

(title assigned)

Ke amo ^l ia a ^e la ka wa'a ma kai e	<i>Carried on the shoulders is the canoe from the sea</i>
Waiho Mahinui ma uka e,	<i>Put down at Mahinui in the uplands</i>
Ka ulukoa o Neawe e,	<i>The koa forest of Neawe ('Oneawa)</i>
Me he kaulai kapa kea ^l ala,	<i>Like a fragrant white tapa hung out to dry</i>
Ke o ^{ne} lele makai o Kua ^l aohe--e	<i>Is the windblown sand seaward of Kua'aohe</i>

(from: Ka Hoku o Hawaii 12-29, 1925; Translation: Kihei de Silva)

Hi'iaka does another chant while departing from Kawai Nui with her companion Wahine'oma'o. They are looking back at the beach and see the canoes being carried from the sea. Hi'iaka compares them to a koa forest.

KU A'E AHIKI

(title assigned)

Ku a'e Ahiki	<i>Ahiki rises up</i>
Noho iho Pakui	<i>Pakui reclines</i>
Hiki mai ko aloha	<i>My love appears</i>
Kono i ku'u waimaka	<i>Inviting my tears</i>
E hanini ----- e	<i>They overflow</i>
E uwe au ----- e	<i>As I wail</i>

(from: KaHoku o Hawaii, 12-15, 1925; Translation: Kihei de Silva)

There follows a chant Hi'iaka does at Kailua. She is chanting it to Ka'anahau who has been her gracious host. He wants in return her body, but she offers Wahine'oma'o instead.

KA'ANAHAU KA IPO MOE
(title assigned)

Kā'anahau ka ipo moe	<i>Ka'anahau is the sleeping partner</i>
Mea a ko'u ōpū i 'ano'i a ku ai	<i>By filing my stomach he has earned a lover</i>
I ola ku'u lā pōloli ia 'oe,	<i>He gave life to my day of hunger</i>
Ināi pū no me ka waimaka,	<i>Seasoned with tears</i>
A he maumakemake lua no e	<i>Desires doubly strong</i>
'Oia ho'i hā	<i>He brings returning breath</i>
Moea ko kāua hia'i 'ono	<i>Our hunger put to rest; our appetite greatly pleased</i>
Ua hili au a ia be.	<i>I will stray with you</i>

(from: Ka Hoku o Hawaii, 12-15, 1925 Translation: Pukui??)

Hi'iaka gives a second chant to Ka'anahau for his persistent urgings. It seems though that both their desires were strong and that she gives in in the end. This chant would seem to be an answer as well as a reply.

HE UA LA, HE UA
(title assigned)

He ua la, he ua	<i>Lo, the rain, the rain</i>
He ua pi'i mai;	<i>The rain is approaching;</i>
Noe-noe hālau,	<i>The dance-hall is murky,</i>
Hālau loa o Lono.	<i>The great hall of Lono.</i>
O Lono 'oe;	<i>Listen, its mountain walls</i>
Pa-ā-a nā pali	<i>Are stunned with the clatter,</i>
I ka hana a 'Ikuwā-	<i>As when in October,</i>
Pōhā ko 'ele'ele.	<i>Heaven's thunderbolts shatter.</i>
A Welehu ka malama,	<i>Then follows Welehu,</i>
Noho i Makali'i;	<i>The month of the Pleiades,</i>
Li'ili'i ka hana	<i>Scanty the work then done,</i>
A'ia a e'e-u	<i>Save as one's driven</i>
He'eu no ka lā hiki.	<i>Spur comes with the sun,</i>
Hiki mai ka Lani,	<i>When day has arisen,</i>
Nauweuwe ka honua,	<i>Now comes the Heaven-born;</i>

Ka hana a ke ʻōlaʻi, nui
 Moe pono ʻole koʻu pō
 Nā niho ai kalakala,
 Ka hana a ka Niuhi
 A mau i ke kai loa.
 He loa o ka hikina
 A ua noa, a ua noa.

*The whole land doth shake,
 As with an earthquake;
 Sleep quits then my bed:
 How shall this maw be fed
 Great maw of the shark
 Eyes that gleam in the dark
 Of the boundless sea
 Rare the king's visits to me.
 All is free, all is free*

(from: Emerson, Unwritten Literature of Hawaii, 1909, pp. 216-218.)

This chant seems to describe the amphitheater-like setting of Maunawili. It is the great dance hall of Lono. As it goes on, it tells of the coming of someone of high rank. It also tells of the many people that will come to see this person of high rank. The ending lines are hard to understand. Whether this person is comparing the shark and its hunger to the people and their hunger is not really clear.

KUALIʻI

(title assigned)

Noho i ka lulu o Waianae
 He lae Ka'ena,
 He hala o Kahuku,
 He kuamauna hono i kehau Ka'ala,
 Noho mai ana Waialua i lalo -- e
 O Wailua iā.
 O Mokuleia, Kahala ka ipu,
 Ka loko i'a mano lalawalu,
 Hiu lalakea i Ka'ena,
 Mano hel e lalo o Kaua'i --e
 Olalo o Kaua'i, ku'u 'aina
 O Kaua'i---
 Ke holo nei Ku i Kaua'i
 E 'ike i ka o'opu makapoko o Hanakapiai.
 Ke ho'i nei Ku i O'ahu --e
 I 'ike i ka o'opu kui'a, i'a

*Sitting in the calm of Waianae
 Ka'ena is a point,
 Kahuku is hala wreathed.
 Covered with dew is the back of Ka'ala
 There below doth Waialua sit,
 That is Waialua.
 Mokuleia with its dish of Kahala;
 A fish-pond, like cooked shark,
 The tail of the hammer-headed shark
 is Ka'ena,
 The shark that travels at the bottom
 of Kaua'i,
 At the bottom of Kaua'i, my land;
 O Kaua'i
 Ku is sailing to Kaua'i
 To see the worm-eyed o'opu of
 Hanakapiai
 Ku is returning to O'ahu
 To see the transient o'opu,*

Hilahila o Kawainui

E lana nei i loko o ka wai.

A pala ka hala, ʻula ka āʻī -- e

He hailona ia no Ku.

(from: Fornander Collection 4: 370-394, 1920)

The shameful fish of Kawainui

Floating meat the surface of the water.

When the hala is ripe the neck becomes red;

Tis a sign of Kualii

The above chant is a portion of a 610 line chant for Kualii. The ending half where Ku is returning to O'ahu is probably the important section for the purpose of this section. Kualii is a shark who conquers districts one at a time. The last six lines of this portion of the chant indicate the Kualii came home to O'ahu, to Kailua.

The following is an index of chants taken from KA NUPEPA KUOKOA, a Hawaiian language newspaper. "MAKALEI KA LAU PI'ONA A KA I'A O MOA-ULA-NUI-AKEA I KAULANA". The chants with asterisks (*) are the ones with obvious importance in the Kailua-Kawai Nui traditions. The others, without asterisks, may be of similar, but less obvious relevance. Much work needs to be done in further translation and study of the entire collection.

Jan 13, 1922

Nana ae au a o Ahiki*
O Haloa lani o ka Houpo
O Uliuli wahine o Nuumea
Ke kapi la i ka pueone
O moe a hauna o Milipo, mea

Jan 20, 1922

O lailai o olai ka honua*

Feb 3, 1922

A lulu ka iako pala ehū ke oho*
Aloha ae no hoi au

Feb 10, 1922

Kiekie iluna ke ku a Ahiki*

Feb 17, 1922

Auheā wale ana oe*
Ko ma'i auka gula la'a ke*

March 3, 1922

Eia ae ka ua ke hele mai nei*
Kanikau ae nei Olopana*
Iluna i Halulu ke lani

March 31, 1922

He pa no Kailua ka pali o Lualualei*
O Niuula i ke aka o Kuwalopau ka moku*
Auhea wale oe e ka mamo

April 7, 1922

Ke nu mai nei ka makani*
Moe ana Hoolona ana*

April 28, 1922

Pale ka ike ina kiki o Kolokini

May 11, 1922

O aniani ka lani o Hoomiha e*
Opaipai ka mauna

May 25, 1922

Hapuna ka haka wai*
Moe ae ka lau o ke kalo
Halulu i hale kumu ka lani
He'e aku i ka nalu opuu
He eueu au no Kahikina

July 13, 1922

Kaulana mai nei o Hakipuu
I ae la Kahiki ku hauna ka moku
Hui puuwai e hee ka nalu

Aug 10, 1922

Aloha oe la e ku'ekaiiki
Nihi malu he palanaiki ka moe
Nolaila (?) ka hana i kani pono
Nanai (?) wale Poniuailana*

Aug 24, 1922

Me ole ke kua o Alele*
Pakela ka oni kamaano
Ka nalu, e ku ka nalu mai Kona
Kuupau ana ka paka a ka ua i Puaakanoe

Sept. 7, 1922

E kukulu o Halaaniani e -- ilalo i Mulihana*
He mano no huluhulu
O Ho'okuku, i hoonana

Sept 21, 1922

Halulu ka lani, malu ka moana*
Kanikau kani a aina*

Oct 5, 1922

O u-ao noeo ula ka pua o ke a'ali'i*
(O uao noweo . . .?)

Oct. 12, 1922

Hiahialani ka maka o ke kaunoa

Oct. 19, 1922

Ea, mai ke Koholalale haualii i ka moana

Nov. 2, 1922

Hoolau kanaka ia ka leo o ka manu*
Ia Ahiki ma e nanea nei i ka:*

Nov 16, 1922

Po kuka i ka uahi a ke kai e
Huli haliu i ka waikin a Kane

Dec. 7, 1922

Ua hoi mai la ke oe e ka maka-liula
O hookuku, i ke pii i Ku*

Dec 14, 1922

Hele i pawa i ka moku ana o ke ao
O Kalohia o ka 'ia mawailualani*
Ku mai ka malu nui malu iki
Ialau (Lalau?) na koa aupuni

Dec 28, 1922

O Upolu e Wawau
Oni mai Kanewai i ka ua kuahine
Ka uauahi lena o ke ki o Koolau
Nani wale ka uka i Pa-kui*
O Kahiki-ku la i ka lani

Jan 4, 1923

Ke welina mai ner(?) ke kin olalo
Uliuli o Maihea

Jan 11, (or Jan 18?) 1923

Mo'a maka-li ka ohia o Moewakea*
Ia maikai lili hemolele i ka la

Feb 8, 1923

Makemake au o ike ia Kaleponi
O ka moku mua loa keia

Feb. 22, 1923

Moe kokolo ka uwahi o Kula he hau e
I ke one kani o Nohili
Hapai kunu ae au
Hoonoenoe i na uka o Lihue
Nee nee mai a pili
Ke hoi la no nae ae la

Still other relevant chants which may be of interest to the reader are as follows:

From Ka Hoku o Hawai'i

Ka'anahau ka ipo moe, 12-15-25
 Ku a'e Ahiki, 12-15-25
 Ki'eki'e iluna ke ku o Ahiki, 12-15-25
 O Kailua i ke oho o ka malanai, 12-29-25
 Ke amo 'ia a'e la ka wa'a makai, e, 12-29-25

From Ka Na'i Aupuni

'O Apuakea, wahine u'i, 1-13-1906

From Nathaniel Emerson's Pele and Hi'iaka

Ku'u kane i ka pali kauhuhu, 186

From Nathaniel Emerson's Unwritten Literature of Hawai'i

'O 'oe no paha ia e ka lau o ke aloha, 82
 Ku i Wailua ka pou hale, 191
 He ua la he ua, 216

From Abraham Fornander's Collection of Hawaiian Antiquities

'O Kealiaia liu o Mana, 4:283
 'O Kahikahonua ia Elekaukama, 4:303-6
 Ku'u pali lehua o Kilou, 4:306
 Palahalaha wale, 4:314
 Akahi au opu mai, 4:316
 'O Hilo ia, 4:316
 'O Lililehua ia, 4:318
 Aloha kahalemilo o ka la la, 4:318
 'O Moihala nei, 4:320
 The chant of Kualii'i, 4:370-394
 E Kaulu e, awa'a ia, 4:531

From Abraham Fornander's Account of the Polynesian Race

'O Kaulu nei au, 2:13-14
 'O Paumakua ka lani o Moenaimua, 2:25-26.

Contemporary chants

He oli aloha no Kailua, Robert Snakenberg,²⁵ 1976
 Ku i Ahiki ka ne'e mua, Kihei de Silva, 1980
 Ho'i ka manu 'iwa ma Ka'iwa, de Silva, 1980
 A pō Ulupō i ka aulia manu, de Silva, 1981
 Ho'opuka e ka lā kai o Mokulua, de Silva, 1981
 Kōnane Hā'una me nā wahine lua, de Silva, 1981
 He mele aloha no Kaiwi'ula, de Silva, 1982
 He mele aloha no Māpuana a me Kihei, Kaha'i Topolinski, 1982

FOOTNOTES FOR CHAPTER 2

1. The opening four paragraphs of this chapter have been written by Muriel B. Seto, Historic Sites Chair of the Congress of Hawaiian People. The remainder has been written by "Manu" Cathy Coleman and "Mele" Lisa Watkins, with advice and input from one of their instructors in the hula "Hā lau Mōhala 'Ilima, Mr. Kihei de Silva. Mr. de Silva is a researcher and author of Hawaiian chants and assists his wife, Mapuana de Silva, in the direction of the hula halau named above.
2. For further details of the discovery of early agricultural sites at Kawai Nui, see Clark, Jeffery T., Phase I Archaeological Survey of Castle Estate Lands around the Kawainui Marsh, Kailua, O'ahu, Manuscript No. 040180 (Honolulu: Bishop Museum Dept. of Anthropology, April 1980).
3. Based on geological research of Dr. John Chris Kraft as reported in Allen-Wheeler, Jane. Archaeological Excavations in Kawainui Marsh, Island of O'ahu, (Honolulu: Bishop Museum, Dept. of Anthropology, November 1981).
4. Beckwith, Martha. Hawaiian Mythology, (Honolulu: The University Press of Hawaii, 1971), pp. 67-80.
5. Westervelt, William. Hawaiian Legends of Ghosts and Ghost-Gods, (Tokyo: Charles E. Tuttle Company, 1963).
6. Ibid., pp. 116-151.
7. Ibid.
8. Pukui, Mary K. and Samuel H. Elbert. Hawaiian Dictionary, (Honolulu: University of Hawaii Press, 1973), p. 395; Beckwith, Martha, op. cit. note 4, p. 203; and Fornander, Abraham. An Account of the Polynesian Race, (Tokyo: Charles E. Tuttle Co., 1969), Volume 2, p. 43
9. Fornander, ibid., pp. 23, 26.
10. Beckwith, M., op. cit., ref. 4, pp. 440-441; and Fornander, Abraham in Fornander Collection of Hawaiian Antiquities and Folklore, (Honolulu: Bishop Museum Mem., 1917), Volume 5, pp. 364 and 370.
11. Fornander, A., op. cit., note 8, pp. 273-274; Newmann, T. Stell. Historic Preservation in Hawaii, (Honolulu: State of Hawaii, Dept. of Land and Natural Resources, 1976) V.1, p. 273, 39; Beckwith, M., op. cit., note 4, pp. 394, 395.
12. Sterling, E. and C. C. Summers, Sites of O'ahu, (Honolulu: Depts. of Anthropology and Education, Bishop Museum, 1978), p. 230.
13. Fornander, A., op. cit., note 8, p. 23.
14. Sterling, E. and C. C. Summers., op. cit., note 12, p. 233.

15. Beckwith, M., op. cit., note 4, p. 329.
16. Sterling, E. and C. C. Summers, op. cit., note 12, p. 235; Fornander, A., op. cit., note 10, pp. 144, 374; Kuokoa, Hawaiian newspaper, 8-12-1965.
17. Handy, E.S. Craighill and Elizabeth G. Handy. Native Planters in Old Hawaii: Their Life, Lore, and Environment, (Honolulu: Bishop Museum Press, 1972), p. 457; and Kamakau, Samuel M. Ka Po'e Kahiko; The People of Old (Honolulu: Bishop Museum Press, 1968), No. 51, pp. 82-85.
18. Sterling, E. and C. C. Summers, op. cit., note 12, p. 231; Ka Na'i Aupuni, Hawaiian Newspaper, 1-22-1906; and Ka Hoku O Hawaii, 12-29-1925.
19. Ka Nai Aupani, 9-4-1906.
20. Beckwith, M., op. cit., note 4, pp. 284-287.
21. Ka Nupepa Kuokoa, "Mukaki Ka la'au pi'iona. . .", 1922-1924.
22. Westervelt, W., op. cit., note 5, pp. 256-259; Kamakau, op. cit., note 17, pp. 82-85; Handy, E.S.C. and E.G. Handy, op. cit., note 17, p. 457.
23. Sterling, E. and C.C. Summers, op. cit., note 12, pp. 230-131; Fornander, A., op. cit., note 10, Volume 6, p. 243; and Handy, op. cit., note 17, p. 457; Kamakau, S., op. cit., note 17, pp. 82-85.
24. Except where otherwise indicated, the titles and translations of the chants discussed from this point to the end of the chapter reflect the interim preliminary analysis work of contemporary student and author of Hawaiian chants, Mr. Kihei de Silva, who -- with his wife Mapuana de Silva -- are the leaders/teachers of students in their hula Halau Mōhala 'Ilima. At time of this writing, 1982, this Halau was honored by receipt of first place in the Hula kahiko or ancient hula competition class at the annual Merrie Monarch Competition, the most prestigious competition among halaus in the State of Hawaii, at date of this writing.
25. Snakenberg, Robert Lokomaika'iokalani is, currently, Coordinator of the Hawaiian Studies Program for the State of Hawaii, Department of Education, Native of Kailua, and fluent in both English and Hawaiian.

Chapter 3. KAWAI NUI: AN ETHNOBOTANICAL PERSPECTIVE

Section 3.1 Introduction

Most scientific studies performed by consultants at Kawai Nui have been initiated to fulfill governmental requirements for Environmental Impact Statements or to recover data essential to effect some development proposal within the area. Rarely have such studies addressed the essence of Kawai Nui in an integrated manner, especially with regard to cultural utilization of its dynamic changing resources through time.

For instance, ornithologists have concentrated their attention on the biological needs of the four species of endangered waterfowl of Kawai Nui, and have paid less attention to the fact that two of these species are considered by Hawaiian tradition to be sacred. Hawaiians feel that it may be significant to science to understand that, as physical embodiments of the goddess Hina who, tradition holds, arrived in the Islands with the great god Kane from the east,¹ the 'alae birds (Coot and Gallinule) are also closely related to similar American species.² Did these birds arrive under their own power or, like other animals and plants, were they introduced to these islands by man?

Archaeologists, primarily concerned with early structures, have been less concerned with the cultural ramifications of the proximity of these fearsome birds to the everyday uses of the known nearby temples, fishponds, and lo'i. For example, could it be that the birds' proximity to Hawaiian house sites was influenced by the presence of the 'alae birds, given the awe in which these birds were held, the sound of whose voice could even stop the work of the priest in the heiau?³

Similarly, several studies have addressed the plant life of the Kawai Nui Cultural District, i.e., Andrew J. Berger in 1976, Margaret E. Elliot and Erin Maria Hall in 1977, Linda Lea Smith in 1977 and 1978. The remarks of noted ethnobotanist Beatrice Krauss are germane to the subject of this section:⁴

Although all of these sources mention or list the flora (species of plants) present in the peripheral areas of Kawainui Marsh, there has been no truly ethnobotanical study made. True, the above authors mention the presence of one-time taro terraces, quoting such references as Handy and Handy (Berger) and McAllister (Smith). However, the presence also of such Polynesian-introduced plants as hau, mai'a (if Polynesian varieties), noni and ulu, along with the kalo terraces, indicate early Hawaiian habitation in the area.

The approach to the study of the flora surrounding Kawainui Marsh has been one which appears almost totally taxonomic and ecological. It would seem to be advantageous to also study the flora from an ethnobotanical viewpoint.

Just as "Hawaiian life vibrated from uka, mountain, . . . to the kai, sea. . .",⁵ life appears also to have been speciated by Hawaiians through linkages keyed to plants. Thus, as one example, the kukui of the uplands had its equal members in the humuhumunukunukuapua'a of the sea and the terrestrial pig moving about on the land, all being manifestations of Kamapua'a, a Lono demi-god of fertility.⁶

Ethnobotany, then is the systematic study of plant lore of a race or people. It represents scientific recognition that plants are an integral part of people's daily lives, whether for foods, medicines, textiles, rituals, or aesthetic purposes. Ethnobotany is as specific as an analysis of the stomach contents of a 4,000 year old Egyptian mummy or as general as charting the parallel dissemination of plants along the migration patterns of a people who used them.

Sources of information of interest to any future ethnobotanical study of Kawai Nui are present in the documentation leading to the Declaration of Eligibility for Kawai Nui as a Cultural District, issued by the Office of the National Register of Historic Places in July, 1979; in the National Register descriptions of nearby and adjacent listed sites: the Pali Complex, Pahukini Heiau, Ulu Pō Heiau, Kawa'ewa'e Heiau, Mokapu Sand Burials, and Bellows Field Complex; also in the State Historic Preservation Office records for Kailua sites formerly listed in the Hawai'i State Register (now threatened), and in state archaeologists' Patricia Beggerly and Earl Neller recommendations, respectively, for state acquisition of Kawai Nui and Maunawili sites; and in Waterbird Recovery reports for Kawai Nui and Nu'upia fishponds; in addition to the sources utilized in preparing this section of the educational guide.

Since this discipline, so fortuitously applicable to the interrelated resources of Kawai Nui, has yet to be practiced there, it is to be hoped that the following section may stimulate interest for that work.

Section 3.2 Kawai Nui and Ethnobotany

An ethnobotanical study of contemporary society might lead the researcher to its libraries, homes, markets, industries, pharmacies, churches, media, and garbage dumps, etc., to determine the cultural uses and values assigned to plants common to that society, or to a special sub-group of the society.

For study of a prehistoric culture, ethnobotanists work in tandem with several other scientific disciplines, including geologists and a variety of anthropologists, for acquisition of plant samples to be examined. Increasingly, anthropologists and ethnobotanists are finding that landforms change over time, impacted both by natural forces and human activities. Therefore, geologists can be instrumental to "reconstructing" an earlier environment, thus ensuring a greater measure of success for archaeological and ethnobotanical investigations:

These types of paleogeographic analyses may prove of use to archaeologists in understanding the reasons for selection of habitation sites. They may also assist the modern occupants of the coastal area in coastal planning and in understanding rates and nature of coastal change. . .

Frequently, the geologists or geoarchaeologists, like the ethnobotanist, are guided in their efforts by pertinent traditions and legends of the ancient peoples being studied. For instance, in the above quoted article, while discussing work relating to the early environments of Messinia, Greece, the authors note:

The writing of ancient authors such as Pausanias, Herodotus, Strabo, and Aristotle frequently refer to geomorphic and environmental changes that have affected the geography and history of the Aegean area.

In the case of the Polynesians -- a migratory people -- anthropologists have collected a body of ethnobotanical evidence through archaeology, historical observation, and the oral traditions of the people. From this evidence and despite the vast oceanic expanses separating the several Polynesian societies, they have observed that some plants are known to be common to most, and are presumed to have accompanied the ancient migrants in their quests for new lands to settle along with swine, dogs, and poultry.⁹ Nonetheless, due to a paucity of ethnobotanical evidence about the initially occupied site, there is very little known about the earliest settlers in Hawai'i, the environment they found, and where or how they put down roots:¹⁰

The general lack of information on the Settlement Period makes it critically important that all archaeological sites which may yield information about this period be preserved and professionally studied. In particular, stratified deposits of cultural materials are of great importance and must be thoroughly studied before any alteration or destruction.

What is possibly the earliest known agricultural site in the islands was recently discovered at Kawai Nui,¹¹ and ethnobotanical evidence obtained from stratified deposits suggests that there has been continuing utilization of the area's resources from earliest settlement to the present, as shown by the following table:¹²

Table 3.1 SITE DATES WITHIN THE KAWAI NUI CULTURAL DISTRICT

<u>Site</u>	<u>Date</u>
Oa-G6-32 TP7 (Kūkānono slope)	Range A.D. 339-629
Oa-G6-32 TP2 (Kūkānono slope)	Range A.D. 532-962
Oa-G6-33 TP5 (Quarry Road slope)	Range A.D. 749-790
Oa-G6-39 (Marsh below Kūkānono)	Range A.D. 1284-1464
Kailua Barrier Beach TP	A.D. 1366 (Corrected)
Oa-G6-39 (Marsh below Kūkānono)	Range A.D. 1550-1710
Site 5* (Kūkānono slope)	Range A.D. 1692-1738
Site 7* (Marsh below Kūkānono)	Range A.D. 1704-1772

* Basaltic Glass Dates

The evidence of plants known to be important to the agriculture of the Hawaiian people is present in most of these sites, either as walls relating to agriculture (taro), or as remnant samples of plants known to have been utilized by the people. It is from plant organisms or their charred remains that carbon dating has been possible. That there are few evidences of permanent settlement among these few sites should not be surprising:¹³

For every fisherman's house along the coasts there were hundreds of homesteads of planters in the valleys and on the slopes and plains between the shore and forest.

However, at the time of discovery of the oldest sites in the Kawai Nui Cultural District (see above), they were the oldest known interior sites as they are almost a mile from today's shoreline.¹⁴ Core samples taken in 1981, however, resolved the mystery by proving that the familiar Kawai Nui landform of today is not the same as that entered into by the first settlers. Indeed, it has embodied several other configurations in the last two thousand years between having been a saltwater bay and a freshwater marsh separated from the sea by a wide barrier beach. Like other early sites, these were also coastal at that ancient time.¹⁵

Land uses, therefore, must have been different also, from era to era, with accompanying or complementary changes in the cultural responses to each succeeding age.¹⁶ It is significant that recorded oral traditions for Kawai Nui and Kailua are unusually voluminous, with plants frequently playing a role in the legends of the area (see Chapter of this guide, covering legends and hula), and with a variety of characters identified with creation themes for humans, land forms, and natural phenomena.

For instance, in the legend of Palila (a creator of land forms),¹⁷ a portion of Olomana is removed by him, which "flew toward the sea, being Mahinui. . ." (See Chapter 2, Section 2.2) In the legend there is no mention of Kawai Nui and, while Mahinui is not far from the sea today, it is more distant than when it was at the landward end of the isthmus separating the former Kailua saltwater lagoon from Kane'ohe Bay in ancient times. (Mahinui, incidentally, was the name of Palila's goddess mother, of Kaua'i, so it may be that the story symbolizes an immigration of Kaua'i folk who had to fight for the right of residency and the use of rich Kailua resources.)

In another account, attributed to the youngest sister of Pele, Hi'iaka, a canoe is carried from the sea and "put down at Mahinui in the uplands," while other canoes at 'Oneawa are compared to a koa forest. (See Chapter 2, Section 2.4) The 'ili (district) name for several land parcels to the north and west of Kawai Nui's shoreline is 'Oneawa. In the chant, however, Kawai Nui is again not mentioned, and there is reference to the "windblown sand seaward of Kua'aohe". The 'Oneawa lands nearest Mahinui lie at its feet in Kapa'a Valley. Could these chants be from a time preceding the Kawai Nui with which we are familiar, and describe a prior landscape while Kapa'a was still an inlet of the saltwater lagoon? The characters are identified with the Pele family, which is estimated to have flowered in that misty, cosmogonic settlement period before the great voyaging period (ca. A.D. 1000),¹⁸ long before Kawai Nui had become a freshwater body.¹⁹

Examining the ancient traditions reveals a list of plants common to the Polynesian peoples, some of which surely accompanied them before they made

landfall on Kawai Nui shores. Similar analyses of the historical records, and materials retrieved from the archaeological and geoarcheological explorations at Kawai Nui will assist ethnobotanists and ecologists to trace the progression of changes in both the family of Man, and in the lands they settled at Kailua. Laboratory detective work is uncommon in Hawai'i that involves palynological analysis (i.e. the study of pollens), but a tantalizing beginning has been made at Kawai Nui, seeking to catalog plant samples taken from the various levels of trenches dug in the wetlands. These include such remnant plant samples as seeds, bark, twigs, leaves, and charcoal, as well as the pollens mentioned above. Some of these have been identified and, with appropriate carbon dating, time frames for certain kinds of human activities and the environment in which those activities took place can now be understood. Thus, the archaeologists can report:²⁰

At Kawainui, the sequence apparently began with marine and coastal bay exploitation, possibly accompanied from the beginning by dryland cultivation on the hillslopes around the bay. Wetland agriculture developed later, probably first in the valley floor inland, along Maunawili and Kahanaiki Streams; archaeological evidence is as yet lacking for this phase. After A.D. 1300, by which time alluvial soils had filled the basin to some depth, pondfield cultivation expanded into the wetlands in the Marsh itself. The adjacent hillsides were terraced for dry and/or wet cultivations during the late prehistoric or early historic periods.

What are the plant evidences on which this reconstruction has been based? How were these plants valued by the Kailua people? Plants having great importance to Hawaiians are frequently identified with their major gods. The creator god, Kane, so closely identified with freshwater, is also associated with taro, sugar cane, and bamboo. Similarly, Ku is identified with coconut and breadfruit, Kanaloa with the banana, and Lono (believed to be the last god to arrive) is linked with the sweet potato and gourd, both of which, interestingly, originated in the Americas. These, then, are plants that are quite literally vital to Hawaiian life and to the relationships with the lands surrounding Kawai Nui. It is understandable that evidences of the above critically important plants have been found in the limited scientific explorations in the Kawai Nui Cultural District sites.

E.S. Craighill Handy has noted that Hawaiians differed markedly from their Polynesian cousins because "The fundamental patterns of this culture were determined by the habits of growth and cultivation of taro",²¹ and goes on to show how the language reflects the powerful influence of taro: the sprout of the taro, 'oha, extended to become 'ohana, the human family; land related to food, 'aina meaning to feed; a child of the land is a kama-'aina; the maka'ainana are those who live on the land which feeds them; the parent plant of taro is called makua, the same as for the human parent, etc.²² He goes on to make this profound statement:²³

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

There were taro species which were used for dyes, for medicines, and for temple religious ritual. Since the entire plant is edible, it has been estimated that:²⁴

On one square mile planted to this crop and diligently cultivated, over 15,000 people could subsist for an entire year.

Concerning taro cultivation at Kailua, Handy describes a veritable "poi bowl" of riches:²⁵

Kailua must formerly have been very rich agriculturally having one of the most extensive continuous terrace areas on Oahu, extending inland one and a half miles from the margin of Kawai Nui Swamp. Terraces extended up into the various valleys that run back into the Ko'olau range. There were some terraces watered by springs and a small stream from Olomana mountain along the western slope of the ridge that lies southeast of Kawainui swamp, and another system of terraces was east of the seaward end of the ridge, watered by the stream which joins Kawainui and Ka'elepulu Ponds. There were also terraces north of the Kawainui Pond, and several terrace areas flanked Ka'elepulu Pond at the base of the ridge to the eastward.

But if taro was king for the Hawaiians, other plants were highly valued, as well. Some of them which are associated with Kailua/Kawai Nui legends are, in addition to taro (of such quantity and quality that an appreciative goddess was willing to "compromise her virtue") (See Chapter , covering hula) are the 'awa, 'ō hi'a, pūhala, 'uki, 'aka'akai, 'ilima, loulu, ki, popolo, and kukui. Most of these same plants have been found in the archaeological or botanical surveys performed at Kawai Nui.

In the very lowest levels on the sands of the ancient beach, kukui nut remnants were found by Allen-Wheeler and Kraft, probably having washed into the lagoon from plantings on the slopes above. Was original hillside or valley vegetation removed with the swidden (slash and burn) agriculture practiced by Hawaiians, to be replaced by stands of kukui?²⁶

The Hawaiian planters were clever in selecting their land. They always looked for land growing well with wild growth. They said that if the wild growth was plentiful, Laka liked the land and it would be fertile. They always turned the wild growth under or burned it after it was cut down. They never took it away, but left it to enrich the soil. The Hawaiians thought of the wild growth as containing some of the vital essence of the land which must not be wasted.

Gourd fragments were found, as well; the gourd also being identified with Hina,²⁷ as well as Lono and native to the Americas. Hawaiians used gourds for containers large and small, for several types of drums used to accompany the hula, and for medicine. It is of interest that the word "ipu," meaning gourd, was also used to describe a learned person who was, after all, a container of knowledge.²⁸

Ethnobotanical studies of the progression of kinds of limu at Kawai Nui could be instructive to both the ecologist and anthropologist. The palynological analysis undertaken in conjunction with Allen-Wheeler's archaeological explorations notes that "The pollen residue contained a dominant and diverse assortment of fungal, algal, and presumably lichen spores."²⁹ "Limu" is the catch-all Hawaiian word for this type of plant life, many varieties from land, sea, freshwaters and mountains being used by Hawaiians for foods, dyes, rituals, etc. A famous saying of the district concerning limu is the following, "'Ola no ia kini i ka limu lomilima o Kai-lua' --- the crowd thrives on the hand massaged seaweed of Kai-lua.",³⁰ which also demonstrates the Hawaiian enthusiasm for making a play on words!

Among other pollens retrieved were a variety of tree species, including the tree fern or hapu'u (Cibotium), two species of which are native to Hawai'i. Hawaiians used the hapu'u fronds to make hats or to feed their swine. The pulu, a silky wool on the stems of the fronds, was used to embalm their dead. The starchy core of the hapu'u was used as a food in time of famine.³¹ 'Ohi'a pollen was found, as well which might be expected since the 'ohi'a lehua is frequently found with hapu'u in the native forests. the 'ohi'a lehua is also identified with Hina, and its groves are sacred to Pele. Its dark red wood was formerly used for mallets, spears and idols,³² which might one day be found in Kawai Nui muds. If it were the 'ohi'a 'ai, however, or mountain apple, it could have been one of those plants introduced by the early travellers to the Pacific islands from Malaya or India.³³

Another tree pollen is of the Araliaceae, which may be the 'olapa or lapalapa, a tree whose wood was valuable as a fuel to Hawaiians, and its bark in brewing a medication for asthma.³⁴

It is highly significant that Loulu (Pritchardia) pollens may be present in the sampling, as this is the tree so closely identified with Kaulu, who bought the lepo-ai-ia, or edible mud, to Kawai Nui. Kaulu concealed himself in this palm" while in the Land-Hidden-by-Kane when he was in search of his brother." This is the only genus of palms native to Hawai'i.³⁵ Might the evidence of this tree being present at Kawai Nui illuminate the hidden meanings of the story of the Hawaiian tree of life, the Makalei, which was reportedly placed by the gods very near the same area where these pollen traces were found? Or as to the very location of that hidden land, also hinted at in the "Mokulana" reference in other of the old chants? (See Chapter 2, Section 2.4) Since the essence of Hawaiians religion is procreative, ethnobotanical investigation by one who is also sensitive to Hawaiian language could be fruitful.

Other shrubs and small trees now known to have been present at first landfall would be of great interest to the ethnobotanists, as well. The Rosaceae, for instance, is a family ranging from the 'Ulei, which provided a tough wood for fish spears and the hoop for fishnets, as well as the stringed musical instrument called the 'ukeke, to the 'ohelo papa, a native strawberry which Hawaiians cultivated and which was a main food of the Nene goose,³⁶ a bird reported to have been abundant at Kawai Nui.³⁷

Of several other plants known to have been growing from early times at Kawai Nui is the Pukeawe, whose pollens have also been found. When King Kamehameha wanted to remove the royal kapu from his body so that he could join

chiefs and commoners in the task of replanting the taro fields, and in working in the fishpond at Kawai Nui, he had to smudge himself with the smoke of a fire made with this wood, accompanied by powerful prayers.³⁸ Perhaps he found the tree necessary for this purpose on the shores of Kawai nui, growing there from earlier times, for the native Hawaiian historian, Kamakau, has reported that this is one of several places around O'ahu, following Kamehameha's victory, where the conqueror labored with the commoners.³⁹

Section 3.3 Implications of Ethnobotanical Approaches to Kawai Nui Studies

That there is great potential for ethnobotanical studies can be drawn from this statement by Dr. John C. Kraft, world-famed geoarchaeologist⁴⁰ whose discoveries at Kawai Nui in 1980 startled the local scientific community:

This coastal zone has probably the largest potential for preservation of archaeological sites and objects from the earliest time of Hawaiian occupancy. It is particularly critical as preservation of materials in this zone would include wooden, bone, and other artifacts that are extremely rare in Hawaii. . .

Ethnobotanical approaches to Kawai Nui's rich history have the potential to unlock the full human panorama, spanning centuries of change. Here, we may find how those first Polynesians who "gave birth" to our islands evolved to become uniquely Hawaiian, and how, along with⁴¹ the more recent immigrants, became American. As Beatrice Krauss points out:

In association with the archaeological survey already made, such an ethnobotanical study should certainly be of some interest and add to the evaluation of this area.

The Hawaiian associative system of connecting plants to other life forms and ultimately to themselves cannot be overstressed, if we are to fully appreciate their culture. Hawaiian culture does not separate things of nature from one another. Rather, it is apparently based on establishing linkages and interdependencies. For "fractionalized" modern humankind, developing a more sensitive understanding of the consummate Islanders, the Hawaiians, may also provide new directions in an age in which the whole earth has become an island. Comprehending and appreciating the full scope of human experience at Kawai Nui may provide a unique and valuable example for the universal islander.

FOOTNOTES FOR CHAPTER 3

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Chapter 4. AQUACULTURE AT KAWAI NUI; PAST PRACTICES AND PRESENT POTENTIAL

Section 4.1 Introduction

Almost every culture in the world has practiced aquaculture to some degree; e.g. the ancient Egyptians stocked artificial ponds with fishes, the Greeks and Romans raised eels, and the Taiwanese walled out tidal areas. Polynesians in the Tuamotos Society, Australs, Cooks, Samoa, and New Zealand entrapped fish by various methods, but only a few had fishponds.

Hawaii is the only known place in Polynesia where the people practiced a true form of aquaculture. In contrast to the rest of Oceania, it had a sophisticated aquacultural system. Nowhere else in Polynesia were there as many types and widespread numbers of ponds as found in Hawaii. In fact, only in Hawaii was there an intensive attempt to utilize practically every body of water for either agriculture or aquaculture.

It was estimated by Cobb in 1901 that, prior to western influence, there were 340 to 360 fishponds in Hawaii. Cobb listed 104 ponds or 2,900 acres in commercial production. For that year, the total pond production was 680,000 lbs. (485,000 mullet and 193,000 of milkfish), or an average pond yield of 270 lbs./acre. Other estimates made of average pond yields have ranged from 175 lbs./acre to 350 lbs./acre. In 1975-1976, the Hawaii State Division of Fish and Game reported a total pond production of only 20,000 lbs. (only 1200 lbs. of mullet), a mere 3 percent of the 1901 production reported by Cobb.

The number of existing fishponds decreased due to a number of economic and social reasons:

1. Money became the standard of exchange;
2. Competition from cheaper imported products;
3. Movement of the population from rural to urban areas;
4. Loss of managerial skills due to deaths and other employment; also loss of maintenance management.

Of course, the forces of nature have played a major role in the destruction of ponds. These forces include:

1. Lava flows
2. Tsunami and sea storms
3. Land erosion-filling ponds with silt
4. Mangroves and other vegetation
5. Natural process of eutrophication

In 1973, Kikuchi and Apple began a study to identify those Hawaiian fishpond remnants worthy of historic preservation. Searching through the literature, Kikuchi found listed, and surveyed 335 ancient Hawaiian fishponds. Using his map, Apple surveyed by helicopter and physically identified the remains of 157 sites and evaluated their conditions. At this point in the survey, 101 of the fishponds were eliminated from further study either because they were almost completely destroyed or overwhelmingly altered. Thus, only 56 of the 355 ponds were even considered for further evaluation. Kawai Nui fishpond was one of those that was overlooked for further evaluation of its present potential. Little information specific to freshwater fishponds is available. Therefore, much of the next section is dependent on information available concerning saltwater fishtraps.

Section 4.2 Types of Hawaiian Fishponds

The Hawaiians had five basic types of ponds: loko, kuapa, loko pu'u'one, loko wai, loko umeiki, and loko ia kalo.

- I. loko kuapā - shoreline fishponds whose primary isolating feature was a seawall (kuapa) of lava and/or coral. Typically it had one sluice gate (mākāhā).
- II. loko pu'u'one - a coastal fishpond. Its primary isolating feature was a sand bar or reef.
- III. loko wai - an inland pond of fresh water. (See Figure 4.1)
- IV. loko umeiki - actually a form of fishtrap which was built similar to a loko kuapā.
- V. loko ia kalo - a taro patch used simultaneously to raise fish, especially mullet.

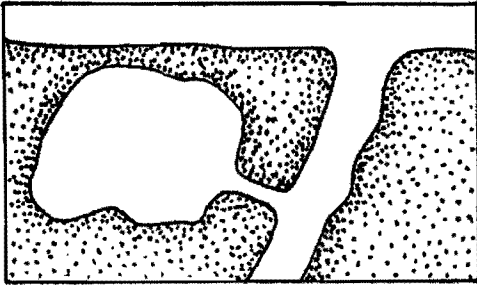
The size of the fishpond varied greatly and was largely dependent on the physical character of the shoreline.

Section 4.3 Fishpond Construction Techniques

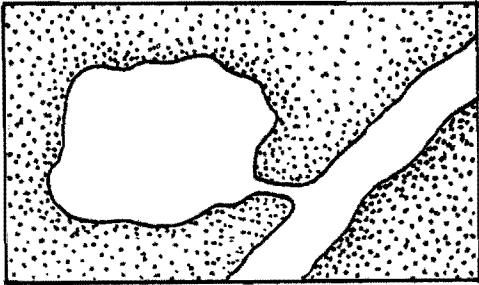
All materials used for the construction of a pond usually came from within the same ahupua'a (major land division).

- a) kuapā (seawalls) - the kuapa were constructed either out of lava rocks, coralline blocks, or rubble of rocks, coral, soil, etc. Smaller rocks and coral fragments filled interior cracks. The wall was permeable to water which permitted the circulation of the water as well as reducing the wave energy. A well built flank (side) was an interlocking of large boulders and smaller blocks. It has been noted that there is a difference in the angle of inclination of the outer wall versus the inner wall. The outer wall was generally more sloped, possibly to make it more resistant to wave action. The average kuapā is 5 feet wide and 3-

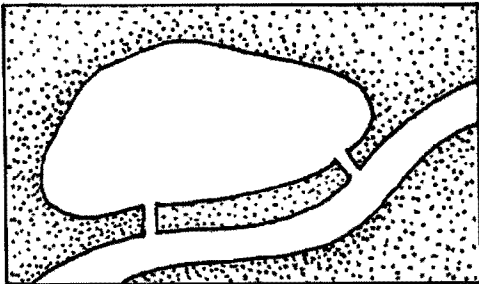
Figure 4.1 Types of Loko Wai Fishponds (Adapted by Artist Donna Kamahale from U.S. National Park Service publication by R.Apple and W.Kikuchi on Ancient Hawaiian Shore Zone Fishponds (July 1975))



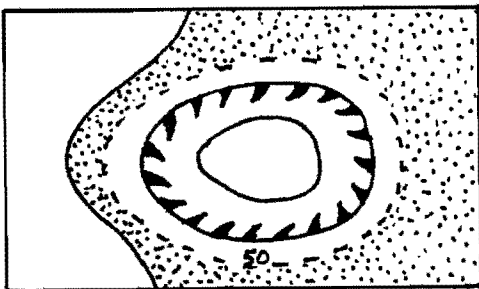
Loko Wai. An inland fresh water fishpond which is usually either a natural lake or swamp, which can contain ditches connected to a river, stream, or the sea, and which can contain sluice gates.



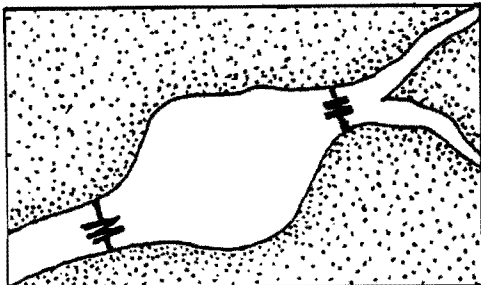
A loko wai whose shape has been altered by man.



A man-altered loko wai which has a dirt and stone embankment-wall separating it from a river or stream and which has a sluice gate(s).



A loko wai which is a volcanic crater.



A loko wai which is formed by walling off a section of a river or stream and which has sluice gates at both ends.

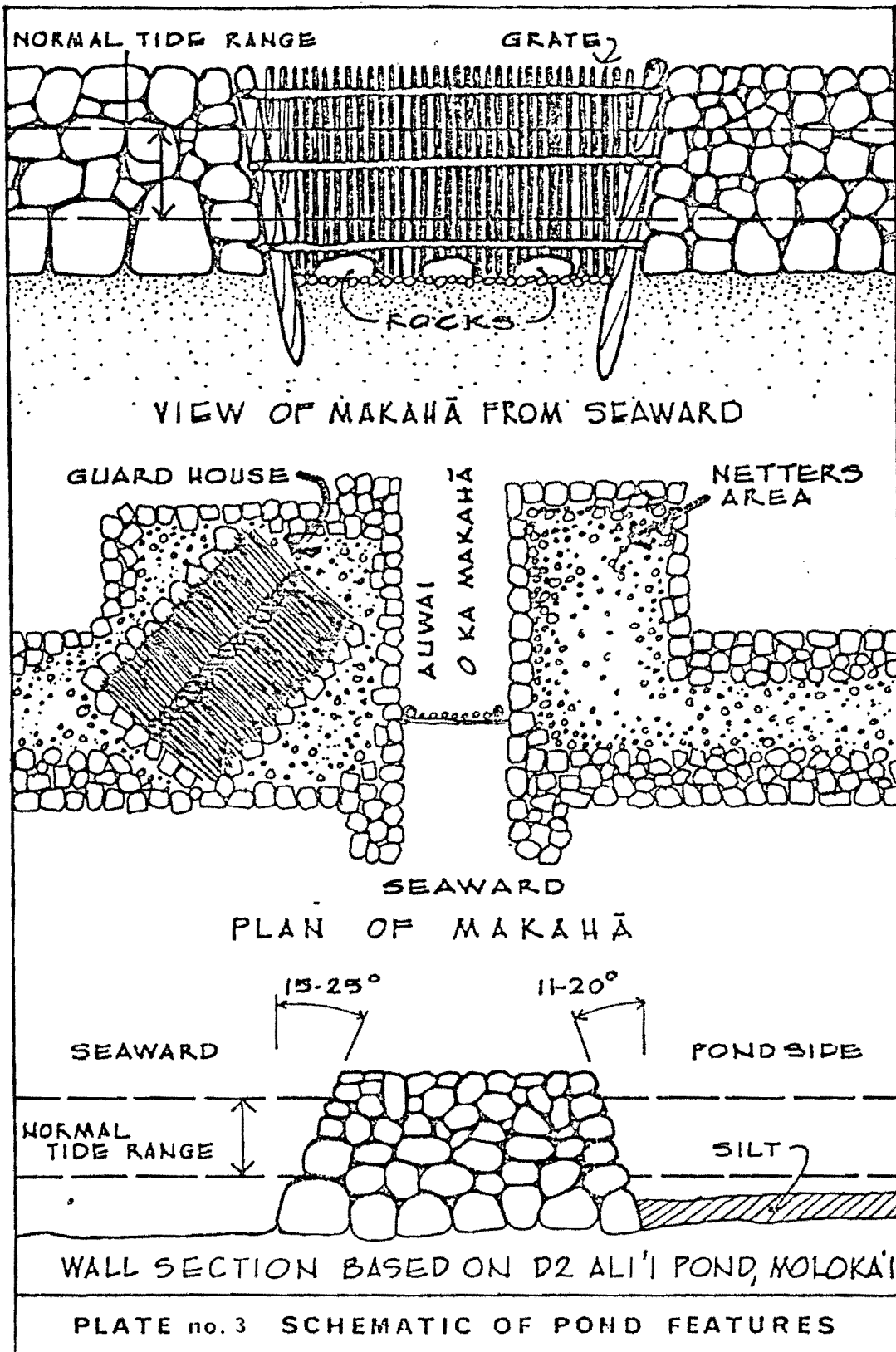


Figure 4.2 Schematic of Pond Features--Kuopā, Mākāhā and 'Auwai-Kai (Taken from: R.Apple and W.Kikuchi's National Park Service Publication(July 1975) on Ancient Hawaiian Shore Zone Fishponds)

5 feet deep. The widest and most massive kuapā is in Kaloko, Kona. This wall is 35-40 feet wide at its base and 6.5 feet high.

- b) Mākāhā (sluice gates) - were the most distinctive and unique feature of a Hawaiian fishpond. These sluice gates were completely stationary and without any moving parts. They consisted of strips of wood lashed vertically to two or three pieces of horizontal wood. They allowed the water to freely flow in and out of the pond for water circulation and flushing, yet the fish were retained. There was no traditional location of the mākāhā, but rather they were positioned to maximize the flow of current through the ponds.
- c) 'auwai-kai (sluices) - were channels which connected the fishponds with the sea. Mature fishes, when ready for harvest, would congregate in the auwai-kai on the pond side of the makaha during the incoming tide and visa-versa on the outgoing tide. Using this knowledge, the kia i loko (pond-keeper) positioned himself at the makaha and caught the fish using dip nets. (See Figure 4.2)

Legend has it that the ponds were built by menehunes. Although there has been no documentation of pond construction, it is believed to have been labor intensive, time consuming and costly. The only known tools to have been used were ropes, litters, and digging sticks. It is commonly accepted that, as in the menehune legends, the rocks were transported by passing the rocks along a human chain sometimes for many miles.

Section 4.4 Management of Fishponds

By the time of the Great Mahele, with its western concepts of land ownership, the first three types of ponds (loko kuapa, loko pu'uone and loko wai) belonged solely to royalty. Control of these ponds was always considered to be a symbol of high status. The fishpond remained a symbol of power even after the Great Mahele. In one study on the leeward side of the Big Island, it was found that seven of the larger fishponds were owned by descendants of King Kamehameha the I. The loko umeiki (fishtraps), loko ia kalo and a few small fishponds belonged to commoners. In former times, because the chiefs were occupied with religious and political duties, they appointed managers:

- 1) konohiki - the land overseer, and
- 2) kia'i loko - resident keeper of the royal fishponds. The kia'i loko was responsible for managing the fishpond, harvesting, and guarding against poaching.

The role of the royal fishponds was neither to provide food for the general public nor for profit. They were solely to provide a reliable, convenient, and ever-ready supply of fresh seafood for the royal court. Maintenance and upkeep of the fishponds were usually done by the commoners. Although the commoners were not allowed to take fish from the pond, they were not necessarily envious. The fishpond signified a rich ahupua'a and people were not taxed as heavily on their own land and sea products, and thus had more provisions for themselves. Therefore they probably were happy to maintain a rich providing fishpond.

Due to openings in the makaha, the ancient Hawaiians had little control over the types of sea life into the ponds. Each pond carried its own type of biota. Fresh, brackish, and saltwater species of plants and animals grew in their respective ponds. Desired fingerlings were caught outside the pond and then stocked into the pond. Seaweed was also intentionally transplanted into the pond.

Fertilization in royal fishponds was both natural and artificial. The fish were fed taro, sweet potato, breadfruit, mussels, and seaweed. Religious beliefs disallowed the use of any type of animal waste for fertilizer.

Small maintenance jobs were done by the kia'i loko. If there was massive damage, the konohiki summoned all the male commoners to rebuild the damages. Periodic removal of seaweed was an all-hands female maintenance operation. A bamboo rake called a kope'ohe was sometimes dragged behind a canoe and the mud was swept out by the current.

Besides the use of scoop nets, the most efficient and practical method of harvesting the royal fishpond was the use of nets. Long seine and gill types of nets were used to take out a large quantity of fish. These nets were the prize possession of the ali'i (chief).

Section 4.5 Cultural Tradition Associated with Fishponds

Fishponds were protected by cultural and religious restrictions. For example, pollution in the form of sewage, rubbish, and metabolites in the water was considered to be an insult to the guardian spirits or Mo'o. Many ponds had such guardian spirits. Freshwater was sacred to Kane, requiring special care for the purity and protection of freshwater ponds.

Ceremonial structures associated with the fishponds were called Waihau, ku'ula, or shrines. They usually honored the god Ku and his wife Hina. The guardian spirits, or Mo'o, which were found in many fishponds manifested themselves either as lizard or dragon-like forms. It was the duty of the kia'i loko to make regular offerings at designated times of the lunar month, in honor of these mo'o. These offerings were made from the Waihau (a type of heiau), or to the ku'ula (a god stone).

The Hawaiians were very aware of the need for conservation. Thus, "kapu" or rules were put in effect which restricted fishing during certain times of the year, in certain offshore waters and also at times when fish were spawning. A branch of hau tree (hibiscus family) marked an area restricted to fishing. Schooling fish could also be declared kapu. Poaching as well as polluting was punishable by plucking out the persons eyeball or strangulation to death.

Section 4.6 Biological Environment of Fishponds

A saltwater fishpond can be likened to an aquatic meadow or an artificial estuary in which a complex food web of numerous interrelated food chains occur. Like estuaries, they can have tremendous productivity. The reasons for this

include the shallow water depth; good circulation brought on by tide flow of sea water, and the nutrients carried in by each tide. Also tidal and stream effluents add to fishpond productivity.

The general food chain of a fishpond begins with microbenthos that transform organic and inorganic detritus and nutrients into a form which can be utilized by a higher level of plant plankton, (phytoplankton), for growth and development. Phytoplankton depend on sunlight for growth and the numerous benthic and flocculent mats of green or blue and green filamentous algae found in Hawaii fishponds represent this food level. The microbenthic primary productivity is light limited, while surface phytoplankton productivity is limited by incident light. Marine plants and zooplankton are most abundant in the upper layers of the water column. Hence turbidity or degree of translucence of the water is the most important factor in establishing and maintaining the growth of lower animal and plant life on which fish are dependent. The animal plankton (zooplankton) feeds on the phytoplankton, and it, in turn, is eaten by larger fish and crustaceans. The food chain progresses upward until humans consume the fish, shellfish, crustaceans, and seaweed. A food pyramid also illustrates these relationships, with a base consisting of phytoplankton and a second layer of zooplankton progressing upward with humans at the apex of the food chain. In each process, there is an energy loss of 90 percent from one level to the next higher one, i.e. 1000 lbs. of phytoplankton to produce 100 lbs. of zooplankton, which, in turn, is the food weight in the production of 10 lbs. of fish. Therefore it becomes clear that a fishpond requires a tremendously large nutrient supply of both inorganic and organic foods in order to produce fish for human consumption. (See Figure 4.3)

Section 4.7 Food Resources of Fishponds

The Hawaiian aquacultural system provided a wide range of foods, which, in some cases, were contingent upon the tide, location, and season (pond type V &) and, in others, upon cultural preference (type I, II, III & IV). The porous nature of sluice gates and seawalls allowed any type of aquatic life forms to penetrate a fishpond. Thus, control of the kinds of fish within a pond was almost impossible. Certain items were chosen, in some instances, as food over other items. And an indication of cultural preference for some fish over others was the practice of seeking the fingerlings of selected fish and transporting them into the ponds. Seaweed was also intentionally sought and transplanted in certain areas to provide beds for selected use. The following is a brief summary of the principal food items provided by the Hawaiian aquaculture system.

- a) Fish. By virtue of their function, fishtraps could not control or segregate the kinds of fish caught. Fish caught at a Molokai fishtrap included: mullet, (Mugil cephalus) or 'ama'ama; tenpounder, (Elops machnata) or awa'aua; thread-fish, (Polydactylus sexfilis) or moi; surgeon fish, (Acanthurus bariene) or manini, kala, pualu; bonefish, (Albula vulpes) or 'o'io; crevally, (Carangidae sp) or ulua; and surmulletts (Mullidae sp) or weke; big-eyed scad, (Trachurops crumenophthalmus); or akule.

Fishponds of types I and II had the largest variety of fish as food resources. The most common ones were the fish called āholehole (Kuhlia taeniura, Kuhlia

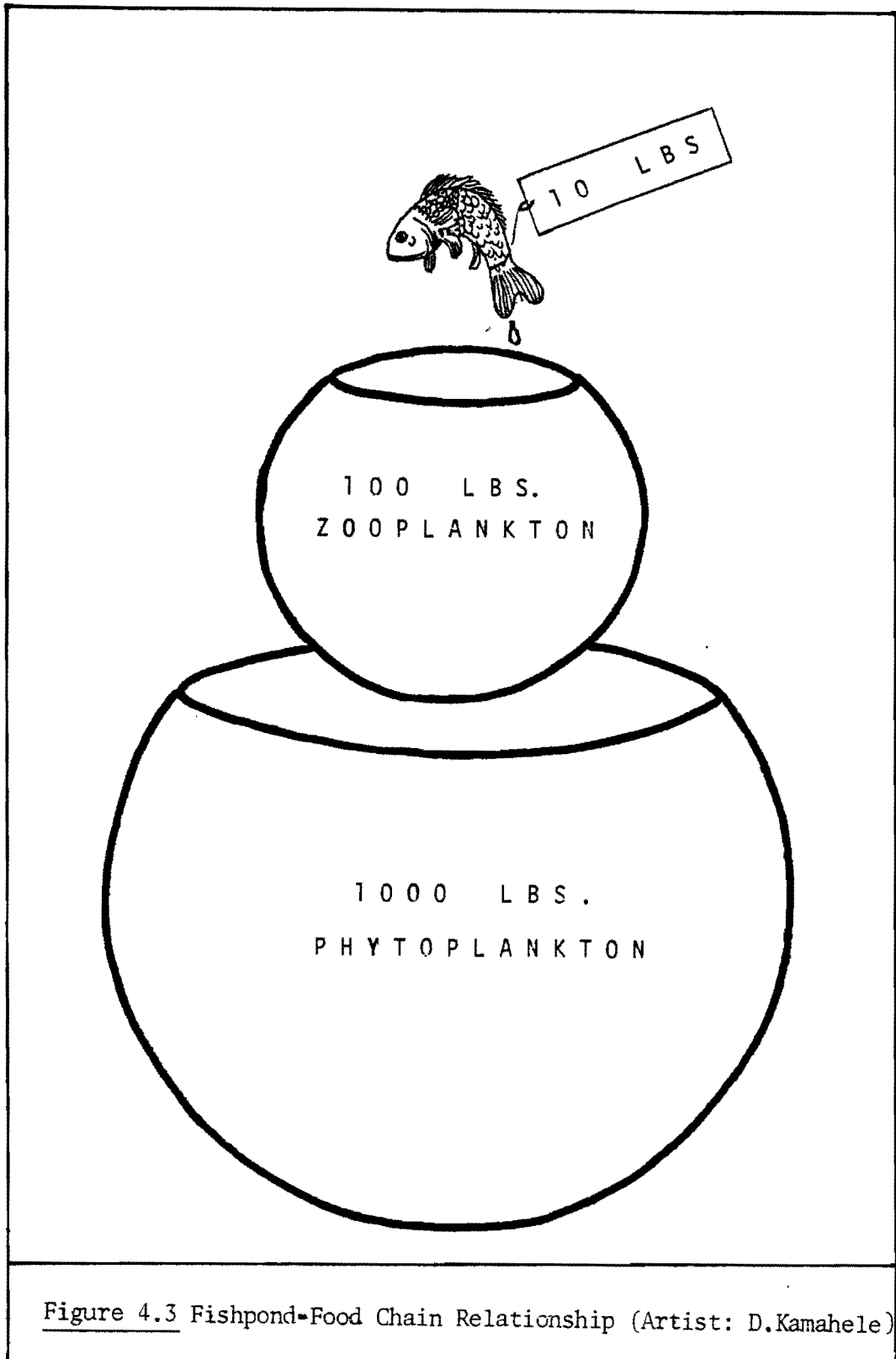


Figure 4.3 Fishpond-Food Chain Relationship (Artist: D.Kamahele)

sandvichnesis); mullet; tenpounder; milkfish, or awa; barracuda (Sphryaena barracuda), or kaku; anchovy (Anchoviella purpirea), or nehu; the fish identified by the Hawaiians as 'o'opu (goby) and the eel puhi. The uncommon fish were: amberfish (Caranx mate), or 'Omaka; goatfish (Parupeneus porphyreus), or kūmu, and various surgeonfish called manini, kala, pualu; bonefish; parrotfish, and crevally.

Fishponds of fresh to slightly brackish water, types III and IV, provided the aholehole, mullet, ten-pounder, and 'o'opu (Gobiidae sp), considered a prize fish.

- b) Crustaceans. The different kinds of shrimp, found in all zones from the the seashore to the upland streams, are distinct enough in form, color, size, and location to be depicted by 14 general characteristics from the general prefix of 'opae. Two main types, the 'opae-huna, transparent shrimp, and the 'opae-kakala, a spiked shrimp, noted to enter through the kuapa and pu'uone fishponds from the sea. Opae-oeha'a (Macrobrachium grandimas), clawed shrimp, washed into the taro plot ponds through the makaha. The only kinds of crabs related to fishponds are the alamihi (Metropograpsus messor) a common black crab, and the papa'i, a general terms for crabs.
- c) Seaweeds. Over 70 distinct species of edible seaweed or limu are present in Hawaii. They are found along the seashore and sometimes fresh water ponds, rivers, and streams. Certain fishponds were chosen in which to cultivate selected seaweeds. Some nobility preferred to segregate and transplant choice seaweeds in the oceans as "gardens" to be harvested on special occasions and to be kept readily at hand.

Only limu-kala-wai (Spirogyra ssp) is recorded as being an edible product of freshwater fishponds. Limu-'ilio (Stigeoclonius amoenum) or hulu 'ilio are also edible freshwater algae.

- d) Miscellaneous Resources. Occasionally, turtles (or honu) were caught and deposited in fishponds or small pools where they were preserved in good health and kept for later consumption.

An unrecorded food resource were the many shellfish, bivalves, and mollusks which could have been harvested from fishponds. There is no recorded evidence for it, but it is assumed that Hawaiians did use all available food resources, and that in the case of shellfish bivalves and mollusks the harvest was marginal, seasonal, and occasional. Edible bivalves consisted of kupekaia (Chama sp); mahamoe (unknown sp); nahawale; 'awa'owaka, and papaua, (Isognomonidae family) and pipi (Pinctada galfsoffi). Common to all shore fishponds and fishtraps are the edible shellfish; kupe'e (Nerita polita), pipipi (Nerita picea and Nerita neglecta) and the choice limpet opihi (Helcioniscus sp).

Section 4.8 Fishpond Features of Kawai Nui

The preceding sections have provided a nutshell account of the basic functioning system and biological components that were involved in ancient Hawaiian fishponds. This section will address how these features were evident at

Kawai Nui Marsh when it was Kawai Nui Loko, one of the largest fishponds of its kind in the islands.

Kawai Nui was a Loko wai type of fishpond but was an inland pond uniquely distant from the shore. Most of these types had natural connections with the sea by way of ditches or streams, and would be partially brackish because of tidal action. Āholehole, 'o'opu, 'ama 'ama, and awa 'aua were found in these ponds. Although its waters were primarily fresh, these fish were also present at Kawai Nui, with at least a historical reference to its being "celebrated for its mullet and awa. The latter fish grows here four feet in length." (Bowser, in Kelly and Nakamura, 1981).

Kawai Nui Loko was 450 acres in extent, according to Kikuchi. Thorough extrapolations by Cobb in 1901, data on commercial production of mullet and milkfish ponds average yields were recorded at 350 lbs/acre/year (max. yield). Multiplied by 450 acres gives one the estimated potential amount of 78 tons/year productivity at Kawai Nui Loko. No actual records of Kawai Nui productivity exist.

There is evidence of a wall separating Kawai Nui waters from those of Ka'elepulu fishpond. Ka'elepulu is a spring-fed pond while Kawai Nui is stream-fed from Maunawili Valley. The wall is reportedly located near the stream draining Kawai Nui into the stream which drains Ka'elepulu. Kawai Nui apparently incorporated only the one mākāhā (sluice gate) located in its drainage 'auwai.

Since Kawai Nui Loko's waters entered it via loko ia kalo through a vast system of such taro gardens reaching deep into Maunawili Valley, fish production must have extended into the valley, as well. This conforms to the "continuum" of inter-dependent food production systems of Hawaiian uniqueness described by Kikuchi.

It is, perhaps, due to the antiquity of the settlement and development of the valley's resources, culminating in the Kawai Nui Loko, which led to its cultural tradition that Kawai Nui's fish production was to be shared with all the people of the area. Like the people, the fishpond was nurtured more by the land than the sea, as were its fish.

An interesting feature of the pond was its "lepo-ai'-ia" or "edible mud". Traditions state that Ka'ulu-a-kalana, a noted chief, brought the mud from Kahiki (foreign place) to Oahu and placed it into the fishpond. The mud is described as thick and jelly-like, having the color of poi (mashed taro). During the invasion of O'ahu, the warriors and servants of King Kamehameha I mixed the mud with their poi in order to stretch the food resources.

Other cultural traditions and features associated with Kawai Nui Loko concern:

- a) the Mo'o Hauwahine who, with her companion mo'o, resided as caretaker in the pond;
- b) the fish attracting Makalei tree.

More on the cultural traditions associated with these features is described in Chapter 2.

Section 4.9 Potential for Restoration of Kawai Nui Marsh's Fishpond Features

The changing demographic character, land use patterns, and cultural practices in the Kailua ahupua'a as factors which led to the decline of the formerly productive fishpond/taro field complex at Kawai Nui have been discussed elsewhere in this Guide (See Chapters 1&2). The feasibility of restoring Kawai Nui Marsh to its former use as a productive aqua/agriculture complex has never been seriously investigated. Today, with a renewed community-based interest in the natural and cultural values associated with Kawai Nui, such an investigation seems timely. The remaining sections of this chapter will discuss some of the problems and potentials associated with such as future restoration project occurring at the marsh.

When Kawai Nui was a functioning fishpond, the open water expanse in the marsh was approximately 450 acres and was surrounded by cultivated wet-and dry-land taro fields, extending a considerable distance up the Maunawili Valley above the marsh. When the Hawaiian practice of actively managing the fishpond ceased (eg. periodically clearing the open water area from encroaching vegetation), the amount of open water began to shrink as the forces of ecological succession took over. These forces (sediment infill and vegetation encroachment) were greatly accelerated by human influences, especially during the present century, as shifting land use patterns in the surrounding areas have led to extensive water diversions from the marsh, rechannelization of the water flow patterns through it; sedimentations in-fill from surrounding hillsides; and vegetation choking it, whose growth has been encouraged by nourishment derived from the effluent of several secondary sewage treatment plants located along the marsh periphery. Observations from recent investigations have shown that the amount of open water in the marsh does not appear to have exceeded fifteen acres since pumping ceased in 1962.

In order for Kawai Nui to again function as a productive fishpond, it would be necessary for much of this vegetation overgrowth to be cleared out, probably through a combination of chemical and physical removal techniques. Once the desired amount of the vegetative overgrowth has been removed, the open water area would have to be maintained through active management techniques (eg. periodic physical/mechanical removal of vegetation).

Theoretically, there are a number of options available for both commercial and non-profit, educational aquaculture restoration projects at Kawai Nui, if the open water area were restored and maintained. One option would be an energy-intensive, high technology plan to build ponds along the mauka end of the marsh area. These ponds would be used to grow freshwater prawns and finfish such as mullet and milkfish. Such an aquaculture project would, by necessity, be a commercial operation, since it would take large amounts of capital investment in order to build a sufficient facility, and the developers would want to recoup their investment through sale of their aquaculture production. Assuming that interested entrepreneurs were available with sufficient capital at their disposal for the necessary initial investment, there would be a number of bureaucratic constraints to overcome as well. Wetland and shoreline areas in Hawaii are among the most

tightly regulated in the state, due to environmental impact and related considerations. At time of writing, there are at least sixteen permits or procedures required before an aquaculture project can get off the ground. (See Table 4.1) Assuming public support existed for the project, it could still take anywhere from 18 to 30 months to successfully complete these permit application procedures. (See Figures 4.4 and 4.5)

The proponent would incur additional expense to retain professional services to complete the various fact finding studies, such as environmental impact assessments, that would be required in order to successfully complete various permit applications. Furthermore, the assumption of public support for a commercial aquaculture operation in the marsh can be easily challenged. Given the current community-based momentum to create a park at Kawai Nui, there is likely to be a significant level of citizen opposition to a commercial aquaculture project proposal anywhere at this site. One of the most significant factors feeding negative public opinion toward the permitting of a large-scale commercial aquaculture operation at Kawai Nui is not so much the fact that it would be a for-profit enterprise in a public park; rather, a more worrisome problem would be the significant levels of water that would be required to run a commercially-viable aquaculture farm in this location. If the operation were to tap Maunawili Stream and Kahanaiki Stream to satisfy its water demand, it could seriously deplete the water input levels of the Marsh area to maintain other desirable components of this living resource, such as the nesting and feeding habitat for Hawaii's four endangered waterbirds and for water-contact recreation. Another water related problem arises from the effluent from the proposed aquaculture farm. A method of wastewater disposal would be needed, and the marsh would be the most logical and cost-effective disposal site. The nutrient-rich effluent would nourish the overgrowth of aquatic vegetation, thus working against the goal of maintaining a large expanse of open water in the marsh.

There are a number of other options that could be implemented in order to return at least some portion of Kawai Nui its former fishpond function. Another type of commercial operation comes to mind, by building ponds on the adjacent land and utilizing Kawai Nui primarily as a water source. One site that shows potential for this purpose is the Ka'pa'a landfill area, once its usefulness as a landfill site has been exhausted. A significant problem to overcome would be the need to pump water uphill to the ponds on this site, at great cost and expense of energy. Another problem would be the potential water contamination from leachates out of the landfill.

Perhaps the most optimistic proposal, in this brief survey, for a viable aquaculture project at Kawai Nui would be to restore a portion of the marsh to a traditional Hawaiian, low-energy, low technology, labor intensive freshwater fishpond. This project could be operated as a non-profit operation, perhaps supported or run by a nearby university or college, as an experiential education project for students majoring in subjects such as Hawaiian Studies, Environmental Studies, Aquaculture, and Marine Sciences. Such projects in other areas such as the Waianae coast Camp Ka'ala project, have proven themselves to be of rehabilitative value for drug-dependent and delinquent youth. Although such a low-energy, low technology, labor intensive enterprise would produce relatively low yields, the major purpose and value of this project would be in its usefulness as both an educational facility and an experimental research station. An end result would be recreational, as well, for fishermen are now limited to Lake Wilson for

COMMON DATA REQUIREMENTS FOR AQUACULTURE PROPOSALS

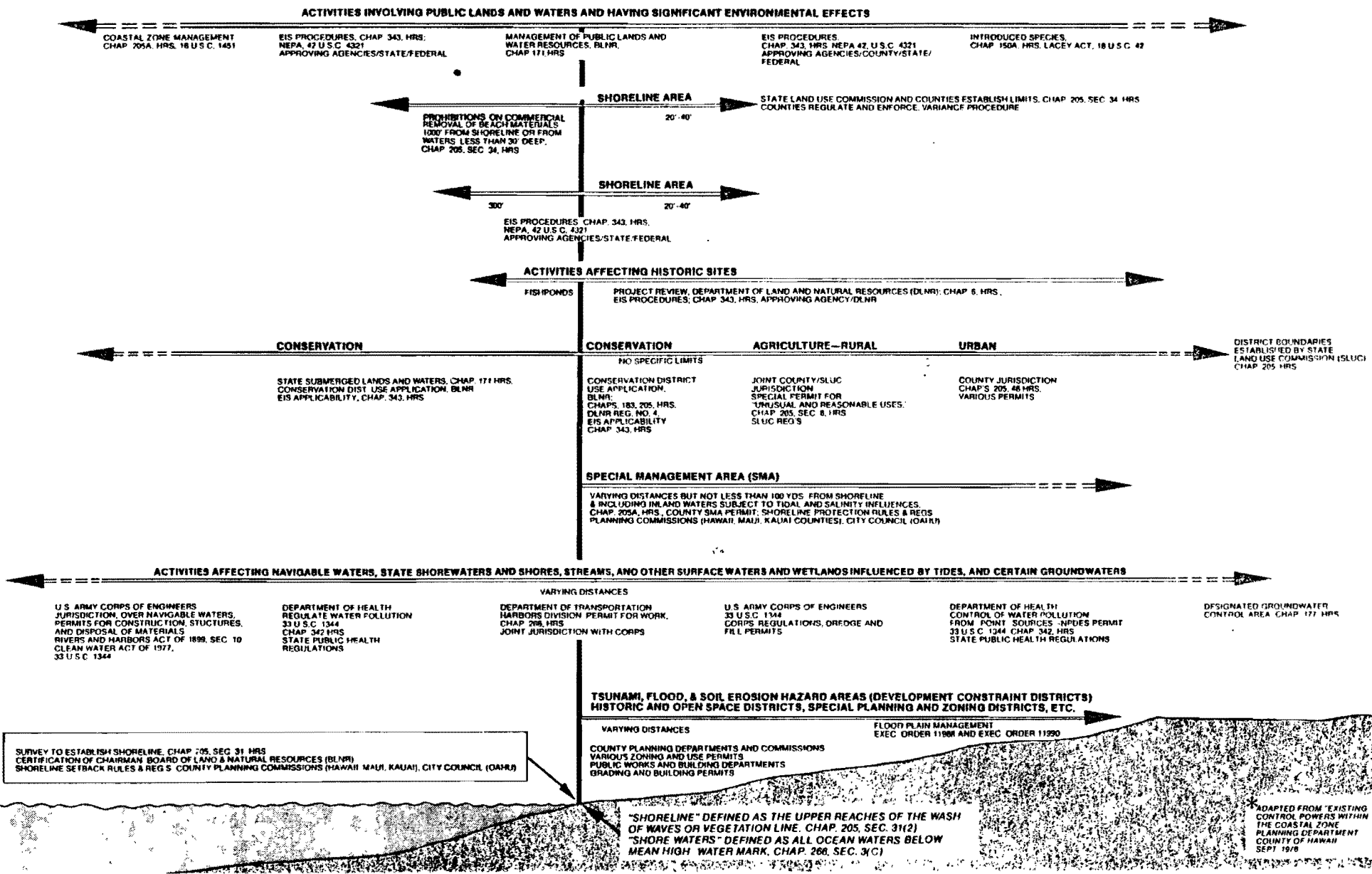
Possible Data Requirements Permit or Procedure	Basic Environmental Assessment Information	Water Quality Data	Soils Data	Archaeological Field Studies	Instrument Survey	Topographic Survey	Engineering Drawings
SMA Permit (County)	*	*	*	*	*	*	optional
Variance from Shoreline Setback Regulations (County)	*			*	*	*	*
Conservation District Use Permit (State)	*		*			*	optional
Historic Site Review (State)	*			*			
Permit for Works in State Shorewaters (State)	*	*			*		*
NPDES Effluent Discharge Permit (State)	*	*					*
State EIS (State or County)	*	*	*	*		*	optional
Corps of Engineers' Permit (Federal)	*	*	*		*		*
Federal EIS	*	*	*	*		*	optional
Well Permit (Honolulu County)		*	*				*
Grading Permit (County)			*			*	
Floodplain Management (County/Federal)	*	*	*	*	*	*	*
Non-indigenous Species Introductions (State/Federal)	*	*				*	*
Hawaii Coastal Zone Management (State)	*	*	*	*		*	*
Shellfish Sanitation Certificate (State)	*	*					*
Designated Groundwater Control Area Use Permit (State)		*	*			*	*

Table 4.1 Common Data Requirements for Aquaculture Proposals (Handout Provided by State of Hawaii, Aquaculture Development Program.)

inexpensive inland fishing experiences.

In conjunction with this proposal, restoration of adjacent taro lo'i along the streams in the upper marsh could serve to once again establish the natural linkages between streams, loko ia kal^o Kawai Nui Loko, the marsh, estuary, drainage canal, and bay, which once made the area so productive. Indeed, some of those old lo'i (taro gardens) might well be used as fishponds for freshwater species, pending removal of the pollutants now entering the marsh.

MAJOR CONTROL POWERS OVER AQUACULTURE USES OF LANDS AND WATERS*



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Figure 4.5 Major Control Powers Over Aquaculture Uses of Lands and Waters (Handout provided by State of Hawaii, Aquaculture Development Program).

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Chapter 5. WETLAND VALUES AND VEGETATION COMPOSITION AT KAWAI NUI MARSH

Section 5.1 Kawai Nui's Value as a Freshwater Marsh Wetland

Perhaps the most conspicuous characteristic of Kawai Nui Marsh today is the predominance of vegetation, both floating and standing, which covers most of the 1,000 acre expanse of the marsh, giving it the deceptive appearance, from a distance, of being a dry, lush green pastureland. Upon closer examination, however, it becomes apparent that even the cattle confine themselves to grazing along the edges, and that the vast interior remains a deep freshwater, vegetation-clogged marsh.

One of the changes in U.S. environmental policy during this past decade has been the development of a national consensus that marshes, such as Kawai Nui, and similar ecosystems -- swamps, bogs, estuaries, wet woodlands, -- ought to be saved in their natural state, rather than drained, dredged and filled, or otherwise "reclaimed".¹

Collectively, for regulatory purposes, these places that have attracted protective attention, have come to be known as "wetlands", although our ancestor's generally referred to them as "wastelands" -- watery barriers to the pursuit of progress which was presumably facilitated if such wetlands were filled in, drained, and then put to a "better" or "higher" use. Now, after an estimated forty percent or more of such natural wetland resources have been thus "reclaimed", the U.S. public has belatedly come to realize that the remaining wetlands are probably more useful when preserved in their natural state.² As such, they can serve many functions, such as nursery grounds for marine organisms, a productive location for wetland agriculture crops (eg. taro, watercress, and rice), a living sewage treatment plant; a flood control basin; a groundwater recharge aquifer; a wildlife habitat; a sediment filter; a nutrient recycler, an open space vista; and a buffer protecting coastal communities against erosion and storm damage.³ Although difficult to quantify, many of these values can be estimated in real dollar terms. Thus, for example, a real estate appraiser recently wrote:⁴

The cost for man to artificially recreate the tertiary treatment that is accomplished by marshlands would exceed \$14,000 per acre per year. This figure rises as our wetlands are depleted. The improved water quality resulting from the existence of marshlands yields a certain aesthetic value and creates untold recreational benefits in connection with surrounding water bodies. It can readily be seen that these workshops of nature are indispensable to our society and our economy.

Kawai Nui Marsh, in its natural state, is currently performing all of these valuable wetland functions for the citizens of Honolulu. Its value as a flood control basin was formally recognized when the central 750 acres were purchased by the City and County of Honolulu to protect the Coconut Grove area of Kailua from repeated occurrences of flooding. (See Section 1.3, Chapter I, for further details). The Marsh's other values as a wetland were also recognized formally when the

State's coastal zone management law included it among the areas to be treated as a "special management area" within which special permits would be required for development proposals, whose value would be rated against their compatibility with the natural resource and cultural values associated with the coastal environment in such areas.

What exactly makes Kawai Nui Marsh a "wetland" and why is it referred to as a "marsh" when maps still refer to it (inaccurately) as a "swamp"? Wetlands are currently defined, for regulatory purposes, as "those areas inundated or saturated by ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."⁶ Although marshes and swamps both fit into the category of being "wetlands", by the above definition, there are distinctions between them. A swamp is a wetland characterized by trees or woody shrubs, which usually comprise greater than fifty percent of the vegetation cover in the wetland area. A marsh, by contrast, is dominated by herbaceous, non-woody vegetation, in the form of grasses, sedges, and rushes.⁷ (See Figure 5.1)

Section 5.2 Vegetation Communities at Kawai Nui, Recent Changes Within Them, and Their Impact on Wetland Values

Hawaiian wetlands, until recently, have as a whole received scant attention in the published literature, a local reflection of a national trend. Kawai Nui Marsh was one of the areas covered in a recent inventory of Hawaii's wetlands recently sponsored by the U.S. Corps of Engineers, in an effort to correct this problem and to develop a descriptive inventory of such wetlands for regulatory purposes.⁸ See Table 5.1 for a species list of principle plant cover found in the marsh, identified during this survey, and including an indication of each species' relative abundance and percentage cover of the area comprising the marsh.

Overall speaking, the vegetation comprising Kawai Nui Marsh can be divided into several distinct plant communities:

1. a grass community, consisting principally of California grass (Brachiaria mutica) interspersed with honohono (Commelina diffusa), arrowhead (Sagittaria sagittifolia), and scattered stands of cattail (Typha angustata). The California grass is a very aggressive and dominant species. It is a large, perennial grass which forms dense patches up to two and a half meters tall. Its leaves have hairy sheaths and blades up to twenty-five cm. long and one to one and a half cm. across.
2. a bulrush community, consisting primarily of bulrush (Scirpus californicus), sawgrass (Cladium leptostachyum) and taro patch fern (Cyclosorus interruptus). Bulrush is a tufted sedge with erect, round or slightly angled stems thirty to ninety cm. tall. Its leaves are reduced to basal sheaths. Bulrush is able to flourish in a wetland such as Kawai Nui because its interior is made of tiny sponge-like air spaces.¹⁰ These air spaces enable the bulrush to extract oxygen out of the water.

The grass and bulrush communities each occupy approximately equal areas in the marsh. Together they occupy several hundred acres of the wetland, rendering

Schematic profile of a typical inland wetland of Hawaii

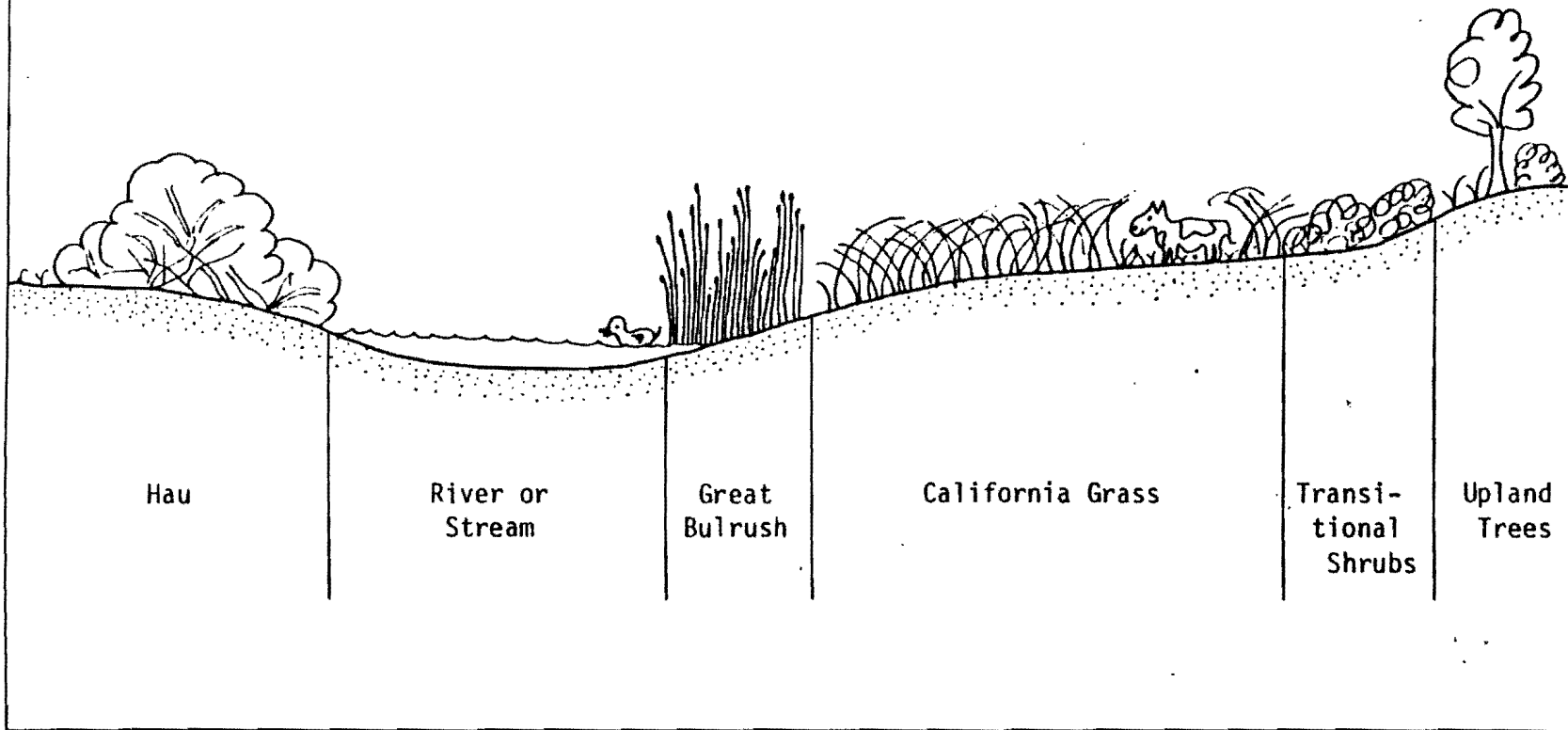


Figure 5.1 Schematic Profile of a Typical Inland Wetland of Hawaii (Taken from: Elliott, Margaret Wetlands and Wetland Vegetation of the Hawaiian Islands, a Master's Thesis through Department of Geography, University of Hawaii at Manoa (May, 1981), Figure 40, p. 37.

				Table 26. SPECIES LIST FOR KAWAINUI MARSH, OAHU (Site 26)			
FILICINAE				Cover	Abundance		
PARKERIACEAE						DICOTYLEDONAE	
** <u>Ceratopteris siliquosa</u>	Swamp fern	1	R				
POLYPODIACEAE						AMARANTHACEAE	
** <u>Cyclosorus gongylodes</u>	Swamp cyclosorus	1	R	<u>Amaranthus spinosus</u>	Spiny amaranth	1	R
MONOCOTYLEDONAE						ANACARDIACEAE	
ALISMATACEAE						<u>Schinus terebinthifolius</u>	Christmas berry
** <u>Sagittaria sagittaeifolia</u>	Arrowhead	1	R			CASUARINACEAE	
ARACEAE						<u>Casuarina equisetifolia</u>	Ironwood
** <u>Pistia stratiotes</u>	Water lettuce	1	O	COMPOSITAE			
COMMELINACEAE						<u>Ageratum conyzoides</u>	Ageratum
* <u>Commelina diffusa</u>	Honohono	2	A	* <u>Eclipta alba</u>	False daisy	1	R
CYPERACEAE						<u>Elephantopus mollis</u>	Elephant's foot
** <u>Cladium leptostachyum</u>	Native sawgrass	2	F	* <u>Pluchea indica</u>	Indian pluchea	1	R
* <u>Cyperus alternifolius</u>	Umbrella sedge	1	O	* <u>Pluchea odorata</u>	Pluchea	1	R
<u>Cyperus brevifolius</u>	Kyllinga	1	R				
** <u>Cyperus difformis</u>	—	1	R	LEGUMINOSAE			
** <u>Eleocharis acicularis</u>	—	1	O	<u>Canavalia cathartica</u>	Mauna-loa	1	R
** <u>Eleocharis obtusa</u>	Pipi wai	1	R	<u>Desmanthus virgatus</u>	Virgate mimosa	1	R
** <u>Scirpus californicus</u>	Great bulrush	3	V	<u>Mimosa pudica</u>	Sensitive plant	1	R
GRAMINEAE						MALVACEAE	
* <u>Brachiaria mutica</u>	California grass	5	V	* <u>Hibiscus tiliaceus</u>	Hau	1	R
<u>Cynodon dactylon</u>	Bermuda grass	1	O				
<u>Pennisetum clandestinum</u>	Kikuyu grass	1	R	MYRTACEAE			
<u>Pennisetum purpureum</u>	Elephant grass	1	R	<u>Eugenia cumini</u>	Java plum	1	R
<u>Paspalum conjugatum</u>	Hilo grass	1	O	ONAGRACEAE			
** <u>Paspalum vaginatum</u>	Seashore paspalum	1	R	** <u>Ludwigia octovalvis</u>	Kamole	1	R
* <u>Sporobolus virginicus</u>	Beach dropseed	1	R	** <u>Ludwigia palustris</u>	Water purslane	1	R
LEMNACEAE						PASSIFLORACEAE	
** <u>Lemna minor</u>	Duckweed	1	O	<u>Passiflora foetida</u>	Scarlet-fruited passionflower	1	R
** <u>Spirodala polyrrhiza</u>	Greater duckweed	1	R	SCROPHULARIACEAE			
MUSACEAE						** <u>Bacopa monnaria</u>	Water hyssop
<u>Musa xparadisiaca</u>	Banana	1	R				
PONTEDERIACEAE						** Obligatc species	
** <u>Eichornia crassipes</u>	Water hyacinth	1	O	* Facultative species			
** <u>Monochoria vaginalis</u>	Cordate monochoria	1	R				
TYPHACEAE						1 = <5% cover; 2 = 5-25%; 3 = 26-50%; 4 = 51-75%; 5 = 76-100%	
** <u>Typha angustata</u>	Cattail	1	O	R = Rare; O = Occasional; F = Frequent; A = Abundant; V = Very abundant			

Table 5.1 Principle Plant Species found at Kawai Nui Marsh (Taken From: Elliott, M. and Erin Hall Wetlands and Wetland Vegetation of Hawaii (Honolulu: Earthwatch Inc., 1977) for U.S. Army Engineers, Honolulu District.

it virtually worthless as a waterbird habitat. In moderation, however, these communities could provide valuable nesting and feeding areas if numerous potholes and channels were opened up throughout the area.¹¹

One of the species in the grass community, the cattail or Typha angustata is an emergent wetland plant that has recently become a pest "weed" of major proportions. Formerly, it was confined to small, widely dispersed pockets near the open pond areas, but now this plant forms an almost impenetrable stand occupying several acres near the confluence of Kahanaiki and Maunawili streams as they converge into the marsh. This recent cattail encroachment in the marsh was a condition that developed after heavy rains in April 1977, which delivered tons of topsoil from the Maunawili valley down into the marsh. The sediment runoff formed an expansive mudflat upon which the aggressive cattail species quickly invaded. So impenetrable has this cattail stand and elevated mud bottom become that, during another heavy rain in January 1980, it effectively diverted flood waters outside of their normal drainage channel near the confluence of the two above-mentioned streams and onto the pasture land to the northeast.¹²

3. a shrub and tree community On the outer edges of the grass and bulrush plant communities along the slopes above the marsh, there exists a tree and shrub community consisting primarily of koa haole (Leucaena leucocephala), guava (Psidium guajava), Chinese banyan (Ficus microcarpa) and monkey pod (Samanea saman). Smith (1978) noted about 119 plant species occurring in the area; eight of which were native, but no endangered¹³ species, while 24 of them occurred throughout the entire marsh.
4. an open-water community, which exists along the inner edges of the grass and bulrush communities, in the marsh interior, as well as in the canals entering and exiting the marsh.

The open-water community consists of the floating vegetation, which is rapidly taking over the diminished open water areas of the marsh. A dominant species in this area is water lettuce (Pistia stratiotes), a floating aquatic herb with a rosette of leaves and abundant dangling dark roots. Its leaves are light green, with velvety pubescence, three to twelve cm. long and two to eight cm. across with a spongy base up to two cm. thick. Its flowers are born on a spadix attached to a short leaflike spathe partially hidden by leaf bases. It has the potential for being a noxious weed that can form dense mats of vegetation which block canals and waterways.¹⁴ At Kawai Nui, Pistia appears to be confined to the Ka'elepulu Canal separating Kawai Nui from Enchanted Lake (formerly Ka'elepulu Fishpond), particularly along the stretch of slow moving water adjacent to the flood control levee on the northeast border of the marsh. Pistia is periodically controlled by City and County of Honolulu personnel using a herbicide in this canal, by the name of Diquat. As a result of this periodic clearing of Pistia, the value of this canal to endangered waterbirds, and to public observation of these waterbirds, for education and recreation purposes, is perpetuated (See Chapter 6, Section 6.3 for further details).¹⁵

Water lilies (Nymphaea sp.) and the water hyacinth (Eichornia crassipes) are by far the predominant floating water plant species which occupy the remaining open space in the marsh interior. Nymphaea are a very recent introduction into the marsh, having been unrecorded in the open water of the main pond until

1978.¹⁶ It is thought that this species was accidentally introduced from private ponds in the Maunawili watershed. Although its percentage cover in the marsh has varied over time, it has been recently observed as covering up to eighty percent of the remaining open water surface of the main pond. In moderate quantities, this species can provide a substrate upon which some waterbirds, particularly the Hawaiian gallinule, have been able to find invertebrate food. However, as the species spreads out in excessive quantities, this value is diminished and the plant reduces the circulation of water, caused by wind and stream flow, thereby increasing the rate at which the water hyacinth (Eichornia crassipes) invades the ponds.¹⁷

Eichornia was present in very localized areas along the periphery of the main pond in the marsh as early as 1972. These plants exist either as free-floating or anchored by roots in the soil of muddy shores. The mature plant consists of a short rhizome (vegetative stem), roots, rosulate leaves, an inflorescence and stolons which connect different plants. These plants reproduce vegetatively and can encroach upon open water areas, under favorable conditions, at rates which stagger the imagination. In Louisiana, for example, ten isolated plants were reported to have produced 1,610 plants in as little as three months.¹⁸ During the active growth phase, the number of water hyacinth plants may double within the first two weeks. The fact that most of this plant's tissues are capable of regeneration further increases its potential for rapidly spreading into an open water area.

Favorable conditions for such rapid spreading of Eichornia throughout Kawai Nui Marsh occurred as a result of the April 1977 flood. Although this flood initially nearly doubled the amount of open water in the marsh, and newly created mudflats from sediment being washed down from the surrounding hillsides created a temporary feeding and nesting habitat for the Hawaiian stiltbird, this temporary increase in wildlife habitat was soon reversed with the rapid invasion of the cattails onto the mudflat, and into the shallow water. As the cattail stand grew more dense and restricted stream flow in the area, water lilies growing on the water surface diminished the wind, which heretofore had prevented Eichornia from encroaching into the open pond area. Now, with cattails blocking the stream flow, and water lilies buffering the wind effect, the conditions were ripe for Eichornia mats to spread out onto the main pond from the periphery. Ever since then, the water hyacinth remains the principal "weed" plant,¹⁹ species in the marsh, now covering several acres of former open water habitat.

In moderation, water hyacinth can provide a substrate on which some waterbirds seek invertebrate food and at least one Hawaiian waterbird species (Hawaiian coot) may feed on its leaves and flowers occasionally.²⁰ However, in dense floating mats, this same species can diminish the availability of preferred foods of the endangered waterbirds and migratory waterfowl found at Kawai Nui. In addition, since penetration of light into the water is radically reduced by such dense mats, the photosynthetic activity by the phytoplankton at the base of the marsh food web is correspondingly reduced, thus creating imbalances in food relationships between species. Decomposer organisms become predominant, as the vegetation mats dies off and sinks to the bottom of the pond. As decomposition proceeds with each successive phase of plant growth and decay, the oxygen supply in the water is correspondingly reduced, thus making it less favorable for the survival of finfish and other aquatic animal life. Even decomposition of the dead plant matter is slowed down in this increasingly anaerobic environment, and the depth of the pond is gradually decreased as dead organic matter accumulates on

the bottom. This filling in of the marsh bottom is accompanied by increased water loss through evapotranspiration from the plant leaf surface, at a rate of loss which has been determined to be 1.3 to 6 times higher than evaporation from the open water surface alone.²¹ The combined forces of increased water loss, vegetation encroachment, accumulation of dead organic matter, and depletion of the dissolved oxygen supply in the water, are forces set in motion that may result in permanent loss of open water wildlife habitat if steps are not taken soon to remove the surface vegetation overgrowth. These forces of change are collectively referred to as eutrophication, a naturally occurring "aging" process in aquatic communities where productivity increases with a gradual increase in nutrient input.²² Unfortunately, in the case of Kawai Nui, this natural aging process has been sped up a great deal by the outpouring of nutrients into the marsh from the sewage effluent of four secondary sewage treatment plants, which have been draining their effluent into the marsh in such quantities as to account for roughly 92 percent of the total fixed nitrogen and 97 percent of the total phosphate entering the marsh and thus fertilizing the continuous vegetation encroachment.²³ In moderate proportions, as indicated in Section 5.1, the marsh can absorb such sewage effluent, and act as a water purifier. At Kawai Nui, where the vegetation growth has not been periodically cropped through active management techniques since former days of rice and taro cultivation, the marsh's natural capacity to absorb such effluents is diminished.

Section 5.3 Field Study of Vegetation Communities at Kawai Nui Marsh

The type and abundance of various species of vegetation are among the key factors which distinguish one type of ecosystem from another. They are also factors which help one determine whether that ecosystem is "polluted" or "healthy". Opportunities for studies of vegetation type and abundance in a freshwater wetland ecosystem, and recent changes in vegetation due to human influences (eg. introduction of exotic species; pollution inputs; urbanization encroachment), are excellent at Kawai Nui Marsh. The two basic methods by which these studies can be carried out is through aerial photo interpretation and transect/quadrat studies. (See Figure 5.2)

(1) Aerial photographs play an important role in vegetation mapping. The four different plant communities which comprise Kawai Nui Marsh, for example, are distinguished from each other on an aerial photo by such factors as differences in color and texture. The open-water community shows up as a brown, blue-black, or dark green colored area. The bulrush community shows up as dark green with a mottled texture. The grass community, by comparison, is light green with a smooth texture. The shrub and tree community shows up as a very dark green with coarse texture and shadows.²⁴ On a false-color infrared air photo, the two principle forms of vegetative cover in the marsh show up in boldly contrasting colors: pink for California grass and dark blue for bulrush.²⁵

The extent and rate of eutrophication of the marsh can be determined by examining a series of aerial photographs of the area over a number of years. Other interesting aspects of human influences over time that are evident in an aerial photo cannot be easily detected at ground level. Thus, for example, a recent wetland archaeological survey of Hawaiian taro lo'i in the marsh was greatly assisted by the availability of aerial imagery, in the form of numerous large- and small-scale obliques and verticals, in color and black-and-white. These

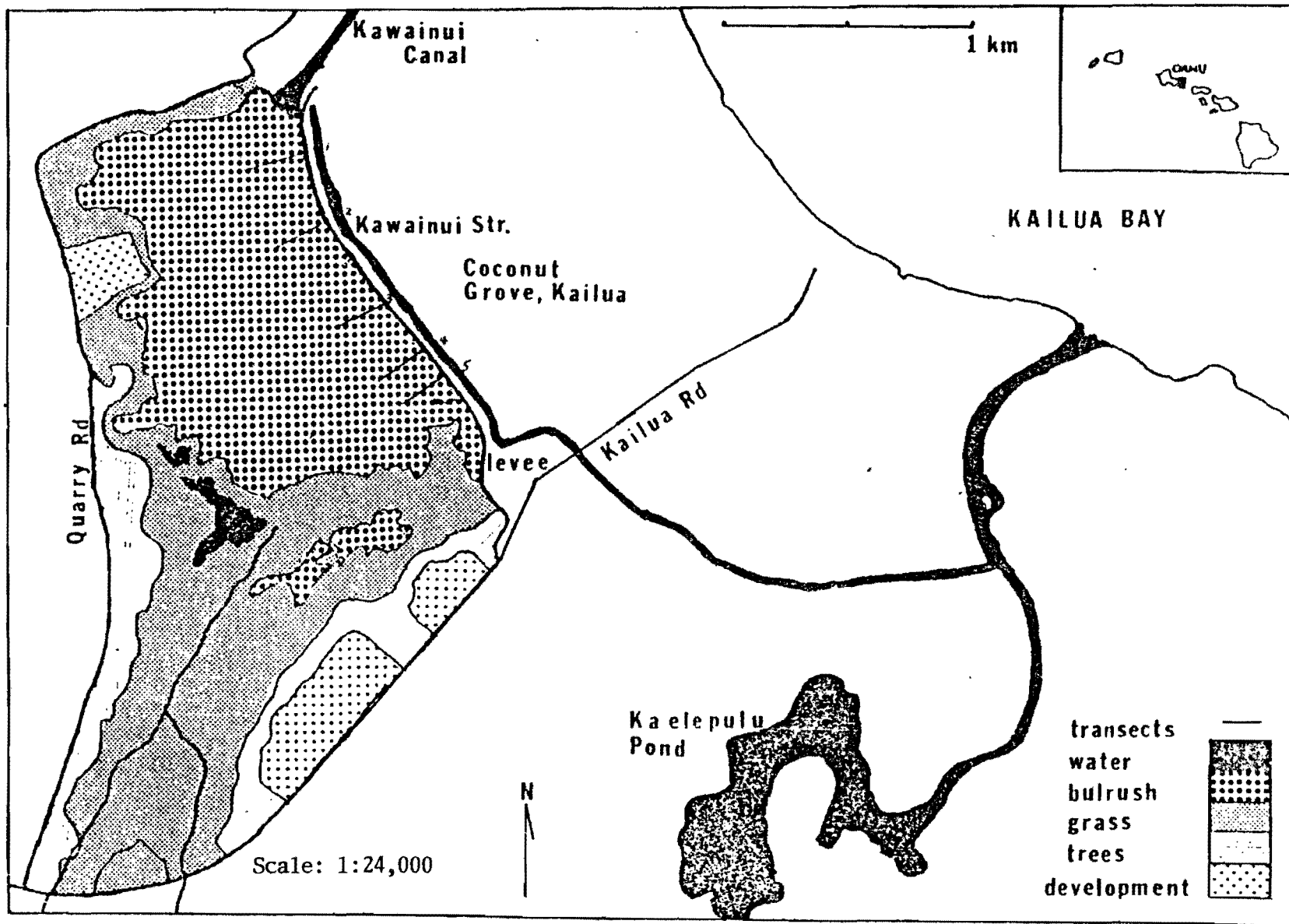


Figure 5.2 Vegetation Map of Kawai Nui Marsh (1974) Showing Transect Lines (Taken From: Smith, Linda L. Development of Emergent Vegetation in a Tropical Marsh, a Master of Science Thesis in Botanical Sciences, University of Hawaii at Manoa (May 1978), Figure 2, p. 21 (Transects were of this thesis study, located by numbered lines shown near the levee. Transects not to Scale, only indicate position.)

photographs especially the pre-1940 photomosaic, revealed the presence of numerous linear shadows, throughout most of the southern and central areas of the Marsh and at its western (Kapa'a Valley) boundary. Most of these linears were indicative of the existence of numerous taro lo'i, buried beneath thick layers of sediment deposited in recent times, and thus not obvious to the naked eye at ground level, but still evident as patterns in the aerial photographs.²⁶

(2) To obtain a thorough description of the type and distribution of vegetation in a particular area of Kawai Nui Marsh, the transect/quadrat method can be employed. This method consists of staking out a specific area on the ground, such as an area measuring one meter square, called a 1 square meter quadrat. One then systematically samples the vegetation within that area. The quadrat sampling continues, for example, along a 100 meter transect line, at regular intervals of 25 meters apiece. By taking note of the changing relative abundance of various plant species within each quadrat sampled along the transect line, the person doing the study can learn to detect the dominant vegetation in different communities, as well as the transition zones where two communities of plants overlap and blend into each other.²⁷ When one uses the transect/quadrat method to characterize various regions of vegetation in a marsh or other ecosystem, aerial photos and maps of the area are usually brought into the field, which greatly assist in the identification process.

FOOTNOTES FOR CHAPTER 5

1. This change in U.S. environmental policy toward the perception of wetlands as valuable resources to be preserved for their natural values is embodied, for example, in section 404 of the Clean Water Act of 1972, as amended. This section of the law and the accompanying regulations (42 Fed. Register 37136-37 (1977)), Section 320.4 (b), summarizes the values of wetlands to be protected. They also lay down guidelines for the regulatory agency, U.S. Army Corps of Engineers, to follow in reviewing and ruling on permit applications for developments that may affect wetlands. See also Executive Order 11990 (42 Fed. Ref. 26961 (1977)), signed by former President Carter, which made wetlands protection an executive priority and a matter of national policy.
2. Estimate of at least 40 percent of wetlands loss is based on the total known wetlands in the 48 contiguous states since records were kept on the subject. For further details, see Horwitz, Elinor, Our Nation's Wetlands, an Interagency Task Force Report (U.S. Dept. of Agriculture et. al., 1978), p.1.
3. Elliot, Margaret E. and Erin M. Hall. Wetlands and Wetland Vegetation of Hawaii (Honolulu: Earthwatch, September 1977), prepared for U.S. Army Corps of Engineers, Pacific Ocean Division, Fort Shafter, under contract No. DACW84-77-C-0014.
4. Poulos, Roger. "Where Have All the Marshlands Gone?" The Appraisal Journal, vol. 43, no. 1, January 1975, p. 125.
5. Section 29 of Chapter 205A of Hawaii Revised Statutes, governing Coastal Zone Management, delegates authority to the counties to establish permit application procedures for development in proposals in "special management areas," such as Kawainui Marsh, and other lands extending from the shoreline inland as delineated on maps created for the purpose of coastal zone regulation. Ordinance 4529, as amended, in the City and County of Honolulu lays out the specific permit review procedures which apply to development proposals in protected coastal areas such as Kawainui Marsh on the Island of O'ahu (City and County of Honolulu). The criteria for guiding decisions on compatibility of development proposals with resources being protected in the SMAs are laid out in Section 2 of HRS, chapter 205A.
6. Definition of "wetlands" as quoted from 33CFR323.2(c) and reprinted in Stemmermann, Lani. A Guide to Pacific Wetland Plants (Honolulu District: U.S. Army Corps of Engineers, 1981) p. 1.
7. Elliott, Margaret and E. M. Hall, op. cit., note 3, p. 7.
8. Ibid.
9. Description taken from "A Preliminary Report on Kawainui Marsh Plants by Ecology Camp Students," a report compiled by high school Ecology Camp participant, Mitchell Ai-Chang, February, 1982.
10. Ibid.

11. Shallenberger, Robert. "Environmental Assessment for Immediate Aquatic Plant Control, Kawainui Marsh," an in-house report for U.S. Dept. of Agriculture, Fish and Wildlife Service, 1980), p. 2.
12. Ibid., pp. 2-3.
13. Shallenberger, Robert. "Kawainui Marsh," an evaluation of the feasibility of developing it into a National Wildlife Refuge, (Honolulu: USDA, Fish and Wildlife Service, p. 5.
14. Ai-Chang, Mitchell, op. cit., note 9.
15. Shallenberger, Robert, op. cit., ref. 11, p. 3.
16. Ibid.
17. Ibid., pp. 4-5.
18. Ibid., p. 5.
19. Ibid., p. 4.
20. Ibid., p. 5.
21. Ibid., p. 6.
22. For more basic background on eutrophication, see, for example, Clapham, W.B., Jr. Natural Ecosystems (New York: The Macmillan Company, 1973), pp. 163-166.
23. U.S. Army Engineer District, Honolulu. Final Environmental Impact Statement, U.S. Dept. of the Army Permit Application for Olomana-Maunawili Sewer Projects, August 1981, p. 17, para. 3.18.
24. Ai-Chang, M., op. cit., note 9.
25. Elliott, M. and E. Hall, op. cit., note 3, p. 101 and Plate 23.
26. Allen-Wheeler, Jane. Archaeological Excavations in Kawainui Marsh (Honolulu: Department of Anthropology, Bishop Museum, November 1981), prepared for State of Hawaii, Department of Planning and Economic Development (DPED), p. 6.
27. Ai-Chang, M., op. cit., note 9, and Monnette, Mike, Draft Curriculum Guide for conducting biological science studies in Kawainui Marsh Spring 1981, completed as part of class project for Ed Ef 686, Environmental Education, instructor, Dr. Diane Drigot, University of Hawaii.

Chapter 6. SOME UNIQUE AND ENDANGERED WATERBIRDS FOUND AT KAWAI NUI MARSH

Section 6.1 Introduction

"The necks of the birds appeared on the pond of Kawai Nui among the rushes . . ."¹

Among all the land and freshwater birds ever identified in Hawaii, an estimated 20 genera, 44 species, and 32 subspecies belonging to 11 families of these birds are classified as "endemic"; i.e. they are birds that have been found nowhere else in the world.² Due to a variety of factors (eg. predation by humans and by introduced mammalian predators such as rats, mongoose, cats, and dogs; habitat destruction; competition from introduced birds; and decimation from diseases imported with the introduced birds), 26 species or subspecies of these endemic birds are now known or believed to have become extinct, while another 36 are considered to be close³ to extinction and are protected by state and federal endangered species laws.

Four of these endemic, endangered species of birds remaining in this group are found at Kawai Nui Marsh today: the Hawaiian Coot; its close relative, the Hawaiian Gallinule; the Hawaiian Duck; and the Hawaiian Stilt. These endangered waterbirds, along with the more abundant, indigenous Black-Crowned Night Heron and the introduced Cattle Egret, are the principal waterbird species associated with this largest of Hawaii's freshwater marshes. Another indigenous bird species, the Great Frigatebird, is a seabird which regularly visits the marsh. As an indigenous, rather than an endemic bird in Hawaii, the Frigate is also found throughout most of the tropical Pacific. In other words, it is representative of indigenous birds--uniquely found not only in Hawaii, but peculiar to a wider geographic region--in this case, the tropical Pacific.

In addition to these endemic and indigenous fresh water and seabirds found at Kawai Nui Marsh, a number of migratory water and shore birds which winter in Hawaii are often observed here. A number of introduced land birds are also commonly found. Table 6.1 contains a full listing of birds that have been repeatedly observed at Kawai Nui Marsh, listed according to their scientific, common, and Hawaiian names.

This large wetland habitat for a diverse assemblage of endemic, indigenous, and more common birds at Kawai Nui is located within ten miles of the downtown district of Honolulu, O'ahu -- the island which, for humans, is the most densely settled and visited island in the Hawaiian chain. The wildlife resources at Kawai Nui are being observed, studied, and enjoyed by many people. However, the marsh's continuing value as a habitat for the endemic, endangered, and indigenous birds is severely threatened by direct and indirect human influences. Heavy hunting pressure prior to World War II, predation from introduced mammals (eg. mongoose, dogs, cats, and rats), and the steady encroachment of exotic vegetation and sediment into the open water of the marsh, as urbanization of the surrounding land area continues--all of these factors have contributed to the decline in numbers of the endemic and indigenous bird species found here.

Table 6.1 Birds Found at Kawai Nui Marsh

NAME			
TYPE	Scientific	Common	Hawaiian
Endangered Endemic Waterbirds	<u>Fulica Americana alai</u>	Hawaiian Coot	'alaekē'oke'o
	<u>Gallinula chloropus sandvicensis</u>	Hawaiian Gallinule	'ālae 'ula
	<u>Anas wyvilliana</u>	Hawaiian Duck	kōloa maoli
	<u>Himantopus mexicanus knudseni</u>	Hawaiian Stilt	ae'o kuku'ua'o
Indigenous, Freshwater and Seabirds	<u>Nycticorax nycticorax hoactli</u>	Black-crowned Night Heron	auku'u
	<u>Fregata minor palmerstoni</u>	Great Frigate Bird	'iwa
Introduced Waterbirds	<u>Bubulcux ibis</u>	Cattle Egret	---
Migratory and Shore Birds	<u>Pluvialis dominica</u>	Golden Plover	kōlea
	<u>Anas platyrhynchos</u>	Mallard Duck	Kōloa-pīwai
	<u>Heteroscelus incanus</u>	Wandering Tattler	'ulii
	<u>Caladris alba</u>	Sanderling	huna-kai
	<u>Arenaria interpres</u>	Ruddy Turnstone	'akekeke
	<u>Anas clypeata</u>	Northern Shoveler	Kōloa-mōnā
Introduced (U = Urban) or (F = Forest)	<u>Anas acuta</u>	Pintail Duck	Kōloa-Māpu
	(U) <u>Columba livia</u>	Rock Dove	---
	(U) <u>Streptopelia chinensis</u>	Spotted Dove	---
	(U) <u>Geopelia striata</u>	Barred Dove	---
	(F) <u>Garrulax canorus</u>	Melodious Laughing Thrush	---
	(U) <u>Pycnonotus cater</u>	Red-vented Bulbul	---
	(F) <u>Copsychus malabaricus</u>	Shama Thrush	---
	(F) <u>Zosterops japonicus</u>	Japanese White Eye	---
	(U) <u>Acridotheres tristis</u>	Common Myna	---
	(U) <u>Carpodacus mexicanus</u>	House Finch	---
	(U) <u>Lonchura punctulata</u>	Spotted Munia	---
	(U) <u>Passer domesticus</u>	House Sparrow	---
	(U) <u>Cardinalis cardinalis</u>	Northern Cardinal	---
(U) <u>Paroaria coronata</u>	Red-Crested Cardinal	---	

The following quote from a recent U.S. Department of Interior, Fish and Wildlife Service publication, summarizes how these factors, in general, have led to the current endangered status of the many Hawaiian waterbirds, at Kawai Nui and at other wetland areas in the Hawaiian Islands:

Habitat for waterbirds has declined drastically since 1900. Sub-divisions, hotels, dumps, croplands, and factories have replaced former native environments. The rate of habitat destruction has accelerated in the past decade. Rice and taro fields once provided over 34,000 acres of habitat; today such fields comprise but a few hundred acres. Fewer and fewer duck and shorebirds visit the islands during their annual migrations across the Pacific. The numbers of birds dependent on wetlands for food and a place to raise their young have declined as these areas were destroyed. The non-migratory Hawaiian birds like the stilt, coot, duck (koloa) and gallinule are now threatened with extinction because of this loss.

Chapter 1 of this guide traces the factors--natural and human--which have changed the environment at Kawai Nui to become less favorable for these unique waterbirds. That chapter also traces the forces now underway to reverse this trend and restore the open water area in the marsh to become more valuable as a habitat for the unique Hawaiian waterbirds and the people who enjoy them.

This chapter will concentrate on giving the reader an introduction to the unique Hawaiian waterbirds found at Kawai Nui Marsh, not only from a biological point of view, but from the standpoint of their unique place in the cultural heritage of the native Hawaiian people. The Hawaiian historian, David Malo, said that feathers "were the most valued possessions of ancient Hawaiians", and that lands producing feathers were taxed heavily since such offerings were most acceptable to the Makahiki idol.⁵

Feathers were used to produce items of great beauty and value for the ali'i class. These included cloaks and capes (from the feathers of forest birds),⁶ necklaces and wreaths,⁷ women's hair ornaments,⁸ and for kahili (the royal standard and fly whisks), which were made from the feathers of the nene (goose) and 'iwa (frigate bird).⁹

Hawaiian attitudes toward birds appear to be more ambivalent than with other, perhaps more predictable, creatures.¹⁰ The 'ulili (tattler) and kolea (plover), for instance,¹¹ are perceived as spies,¹⁰ or with 'akeke (turnstone) as messengers.¹¹ Frequently, gods appear in bird forms, as well.¹²

Section 6.2 consists of an annotated list of the principle endemic and indigenous waterbirds that are known to breed or otherwise frequent the marsh. Section 6.3 will describe how a recent field study of these birds was carried out by a group of high school and university students, led by professional ornithologists, and sponsored by the Sierra Club High School Hikers Program.

Section 6.2 Annotated List of Principal Waterbirds Species Found at Kawai Nui Marsh

The Hawaiian Coot, Fulica americana alai, or 'alae ke'oke'o ("alae" meaning "forehead", "ke'oke'o" meaning "white") is an endemic subspecies of the American Coot. About fourteen inches in size, it is solid grayish-black except for white patches under the tail, and has a conspicuous white bill and frontal shield. The feet are lobed, and the Coot is duck-like in appearance. Immature birds are brownish and have a yellowish-brown frontal shield that gradually turns white. Its call is a variety of short, harsh croaks. Coots prefer open water areas in Kawai Nui, and nest along fringes or in small open areas in the marsh vegetation, from March through September. They build large, floating nests of aquatic vegetation, and lay four to ten tan and speckled eggs. The newly hatched coots are covered with black down except for the head, neck, and throat, where the down is reddish-orange. They can swim soon after hatching. Coots eat seeds, green parts of aquatic plants, invertebrates, tadpoles, and small fish. This species was the waterbird most adversely affected by the loss of open water habitat in Kawai Nui. As many as 75 have been recorded during official census counts, but numbers observed are usually lower than 15. Recent records of Coot nesting in Kawai Nui are lacking, but the most recent scientific survey reports concur that the Marsh probably supports between 20 and 30 resident Coots.¹³ (See Figure 6.1)

In Hawaiian cultural and spiritual beliefs, the Coot was a sacred bird, being one of the children born to the goddess Hina. However, with the decline of these beliefs in the 1800's, the Coot was widely hunted and eaten for food. It was a legal game bird in Hawaii until 1939. It is now a legally protected waterbird, on the state and federal list of endangered species.

The Hawaiian Gallinule, Gallinula chloropus sandvicensis, or 'alae 'ula ("ula" meaning "red") is an endemic Hawaiian subspecies of the North American Common Gallinule. Thirteen inches in size, it is slate-gray in color; darker on the head and lighter in color on the back, breast, and sides. When viewed at closer range, however, its distinctive coloration becomes apparent. It has white feathers on the flanks and under the tail. The bill and frontal shield are a distinctive bright red, except for a yellow tip. It has large, unwebbed feet, and long legs that are yellowish-green except for red patches near the body. Immature birds are olive-brown to grayish-brown, and have a pale yellow or brown bill. Its voice sounds much like a chicken call or croak, higher in pitch than its close relative the Coot. Gallinules can nest all year, but are most commonly seen nesting from March through August. They lay six to thirteen cream colored, speckled eggs in nests built on folded reeds or other aquatic vegetation. The young chicks are black, except for a bright red bill, and can swim soon after hatching, but run close to the parents for several weeks. 'Alae 'ula consume algae, grasses, aquatic insects, and molluscs. They are wary, somewhat secretive birds, and usually remain closer to vegetation than the Coot. They are often seen walking across floating vegetation in search of food and cover. This bird was legally hunted until 1941, and is now a protected endangered waterbird. (See Figure 6.2)

As Kawai Nui changed, these birds have dispersed to other water habitats. One of the largest concentrations of Hawaiian Gallinules still found in the vicinity of Kawai Nui is along Hamakua Drive, in Kailua, where the Kae'epulu Stream drains the Marsh and flows through Enchanted Lake (formerly Ka'elepulu fishpond)

Figure 6.1 Hawaiian Coot (Taken from: Shallenberger, Robert. An Ornithological Survey of Hawaiian Wetlands (Honolulu: Ahuimanu Productions, 1977), for U.S. Army Engineers, Honolulu District.)



Hawaiian Coot
'alae ke'o ke'o
Fulica americana alai

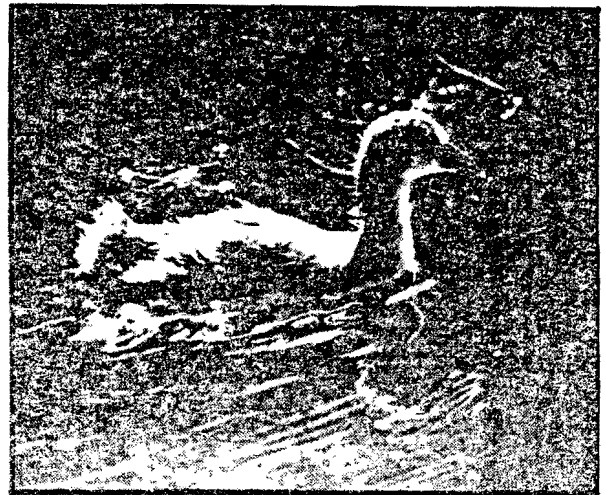


Figure 6.2 Hawaiian Gallinule (Taken from: Shallenberger, Robert. An Ornithological Survey of Hawaiian Wetlands (Honolulu: Ahuimanu Productions, 1977)



Hawaiian Gallinule

'alae 'ula

Gallinula chloropus sanduicensis



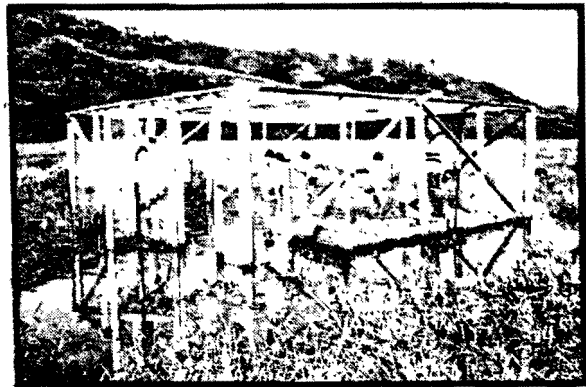
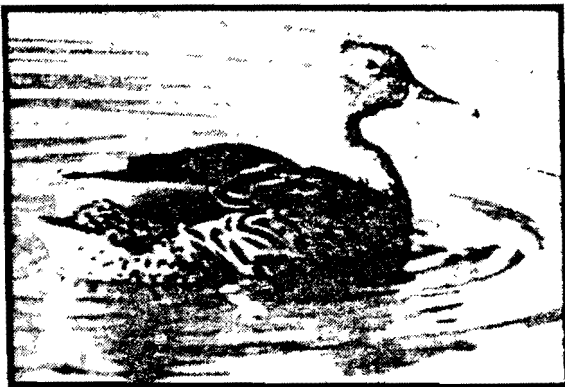
Figure 6.3 Hawaiian Duck (Taken from: Shallenberger, Robert. An Ornithological Survey of Hawaiian Wetlands (Honolulu: Ahuimanu Productions, 1977)



Hawaiian Duck

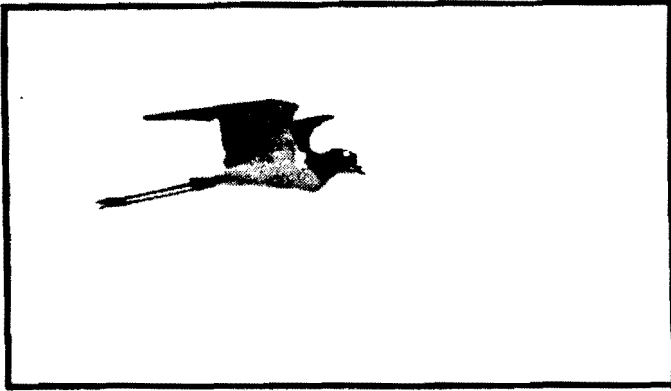
koloa maoli

Anas wyvilliana



Koloa release cage.

Figure 6.4 Hawaiian Stilt (Taken from: Shallenberger, Robert. n Ornithological Survey of Hawaiian Wetlands (Honolulu: Ahuimanu Productions, 1977)



Hawaiian Stilt

ae'o

Himantopus mexicanus knudseni



and out into Kailua Bay at Lanikai. Recent surveys have documented 10-15 Gallinule in this area, including at some times as many as three pairs nesting simultaneously. The secretive nature of this bird makes it quite likely that counts have consistently underestimated their numbers, occurring here and elsewhere in Hawaii. Before the mid-1960's, official surveys had recorded up to 11 Gallinule at Kawai Nui. Since then, both formal and informal counts have usually recorded only 2 or 3 observations at a time. The most recent survey resulted in a high count of 7 Gallinule in the Kawai Nui area (September, 1981). However, most ornithologists who have conducted these surveys concur that, since the secretive nature of this bird probably results in underestimation of their number during surveys,¹⁴ it is very probable that a minimum of about 15 of these birds exists in the area.

Culturally and spiritually significant to Hawaiian people, the 'Alae 'ula was, like the 'Alae Ke'oke'o, the sacred offspring of the goddess Hina. According to Beckwith, 'Alae-a-Hina is one of the gods invoked by sorcerers for the purpose of bringing death to an enemy. The 'Alae 'ula is also mentioned in The Kumulipo or Creation Chant. Here, the bird is considered the parent of the Apapane bird. The well known Hawaii trickster, Maui, in The Kumulipo, uses the 'Alae 'ula to bait the great hook that pulls the Hawaiian islands from the sea.¹⁵ Another recently recounted story of the 'Alae's place in The Kumulipo, or The Creation Chant, says that the geneological history of the Kalakaua dynasty, brings the 'alae from an egg out of the brain of the Goddess Hina after she wraps herself in a malo which she finds on the sand and goes to sleep in the warmth of her setting. She awakens and wonders about the egg and the bird, because she has not slept with a bird, but there it is!¹⁶

According to Fornander, the 'Alae'ula had the power to stop services at a heiau. If the bird chirped while services were being observed, the priest would say; "the services are inauspicious, and inappropriate", and would stop immediately.¹⁷ He also told of hearing the clucking of the bird, and saying, "some persons will soon die, the mud hen is clucking."¹⁸

Nevertheless, it is the story of the 'Alae 'ula bringing the¹⁹ knowledge of how to make fire to the Hawaiian people for which it is best known. It is said that at one time man did not know the secret of fire, and was forced to eat food raw, and to suffer the cold. Only the 'Alae birds knew the secret, and they refused to tell man how to kindle fire. The trickster Maui attempted to discover how fire was made from the birds, but they either put the flames out or did not kindle fire when he was present. One day Maui tricked the birds, by putting a tapa-covered calabash to represent himself in his brother's canoe, and watch them then light their fires. But the bird still did not easily give Maui the secret. First, it told Maui to rub the stalk of the ti plant with dry wood, Maui did so and produced only water. The bird then told Maui to rub the taro stalk the same way. Again Maui did so but again only water came forth. He again insisted the bird tell him the secret. This time the 'Alae said to rub green sticks together. Maui did so, but only got sap. By this time, he was so angry at the bird that he threatened to kill it. The 'Alae then told him to rub dry wood together, and this Maui did, finally making fire. With the blazing stick he had kindled, he then made a red mark on the head of the 'Alae, in order to tell men that the 'Alae knew the secret and kept it hidden, but that now men knew the secret.

The Hawaiian Duck, Anas wyvilliana or Koloa maoli, a native koloa, is similar to and probably derived from a common ancestor of the Mallard Duck of North

America. Males are about twenty inches and dark brown; females tend to be smaller at about sixteen inches, and lighter brown in color. Both sexes have a speculum (a distinctly colored patch on the secondary feathers), varying from greenish to purplish-metallic blue in color. Immature birds are brownish-yellow. Its call is a "quack" like the Mallard Duck. Koloa breed on the ground, near water, mainly from December through May. They lay two to ten white or tan colored eggs in well-concealed down and feather-lined nests. The young can swim soon after hatching. (See Figure 6.3)

Endemic to Hawaii, they were once very abundant and were formerly found on all the larger islands in the Hawaiian chain, including Niihau. The native Hawaiians sought them for food, particularly during the molting season, which rendered them flightless. During the earliest recorded counts, in the early part of this century, numbers of Koloa were reported as high as 8,000 on the island of Hawaii alone.²⁰ Populations of Koloa on all the islands began to decline rapidly due to hunting pressure, loss of habitat, and serious predation by dogs, cats, and mongoose. This bird was legally hunted in Hawaii until 1939, and a bag limit of twenty-five birds a day was set. By the 1950's, their numbers had decreased so drastically as to become extinct on all the major islands except Kauai. Then, the State established captive breeding programs and between 1969 and 1979, two hundred captive-reared Koloa were released in the Kawai Nui area, in an attempt to reestablish the species there. Since then, only about sixteen Koloa have been sighted at Kawai Nui at any one time.²¹ This apparently low survival rate suggests that these birds are very vulnerable to predator pressure from dogs, cats, and mongoose, and to reduction in their habitat through the vegetation encroachment in the marsh. The State will either have to continue the captive-rearing and releasing program for an indefinite time in to the future and/or improve the habitat for Koloa at Kawai Nui and elsewhere, if the extinction of this bird is to be avoided. The existence of much open water and good vegetation cover are two factors which, if expanded at Kawai Nui, would make an important contribution to the restoration of this bird's population in the area.²² Biologists are concerned about the growing number of feral (domestic birds gone wild) mallards that are found around Kawai Nui, particularly along Kawai Nui Canal and Kaelepulu stream. These birds will interbreed with Koloa species. Many residents who encourage mallards to breed or feed in their yards think they are helping wildlife, but they are actually doing a serious disservice to the unique Koloa.

The Hawaiian Stilt, Himantopus mexicanus knudseni, or *āe'o kukuluāe'o* (meaning "one standing tall") is an endemic Hawaiian subspecies of waterbird derived from the Black-necked Stilt of North America. At sixteen inches, it is the tallest stilt in the world. Adults are black above and white below, with a straight black bill and long pink legs. Immature stilts are brownish above and have duller leg colors than adults. The stilt can give a soft, muted call while resting, and a sharp, loud "keek" while in flight, or when disturbed on the ground. The *āe'o* nests from early spring through summer, usually in a shallow depression on the ground lined with stick, pebbles, and debris. It normally lays four camouflaged eggs. Young stilts, also well-camouflaged with a coat of variegated brown, buff, and black down, can leave the nest and feed with adults soon after hatching. Stilts are tall, wading birds, that probe the water for fish, crabs, worms, and water insects. This bird was hunted as a game bird until 1941, and is still sometimes shot illegally.

At present, the *āe'o* is not common to Kawai Nui. When present, it is usually observed infrequently on limited mudflat areas in the marsh. After a large storm

in May 1977, Shallenberger (1977) did find two pairs nesting there shortly thereafter. Lack of suitable habitat accounts for the stilt's rare occurrence in the marsh area.²³ However, approximately five percent of the remaining population of the Hawaiian stilt does nest in the nearby Nuupia Ponds at the Kaneohe Marine Corps Air Station on Mokapu peninsula, scarcely a mile away from the Kawai Nui Marsh area.²⁴ If the habitat at Kawai Nui were improved, it is suspected that the stilt population from this nearby colony would once again frequent the marsh area more often. In fact, under the right circumstances, the Hawaiian stilt population has been shown to thrive in human-managed wetland areas. Thus, for example, the Hanalei National Wildlife Refuge on Kauai, is a prime example where modern wetland taro cultivation is encouraged and has proven to be compatible with stilt and other waterbird usage. In fact, this human-managed wetland actually enhances the habitat for these birds, while producing food for humans.²⁵ This kind of symbiotic management relationship between wildlife and human populations shows the potential for realization of our national environmental goals, stated in such laws as the National Environmental Policy Act, which says that it is the policy of the United States to encourage a condition of "productive and enjoyable harmony" between humans and nature.²⁶ (See Figure 6.4)

The Great Frigatebird, Fregata minor palmerstoni, or 'iwa, is a large, majestic, primarily black and slender bird, with long, pointed and angled wings, and a deeply forked tail. The average size of the 'iwa is about forty-three inches, and its wingspan is about ninety inches—about eight feet. These indigenous seabirds probably roost on Moku Manu islet, off the coast of O'ahu at Mokapu peninsula, and come to the marsh to drink fresh water, and possibly to fish.²⁷ The 'iwa bird was well known to the Hawaiian people, and is frequently mentioned in legends, often used as the overseas messenger of the gods. In the legend of Keaomelemele, the 'iwa carries the fish attracting Makalei tree from the mythical land of Nu'umealani to Paliuli, on the island of Hawaii. This is the same Makalei tree that later came to 'Oahu, where it was eventually planted and thrived in Kawai Nui, and made Kawai Nui famous for its large fish population. The black and gray feathers of the 'iwa were used for kahili and to adorn the Makahiki idol at the New Year. More information on the role of the 'iwa bird in Hawaiian legends and chants associated with Kawai Nui is outlined in Chapter 2 of this Guide. (See Figures 6.5 & 8.4).

The Black-crowned Night Heron, Nycticorax nycticorax hoactli, or auku'u is an indigenous Hawaiian waterbird found at Kawai Nui and nearby areas. Scientists consider it to be indigenous rather than endemic, because the auku'u has not developed distinct characteristics different from other herons found on the American continent, where the auku'u is believed to have originated. Adult birds are about twenty-six inches long, are black on top of the head, back, and bill, are pale gray below; and have yellow legs and feet. Three (usually) highly modified long, narrow, white feathers grow backward from the head. Immature birds are brown, with underparts streaked with white. Its call is a short hoarse "quok", often heard while the bird is in flight. It lays two to four bluish-green eggs in a bulky tree nest of twigs and sticks, usually in the spring and early summer. The auku'u feeds mainly on aquatic insects, fish, frogs, and mice. As stated in a recent scientific survey of Kawai Nui waterbirds²⁸

Auku'u are regular inhabitants of Kawainui, roosting in the trees that border the Marsh. Shallenberger (1977) felt that the numbers of birds in juvenile plumage indicated that nesting occurs in the forested areas, but was unable to

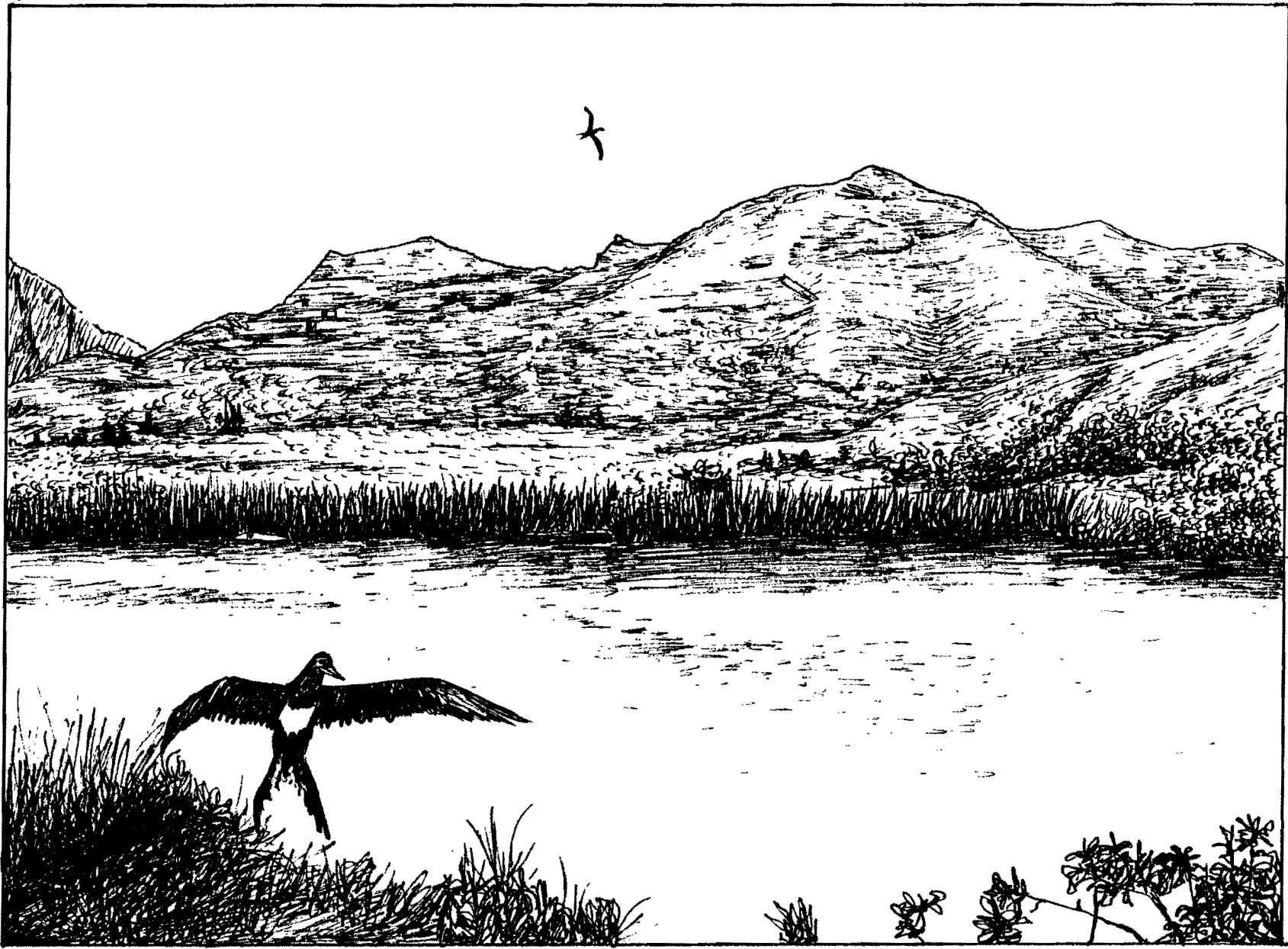


Figure 6.5 Artist's Rendition of The Great Frigatebird ('iwa) at Kawai Nui Marsh (Artist: Donna Kamahele)

confirm his suspicions. Most Auku'u are seen at the edges of the open water ponds in the upstream part of the Marsh, where Shallenberger (1977) recorded a high of 24 birds.

The highest total Shallenberger count for the entire Marsh of auku'u was 32 birds. In July 1981, a high of 48 of these birds was recorded by Conant in only one pond area of the Marsh. The highest State sponsored count ever recorded was in 1973, when 65 birds²⁹ were observed. Hawaiians have several sayings likening spies to the 'auku'u.³⁰

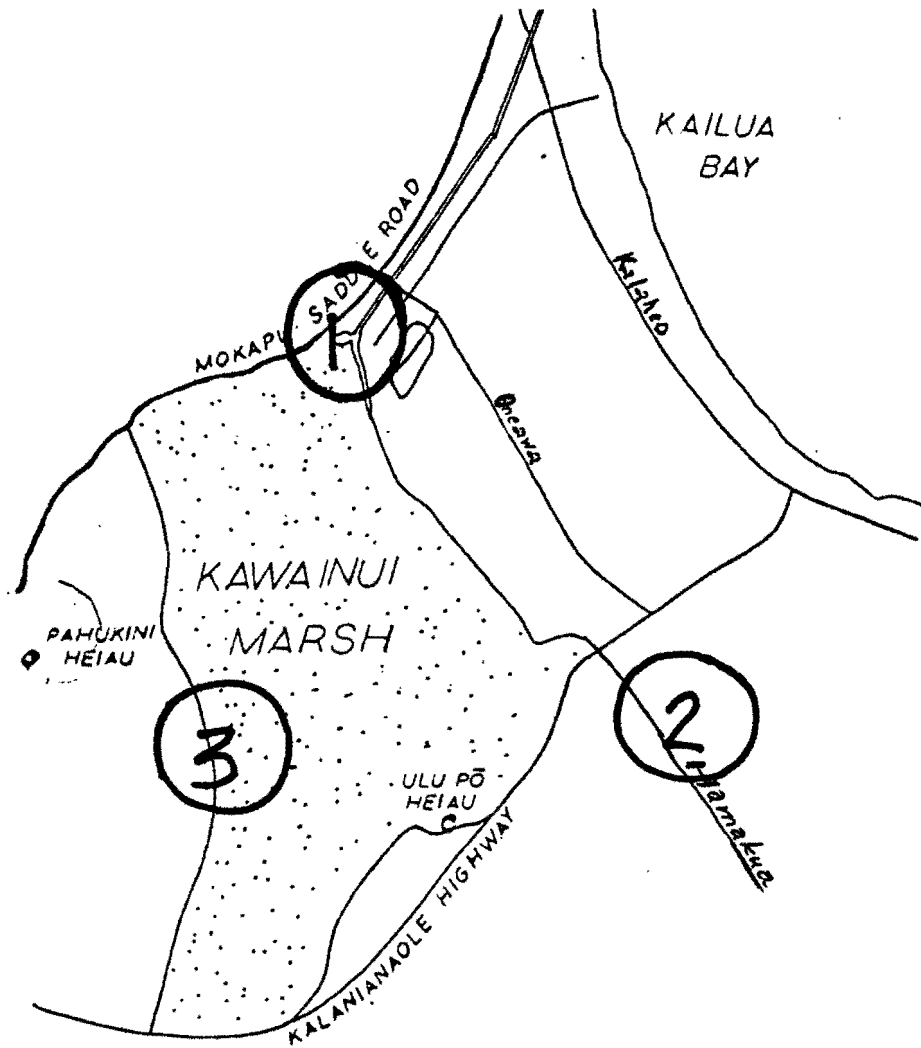
The last principal waterbird species to be discussed in this section is the most common, conspicuous one to be seen at Kawai Nui Marsh--the Cattle Egret or *Bubulcus ibis*. This small, white heron, about twenty inches tall, was introduced to Hawaii in 1959 to control insect pests in cattle. Immature birds have green or black legs and bills, and adult egrets have yellowish legs and bills. Its call is a deep "kwark" repeated frequently when the bird is disturbed. The Cattle Egret feeds on flies, grasshoppers, other insects, and crayfish. Large flocks are observed flying between its rookery at Kaneohe Marine Corps Air Station (KMCAS), on Mokapu peninsula and daytime feeding areas at the marsh. However, many egrets actually live in the marsh and are abundantly concentrated about the Kapa'a sanitary landfill above the marsh on the mauka side. Since 1967, Cattle Egrets have been regularly recorded at Kawai Nui on all formal and informal surveys, in numbers as high as 350 on a single count. The egret colony at the nearby KMCAS has been estimated to support 2,000 birds or more, many of which regularly visit the Marsh.³¹ Unfortunately, the population of Cattle Egrets in Kawai Nui Marsh and other wetland areas in Hawaii has grown to numbers which far exceed their intended usefulness when first introduced. They even pose a hazard to navigation in some airport landing areas and must be actively controlled as a "pest" species.³² As such, they represent a sadly too frequent example of poorly conceived, well-intended introduction of non-native species into a fragile island ecological balance, making perturbations in that balance which have led to significant and -- in many cases -- irreversible disruptions in the native ecological systems here.

Section 6.3 Representative Field Study of Unique Waterbirds at Kawai Nui Marsh

During the February 14, 1982 Ecology Camps at Kawai Nui Marsh, sponsored by the Sierra Club High School Hiker's Program, Dr. Robert Shallenberger, Supervisory Wildlife Biologist for the U.S. Department of Interior/Fish and Wildlife Service in Honolulu, led high school and university students on a study of the primary waterbird habitat along the makai edge of the Kawai Nui Marsh, at two field stations: one along Hamakua Drive, where the Marsh water flows into Ka'elepulu stream toward former Ka'elepulu Fishpond (now Enchanted Lake) and out into Kailua Bay at Lanikai. The other field station was at the northeast corner of the marsh where the water flows into Kawainui Canal and out to Kailua Bay. Both of these areas are excellent for viewing wildlife activity because of their open water and accessibility. (See location of these field sites in Figure 6.6 of this chapter.)

At each of these field stations, the students were split into groups. Each group was given a spotting scope, binoculars, an identification book on Hawaiian birds published by the Hawaii Audubon Society,³³ and a clip board with datasheet

Figure 6.6 Map of Marsh, Showing Bird Field Study Station Sites
 (Based on Map prepared by Jennifer Tyau)



1. Estuary End of Marsh at Kawainui Canal
2. Hamakua Drive
3. Pohaku au Hauwahine

Figure 6.7 Hamakua Canal Field Notes (Bird Observations)

Observer(s): Daniel Nahoopii Date: 2-14-82
 Time: 2 to 3 p.m.

Wind: 10-15 mph Cloud: 5% Rain: none Other: clear, warm, sunny

Survey Method: north to south in 3 sections Binoculars: _____ Scope: _____

Habitat condition: low water level

Vegetation in canal: none to very little

Human disturbance level: minor

Cattle: (Number/distribution) 10 cows, most under trees

Other Habitat Notes: See sketch/map - next page

Birds: _____
 (numbers, adults/young, sex, markings, behavior during obs., response to disturbance, vocalizations, indications of nesting, interspecific/intraspecific behaviors, distribution - show on map)

Gallinule: Male Gallinule going after female

Coot: Displays territorial behavior by lifting tail to show white underside; wards off other Gallinule

Stilt: _____

Koloa: _____

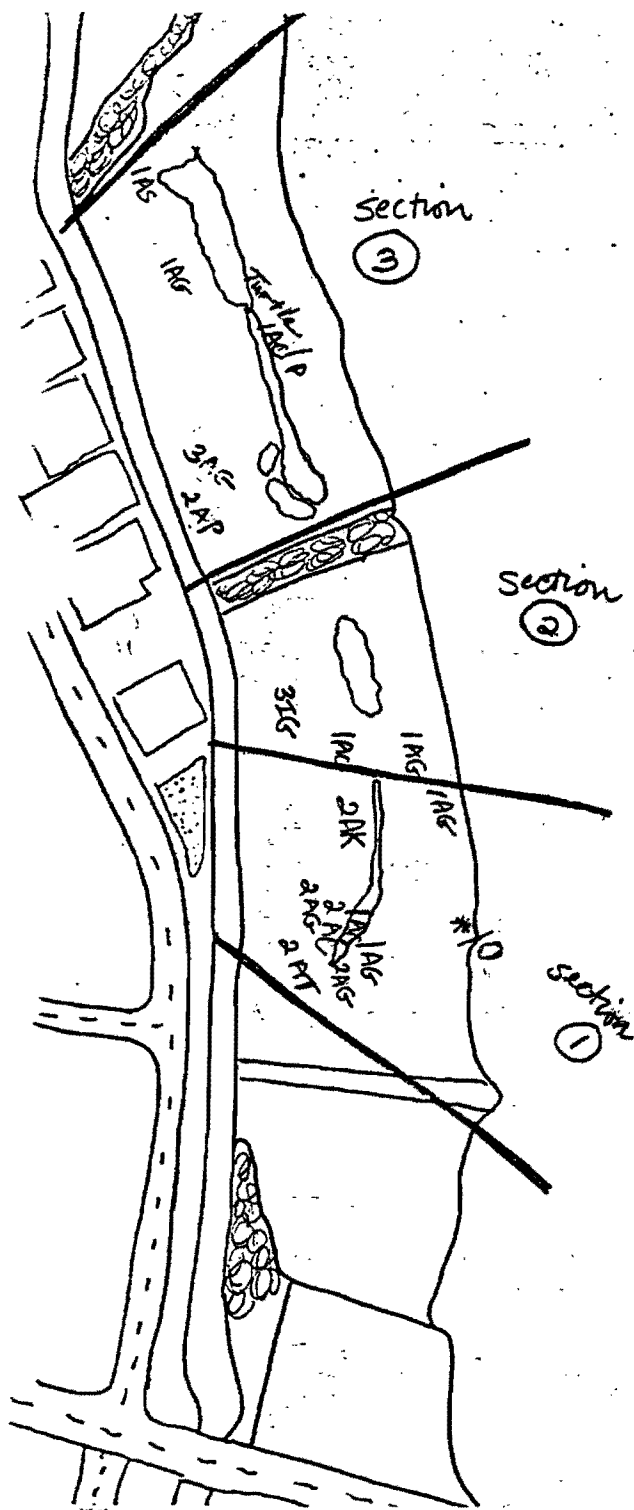
Other ducks: _____

Hérons/egrets: _____

Shorebirds: _____

Predators: _____

Figure 6.7 (continued)



Birds:

adult - A
 attended young - Y
 immature - I

gallinule - G
 coot - C
 stilt - S
 koloa - K
 other ducks - label
 heron - H
 egret - E
 plover - P
 turnstone - T
 wand. tattler - W
 sanderling - SG
 other shorebirds - label

mongoose - M
 dog - D
 cat - CT
 cattle - *
 people - +

on it. The data sheet for the Hamakua Drive field station, for example, had a map of the ponding areas there on one side and on the other side of the data sheet was a list of birds normally found in the marsh, and a section for observations. The map-side of the data sheet was used to record where the different kinds of birds were found, and the flip side was used to record the numbers of different species, the time, date, wind direction, velocity, cloud cover, rain, direction of survey, whether or not a spotting scope was used, condition of the habitat, and any human disturbance in the area. (See copy of representative filled out data sheet, in Figure 6.7)

The group moved from north to south along the study area at the Hamakua Drive/Ka'elepulu Stream field station, dividing the area into three sub-areas for observation and recording purposes. Dr. Shallenberger warned the group to be careful not to count any bird observed more than once, if it happened to move from one area into the other. Most of the birds were located in among the bulrushes and grass vegetation in the area, at some distance beyond the canal banks where the group was standing. (See Figure 6.8 for view) The spotting scopes and binoculars thus proved invaluable in getting a closer look at the birds.

While moving through the first area along the Hamakua Canal/Ka'elepulu Stream field station, the group saw the Hawaiian Duck, the Hawaiian Coot, and the Hawaiian Gallinule. At the second area, the group saw, in addition to the waterbirds already sighted in the first area, the Hawaiian Stilt. At the third area, both the Wandering Tattler and the Ruddy Turnstone birds were observed. These are both migratory birds that winter in Hawaii. Also in this last area, the group saw several Gallinule and a nesting Coot with mate. There was one immature heron as well.

According to Dr. Shallenberger, this area is unique in that all four of the Hawaiian native endangered waterbirds can easily be seen together, and within a very short distance from the road. One university student observed the reactions among the highschool students in attendance at this fields study as follows:³⁴
(See Figure 6.9)

The kids seemed able to relate to the birds at a heart level, watching with enthusiasm, how the birds live and take care of their young. As urbanization continues to grow, on Oahu, areas and experiences like this become increasingly important as ways we can look beyond the human experience into the wisdom and beauty of nature and perhaps get more insight into ourselves and the world around us.

These student comments on the educational values associated with water bird studies possible at Kawai Nui Marsh have been reinforced by official studies of its present and future potential development for this purpose. Thus, for example, in a recent study of the feasibility of including Kawai Nui Marsh as a unit within the National Wildlife Refuge System, the U.S. Fish and Wildlife Service said:³⁵ (See Fig. 7.0)

Outdoor classrooms and educational assistance are two major elements of the Service's environmental education program. Current use of the marsh by private and public school teachers and students is substantial in spite of difficulties in access, lack of facilities, teacher training, and interpretive materials. The Service has actively

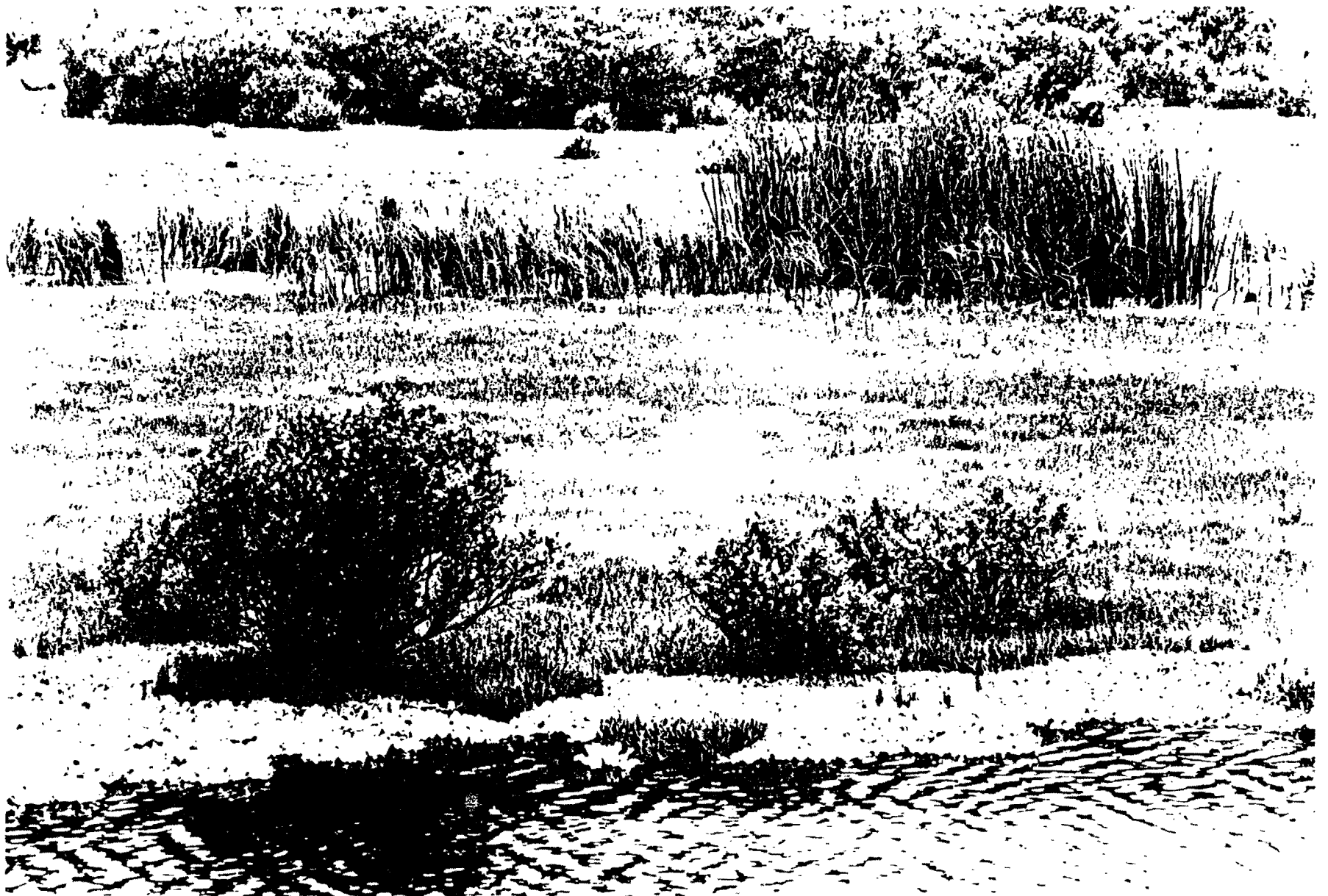


Figure 6.8 Photo of Ka'elepulu Stream, as Viewed from Bird Observation Site Along Hamakua Drive
(Photo by William Stifel)

Figure 6.9

Wetland Bird Study, Field Trip Report

By
Daniel Nahoopii
(Participant, Sierra Club Highschool Hiker's Program)

- Purpose:** To observe, locate, and classify bird life along the Hamakua Canal, Kailua, Oahu.
- Procedure:** Observation of the canal was divided into three sections. The first was located near the dirt path, the second across the parking area, and the third at the large pond area. Each observer was asked to plot on his/her map the location of birds observed. Worksheets were used to collect data.
- Data:** Date - 2/14/82 Time - 2:00 pm
 Wind - 10-15 mph Cloud - 5 percent
 Rain - none Other - warm sunny
 Habitat condition: Low water level
 Vegetation in canal: None to very little
 Human disturbance: minor
 Cattle: 10 cows most under trees
 Hawaiian Gallinule (Gallinule chloropus sandvicensis) 'alae 'ula numbers: 14; adults - 8; immature - 6; young - 0
 Male gallinule observed chasing female
 Hawaiian coot (Fulica americana alai) 'alae ke'o ke'o numbers: 7; adults - 7
 Displayed territorial behavior by lifting tail to show white underside; warded off gallinules.
 Hawaiian Stilt (Himantopus mexicanus knudseni) ae'o numbers: 1; adults - 1
 Hawaiian Duck (Anas wyvilliana) koloa numbers: 2; adults - 2
- Conclusion:** In our brief study of the Hamakua canal we have located all of the major endemic waterbirds. It is very exciting to see so many native birds so near to human occupation. This area should be considered for some type of reservation that would be used as an educational tool.



Figure 7.0 Bird Observation Site from Pohaku au Hauwahine Overlooking Kawai Nui Marsh (Artist: Donna Kamahele)

participated in teacher training and outdoor classroom activities which have occurred in the marsh. Each effort has resulted in an increasing demand for more participation by Service personnel. Kawai Nui Marsh was included in recent planning efforts sponsored by the State Department of Education to increase educational use of selected fields trip sites.

Because of its central location, relatively large size, and suitability for study of a variety of wetland habitats (stream, marsh, estuary), Kawainui Marsh provides a tremendous opportunity for outdoor classroom activities. The former Hawaii Director of the National Park Service has described Kawainui as having the greatest potential for interpretive use of any site in the State. As a contrast to the common seashore experience, the marsh provides a unique demonstration of concepts in freshwater ecology, wetland agriculture and aquaculture on a year-round basis. Other subjects, such as archaeology and Hawaiian culture, are currently the focus of field trip programs which could be expanded under refuge status. With proper staffing, the refuge could provide sorely needed educational assistance to teachers in public and private schools. These teachers would, in turn, expand refuge educational outputs through their subsequent use of the environmental education center and the marsh as an outdoor classroom.

FOOTNOTES FOR CHAPTER 6

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21. Conant, Sheila, op. cit., note 4, p. 8.
22. Ibid., p. 20.
23. Ibid., p.
24. Information from census records on file at Kaneohe Marine Corps Air Station (KMCAS).
25. For more information on bird/human coexistence and use of wetland habitat at Hanalei, Kauai, see Wilson Okamoto and Associates, Draft Environmental Impact Assessment for Hanalei - National Wildlife Refuges, Hanalei District, Kauai, prepared for U.S. Fish and Wildlife Service, September 1979.
26. NEPA Law
27. Conant, Sheila, op.cit., ref. 4, pp. 11, 17.
28. Ibid, pp. 9-10.
29. Ibid., p. 10
30. Pukui, M.K. and E.S. H. Elbert, op. cit., ref. 12, p. 29.
31. Ibid.
32. See for example, "Big Island Cattle Egrets" article in 'Elepaio, the Journal of the Hawaii Audubon Society, Volume 43, No. 1, July 1982, p. 5.

Section 6.3

33. See Shallenberger, Robert J. (ed.) Hawaii's Birds, (Honolulu: Hawaii Audubon Society, P.O. Box 22832, 1981), Third Edition.
34. Comments by Linda Lembeck, University of Hawaii Student, in field trip report on Ecology Camp at Kawai Nui Marsh, held February 14, 1981, for Dr. Diane Drigot's IS 489 Environmental Practicum class, as part of Kawai Nui Guide Project.
35. Quoted from U.S. Fish and Wildlife Service, op. cit., note 20, pp. 36-37.

SOME INSECTS FOUND AT KAWAI NUI MARSH

Chapter 7 • SOME INSECTS FOUND AT KAWAI NUI MARSH

Section 7.1 Introduction

It has been estimated that there are six to seven thousand species of insects in Hawaii. They were probably the first terrestrial animals to inhabit the Hawaiian islands. The native Hawaiian insects are a unique resource in that 98% of them are endemic species. The insect population is currently undergoing considerable changes with the introduction of exotic species. Prior to man's arrival in Hawaii the rate of introduction for new insect species was approximately one species every fifty thousand years. In the past twenty years the rate has climbed to an average number of about two dozen species each year.

No comprehensive studies of the insect life in Kawainui Marsh have been conducted thus far. This pamphlet is not intended to serve as the definitive word about the insect life of the marsh. Yet even without detailed knowledge, it is easy to recognize the richness of the insect community. Dr. Wayne Gagné of the Bishop Museum has estimated that a thorough survey of the insect fauna of the marsh would show the existence of several hundred species.

The insect population plays a key role in the food webs of the marsh. Several of the waterbird and fish populations are supported by the insect life.

Section 7.2 Field Study of Kawai Nui Insects

A simple field study requires the following pieces of equipment; alcohol vials, killing bottles, forceps, aspirators and collecting nets. The device used to capture the insects is a sweep net. In the terrestrial areas to be sampled a fine mesh net with a round frame should be used. With the flat edge it is possible to drag this net along the mud at the bottom of the stream. (See Figures 7.1 and 7.2).

It is important to keep the net moving while collecting and to keep the number of sweeps consistent in each area sampled. The locality, habitat or ecosystem, date, and collector's name should be recorded.

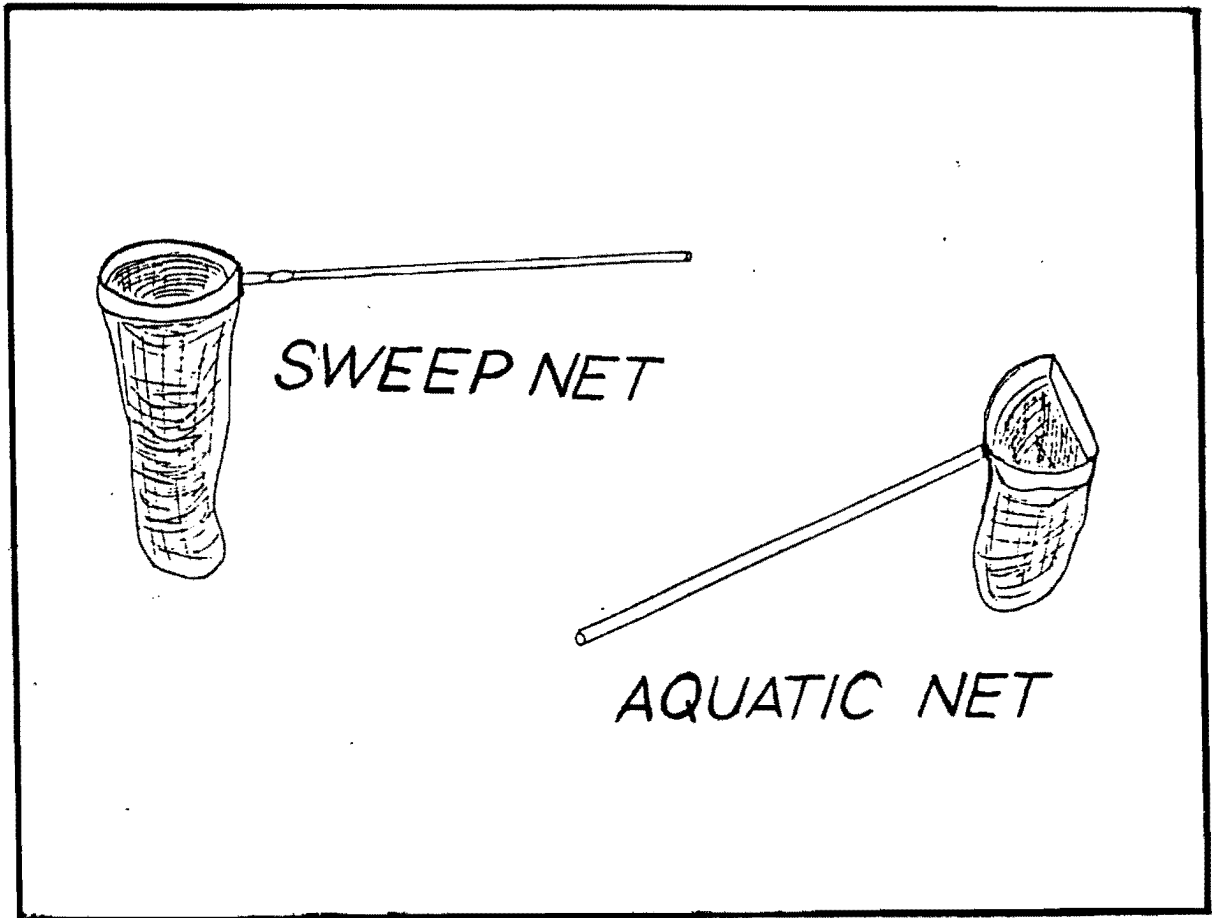
Once the insects are caught in the nets, they must be transferred to other containers for observation and study. With the dry nets, the closed end should be held up toward the sun. This will cause the flying insects to fly toward the sun and away from the open end and will give the collector the opportunity to remove them from the net. Small hard-bodied insects can be removed with an aspirator. Spiders should never be aspirated because they will spin webs in the aspirators which will clog them. Fingers or forceps can be used to remove the other insects.

Soft-bodied insects and spiders should be placed in alcohol vials (70% alcohol solution) to keep them from shriveling. Hard-bodied insects can be placed in killing jars. The killing agent can be potassium or sodium cyanide in sawdust. Safer but less effective agents are carbon tetrachloride or ethyl acetate.

Some field mounting should be done with the insects, especially moths. The spreading of the wings or the movement of the limbs should be accomplished while the insect is still pliable. Larger insects can be attached to boards with pins. The

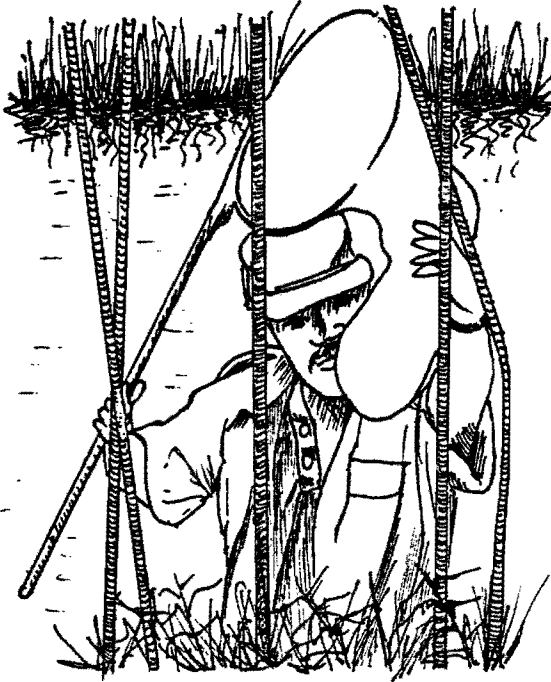
pins should be of good quality (stainless steel or silver) if the insects are to be part of a permanent collection. Inexpensive pins rust and destroy the specimen. Smaller insects can be fixed to paper points.

Figure 7.1 Artist's Rendition of Insect Collecting Nets Used in Marsh Field Studies (Sweep Net vs. Aquatic Net) (Artist: Jennifer Tyau)

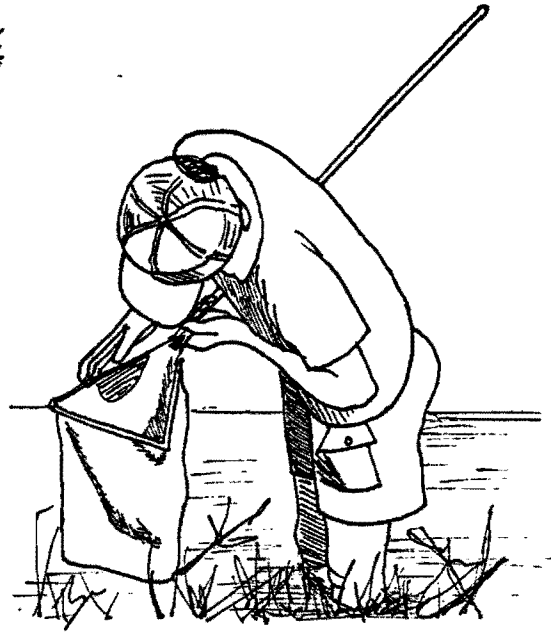


The intended use of this chapter is as a guide on how to study the insects of the marsh. One of the best locations to study a wide range of insect life is in the estuary end of the marsh. Four ecosystems are represented at this site. There is an open or running water ecosystem and a submergent plant zone. The third area, the shoreline, is called the ecotone, since it is an area of transition between the aquatic and land environments. The terrestrial zone is the fourth ecosystem. (See Figures 7.2 and 7.3)

Figure 7.2 Artist's Rendition of Insect Collecting with Nets in Marsh Water, along Marsh Banks, and at Inland Shore (Artist: Donna Kamahele)



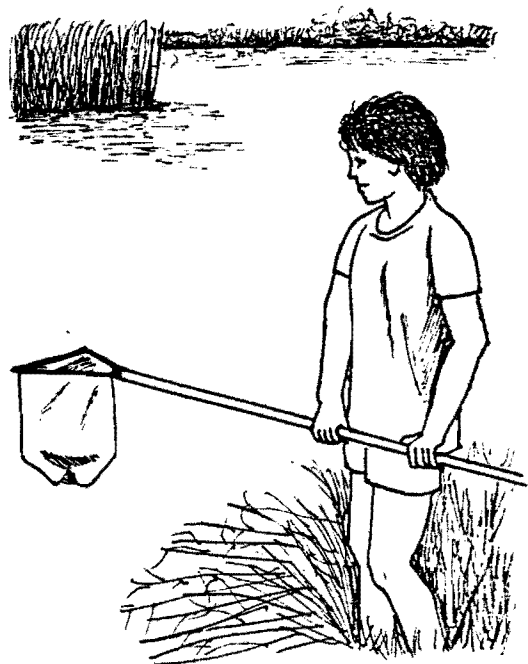
In Water



Along Banks

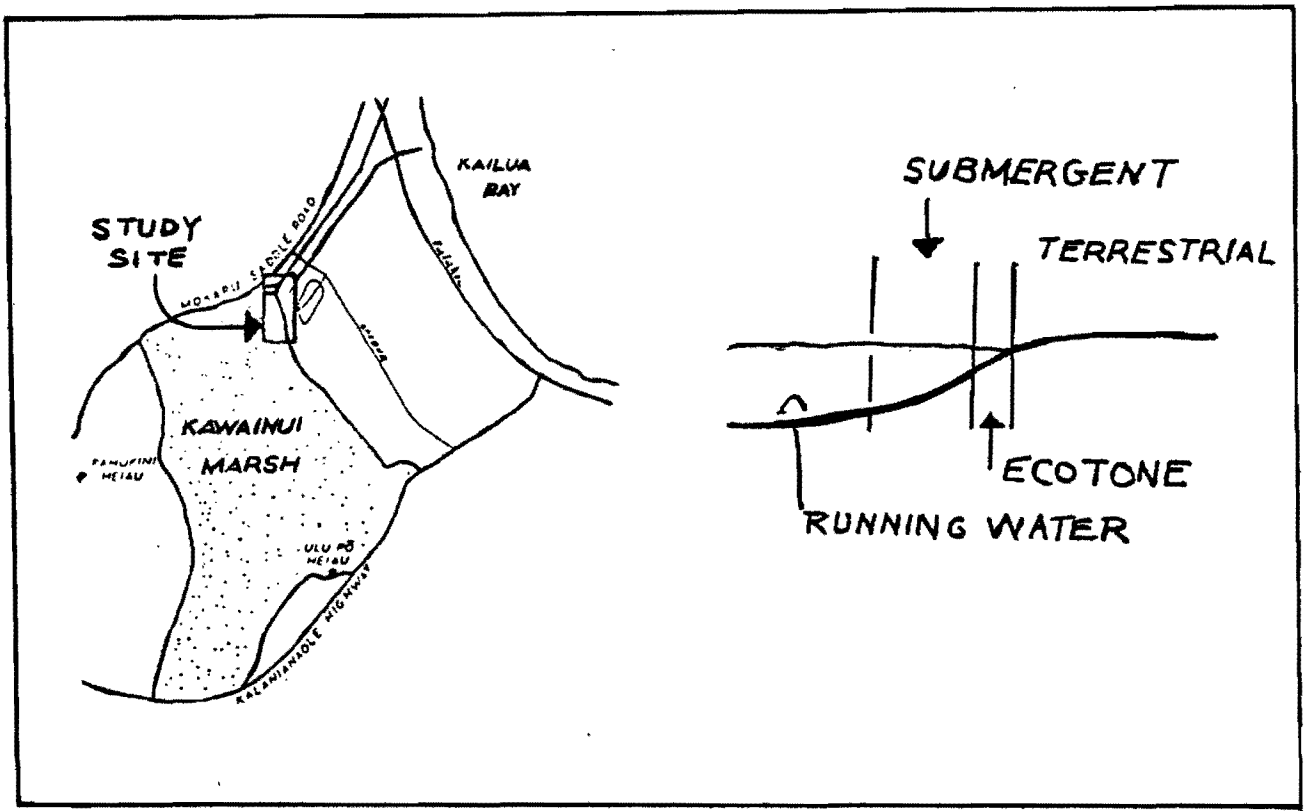


Inland Shore



Along Banks

Figure 7. 3 Map and Cross Section of Insect Study Station at Kawai Nui Marsh
(Artist: Jennifer Tyau)



Section 7.3 Classification of Marsh Insects Identified in Field Study

The insects can be classified by which ecosystem they live in, by what place they occupy in the food web or by traditional taxonomic classifications. The following pages provide examples of insects in the various orders that can be found in the marsh.

PHYLUM: ARTHROPODA

CLASS: ARACHNIDA

ORDER: ARANEIDA

Argiopidae - Orb Web Spiders
Salticidae - Jumping Spiders

CLASS: CRUSTACEA

ORDER: AMPHIPODA

Talitridae - Sand hoppers

CLASS: HEXAPODAORDER: COLEOPTERA

Family: Dytisicidae - Diving Beetles

ORDER: DIPTERA

Family Culicidae - Mosquitos
 Family Dolichopodidae - Long Legged Flies
 Family Anthomyiidae - Seed Corn Maggots

ORDER: HEMIPTERA

Family Aphidae - Aphids
 Family Pentatomidae - Stink Bugs
 Family Delphacidae - Leaf Hoppers
 Family Mesoveliidae - Water Striders
 Family Membracidae - Tree Hoppers
 Family Notonectidae - Backswimmers
 Family Reduviidae - Assassin Bugs

ORDER: HYMENOPTERA

Family Formicidae - Big Headed Ants, Crazy Ants

ORDER: LEPIDOPTERA

SUBORDER HETEROCERA

Family Noctuidae - Cut Worm Moths

SUBORDER RHOPALOCERA

Family Danaidae - Monarch Butterflies

ORDER: ODONATA

SUBORDER ANISOPTERA

Families, Several — eg. an indigenous specie, Pantela flavescens,
 or, in Hawaiian, Pinau:

SUBORDER ZYGOPTERA

Family Coenagrionidae - Damsel Flies

ORDER: ORTHOPTERA

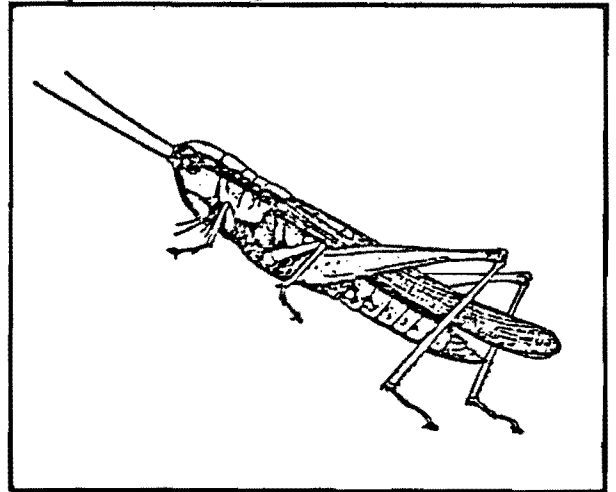
Family Acrididae - Short Horned Grasshoppers
 Family Tettigoniidae - Long Horned Grasshoppers, or Katydid

ORDER: ORTHOPTERA

Short-horned Grasshoppers
(Family: Acrididae)

Members of this family are found in abundance in Hawaii's lowlands. Many species, such as the Chinese Grasshopper, were accidentally introduced in the late 1800's.

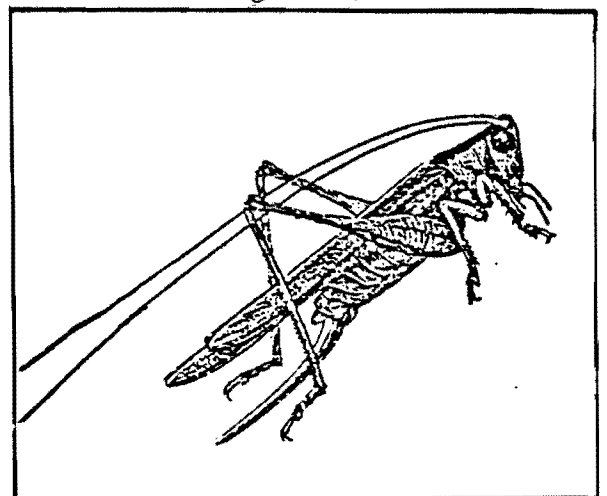
Figure 7,4



Long-horned Grasshoppers or Katydid
(Family: Tettigoniidae)

Some omnivorous species of this group can be found in large numbers in the marsh. Commonly known as katydids, these insects owe their success in this environment to their flexible eating habits. Like the short-horned grasshoppers, they are accidentally introduced.

Figure 7,5



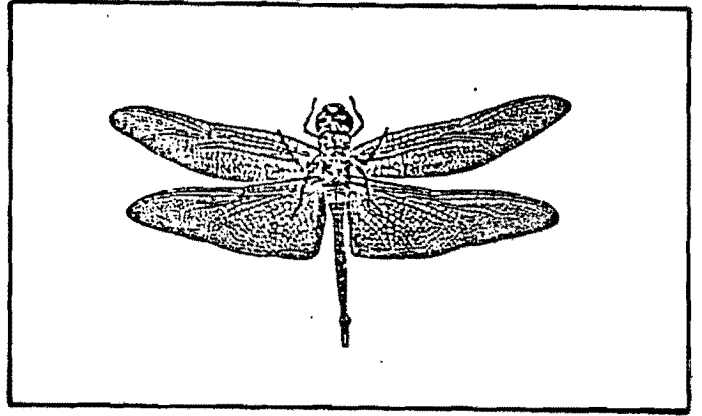
ORDER: ODONATA

Dragon flies

(Suborder: Anisoptera)

There are five species found in Hawaii, including the endemic Giant Hawaiian dragonfly. These organisms show incomplete metamorphosis. The nymphs live in the water and like the adults are predators. The wings of the dragonfly are held in a horizontal position when it's resting.

Figure 7.6

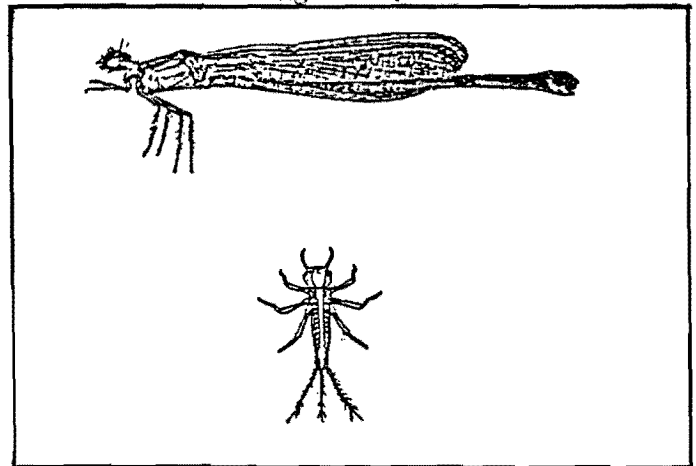


Damselflies

(Suborder: Zygoptera)

This group is related to the dragonfly. Its members are predatory and territorial. A damselfly will fly back and forth over its territory using its feet like a shovel to catch insect food and eat it while moving. The wings of the damselfly fold up perpendicular to its body while resting.

Figure 7.7

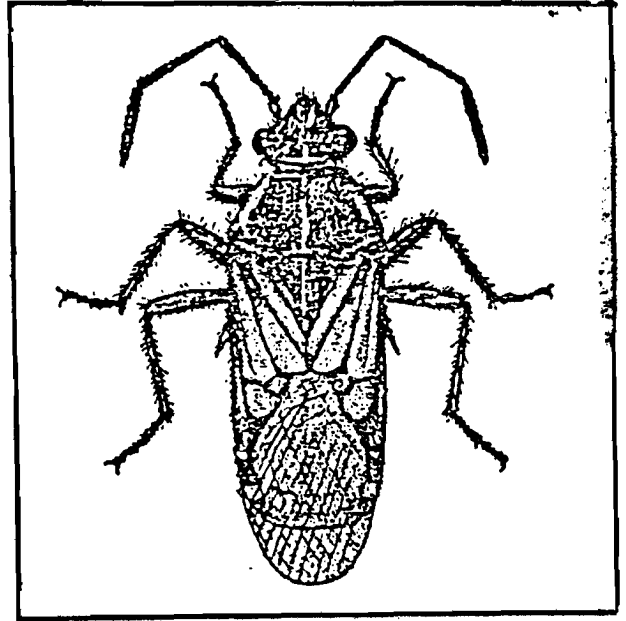


ORDER: HEMIPTERA

Stink Bugs
(Family: Pentatomidae)

These insects have glands that secrete chemicals which act to repel its predators and humans with sensitive noses.

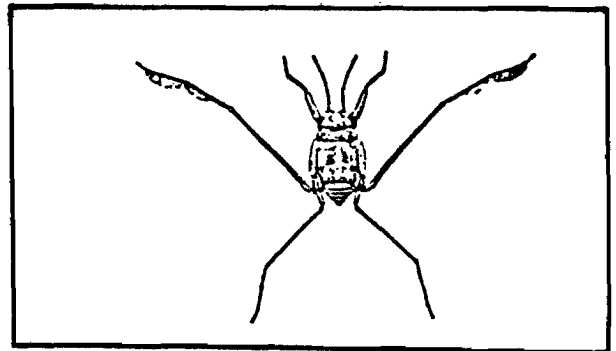
Figure 7.8



Water Striders
(Family: Mesoveliidae)

These insects prefer quiet or gently flowing waters. They skim over the surface of the water using their spider-like legs. Water striders are predators.

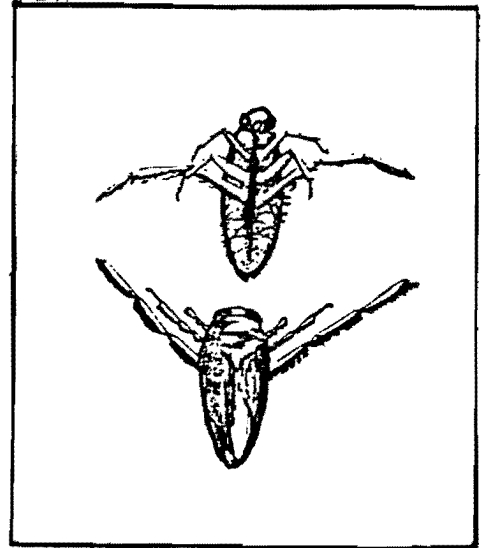
Figure 7.9



Backswimmers
(Family: Notonectidae)

These aquatic bugs swim on their backs using their long hind legs to propel themselves through the water. This predaceous bug is a recent introduction probably arriving into the marsh via a dumped aquarium. They inflict a bite.

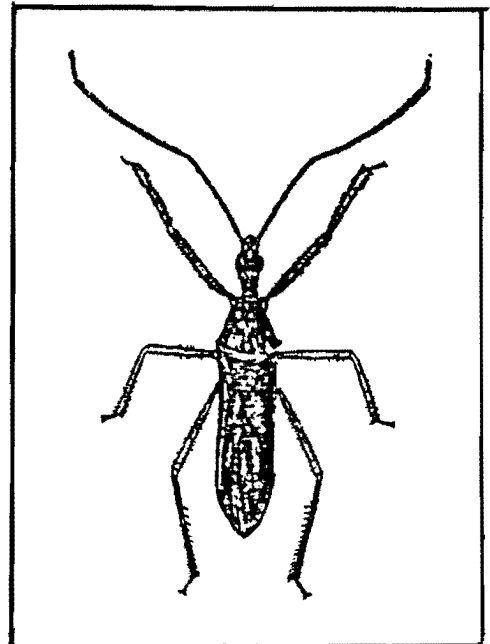
Figure 7.10



Assassin Bugs
(Family: Reduviidae)

These predators have needle-like mouth parts for sucking on their prey. They feed off of the blood of their victims.

Figure 7.11



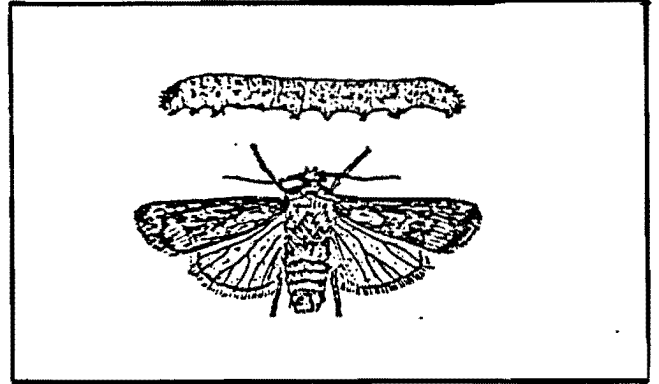
ORDER: LEPIDOPTERA

Suborder: Heterocera (moths)

Cutworm moths
(Family: Noctuidae)

Some of these moths are considered pests because of their caterpillars. The cutworms will eat young plants off at the surface of the ground before they can develop. The adults are mainly nocturnal.

Figure 7.12

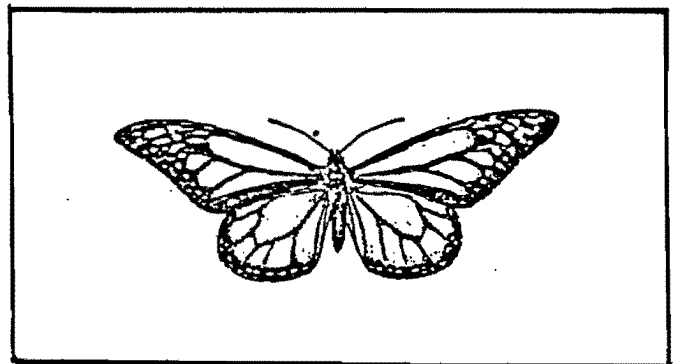


Suborder: Rhopalocera

Monarch Butterfly
(Family: Danidae)

This is one of ten butterfly species found in Hawaii. The Monarch is among the most commonly found lowland butterflies.

Figure 7.13



ORDER: DIPTERAMosquitos
(Family: Culicidae)

Mosquitos are introduced organisms. They undergo complete metamorphosis. The larvae, called wrigglers, and the pupae, are completely aquatic. The adult has a long piercing and sucking tube to obtain its food. Females are blood feeders, while males feed on nectar.

Figure 7.14

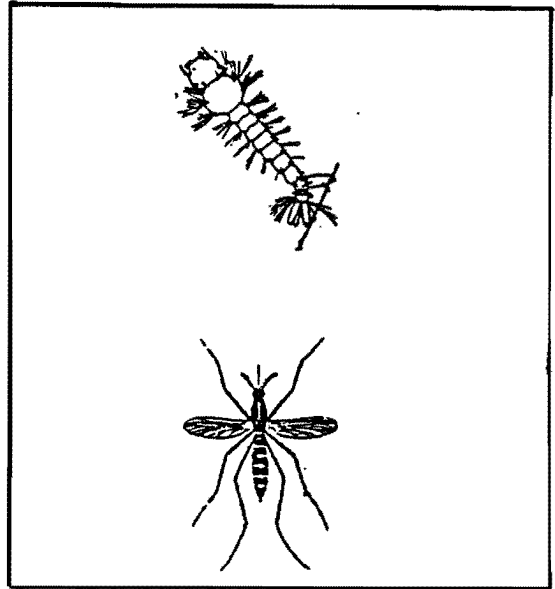
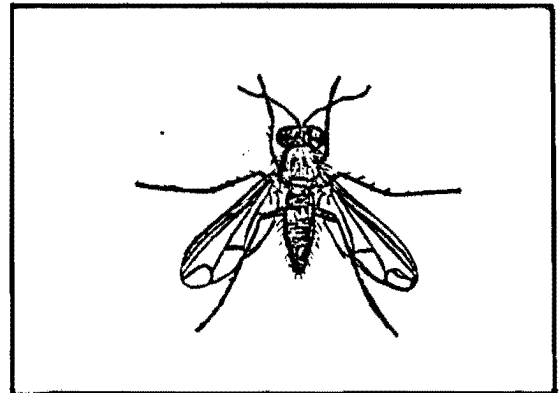


Figure 7.15

Long-legged Flies
(Family: Dolichopodidae)

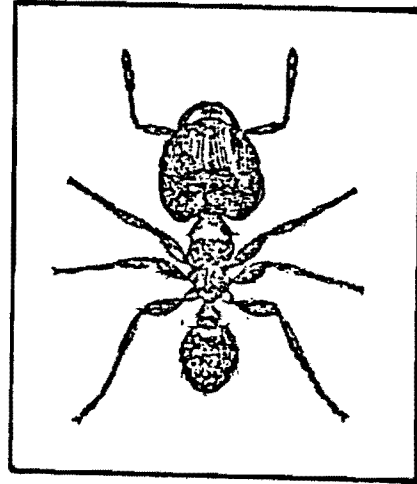
The larvae of these flies live in moist earth and decaying wood, and like the adult form, they prey on small insects. A bright green species can be found in the marsh.



ORDER: HYMENOPTERAAnts
(Family: Formicidae)

The big-headed brown ant is common in many lowland areas, including the marsh. These ants live in colonies. It is an introduced species but has a Hawaiian name, naonao.

Figure 7.16

ORDER: COLEOPTERADiving Beetles
(Family: Dytiscidae)

When breathing, these predaceous beetles are found with their heads below the surface of the water and their abdomens at the surface, thus their name, diving beetles. Their legs are long and slender and adapted for swimming.

Figure 7.17



RELATIVES OF THE INSECTS

CLASS: ARACHNIDA

Spiders
(Order: Araneida)

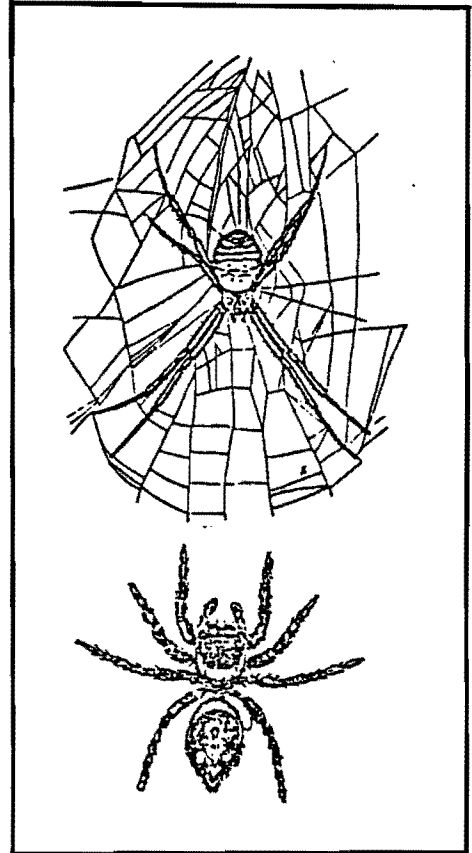
Orb Web Spider

This spider builds a sticky, strong web. These webs are common in the terrestrial environment.

Jumping Spider

This spider is also found in the terrestrial environment. It was named the way it was because it pounces on its prey.

Figure 7.18

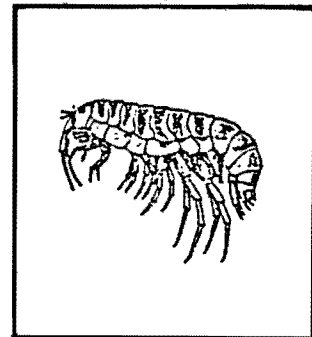


CLASS: CRUSTACEA

Amphipods
(Order: Amphipoda)

These small crustaceans are found in the ecotonal ecosystem. They are able to survive in large numbers because they can escape the mosquito fish.

Figure 7.19



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Illustrations primarily from:

Williams, Dr. Francis. Handbook of Insects and Other Invertebrates of Hawaiian Sugar Cane Fields. A Hawaii Sugar Planters Association Publication, 1931.

Much of the information came from the insect study done at the Ecology Day Camp conducted by Dr. Wayne Gagné of the Bishop Museum, in February, 1982, and sponsored by the Sierra Club High School Hikers Program.

Chapter 8. AQUATIC ANIMAL LIFE FOUND AT KAWAI NUI MARSH

Section 8.1 Introduction

Although the biological productivity of Kawai Nui Marsh today is dominated by an overabundance of vegetative growth, the existence of fish, shellfish, crustaceans, mollusks, amphibians, and other such aquatic animal life (besides waterbirds), in the Marsh is not just confined to the past, during Kawai Nui's heyday as a native Hawaiian fishpond. Although reduced in numbers since then, native Hawaiian aquatic animal life continues to exist in the marsh, in addition to various introduced species (See Table 8.1 for comparison of aquatic animal life found at Kawai Nui — past and present).

Many generations of youth, past and present, in the Kailua area can remember fondly the days spent fishing in and around Kawai Nui Marsh. Senator Daniel Inouye, is one among the more notable of these people.¹ Any casual observer in the marsh vicinity will note that many people utilize the streams and canals leading into and out from the marsh for bait or sport fishing.

Another popular use of the marsh by the younger generation is as a source and repository for aquatic pets, such as turtles. The value placed on the marsh for this purpose is clearly indicated in this recent letter to the newspaper, from two sixth grade children concerned about the future disposition of the marsh:²

Kawainui's value

My friend and I are worried about the debate going on over Kawainui swamp. For sixth grade Animal Care at school, we have a small turtle that came from there. After Animal Care is over, we plan to return him to the swamp, if the swamp is still there.

We have read that developers want to build approximately 150 homes at the swamp site. We have also read that there are several species of water birds which live at the swamp. It is said, that if anything is built there, the birds may become extinct. Building new homes for people, and kicking animals out of theirs has gone on long enough.

My friend and I are very angered over this situation. We have already called the City Council and we have our names down as being opposed to development. We would like to help any other way we can. If you feel as we do about Kawainui marsh, please make your feelings known by contacting your city councilman. Thank you.

JENNIFER SEUBERT and MALIA DENIS
Punahou School, Sixth Grade

Table 8.1 Aquatic Animal Life Possibly Found in Kawai Nui
in Pre-Contact Fresh Water Fishpond and/or Present Marsh Environment

Scientific Name	Common, Local Names	Origin 1, 2, 3
CRUSTACEANS		
<i>Atya bisulcata</i>	Mountain shrimp, opae kala'ole	endemic
<i>Macrobrachium grandimanus</i>	Hawaiian prawn, opae oeha'a	endemic
<i>M. lar</i>	Tahitian prawn	exotic
<i>Palaemon debilis</i>	grass shrimp	indigenous
<i>Podophthalmus vigil</i>	long eyed swimming crab	indigenous
<i>Portunus sanguinolentus</i>	haole, blue-spot crab	indigenous
<i>Procambarus clarkii</i>	crayfish	exotic
<i>Scylla serrata</i>	Samoan crab	exotic
<i>Thalamita crenata</i>	hapa crab	indigenous
MOLLUSCA		
<i>Melania</i> sp.	snail	indigenous?
FISHES		
<i>Chonophons genivittatus</i>	goby, o'opu naniha	indigenous
<i>Chonophons stamineus</i>	goby, o'opu nakea	endemic
<i>Chanos chanos</i>	milkfish, awa	exotic
<i>Clarias fuscus</i>	Chinese catfish	exotic
<i>Caranx</i> sp.	papio ignobilis	indigenous
<i>Eleotris sandwicensis</i>	o'opu okuhe	endemic
<i>Gambusia affinis</i>	mosquitofish	exotic
<i>Kuhlia sandwicensis</i>	aholehole	endemic
<i>Micropterus</i> sp.	small mouth bass	exotic
<i>Mugil cephalus</i>	mullet	indigenous
<i>Oxyurichthys lonchotus</i>	pointed tail goby	indigenous
<i>Poecilia reticulata</i>	wild guppy	exotic
<i>Saurida gracilis</i>	lizard fish	indigenous
<i>Sphyraena barracuda</i>	kaku	indigenous
<i>Sarotherodon mossambica</i>	tilapia	exotic
<i>Xiphophorus helleri</i>	swordtail	exotic
AMPHIBIANS		
<i>Bufo marinus</i>	toad	exotic
<i>Rana</i> sp.	frog	?

¹Terms in this column:

Endemic-occurring naturally only in Hawaii.

Indigenous-occurring naturally in Hawaii and also elsewhere.

Exotic-brought to Hawaii either intentionally or accidentally by man.

²Those species listed as "exotic" were definitely not present in the Kawai Nui Fishpond of the Pre-Contact Period. Many of those listed as "endemic" and "indigenous" are known to still be present in the Present-Day Marsh but in reduced numbers.

³Further information and illustrations of many of these species, including cultural information pertaining to native Hawaiian's use and beliefs, can be found in the following sources: Gosline, W.A. and V.E. Brock. Handbook of Hawaiian Fishes (Honolulu: The University of Hawaii Press, 1980) and Titcomb, Margaret, Native Use of Fish in Hawaii (Honolulu: The University Press of Hawaii, 1972).

The continuing popularity of the marsh as a fishing and aquatic recreation site, despite difficult access through encroaching vegetation, was also observed in a recent waterbird survey by Dr. Sheila Conant, University of Hawaii ornithologist, and her staff (1981):³

During our studies, we have encountered people using boats in the open water, going fishing, and just walking through the Marsh.

One of the more interesting ways to describe the aquatic life which exists in the marsh is by describing methods used to catch, observe, and study these organisms. The next section will describe the results of such an exercise recently employed by a team of university and high school students working together at an "Ecology Camp" field investigation of Kawai Nui Marsh, sponsored by the Sierra Club Highschool Hikers Program.⁴ (See Figures 8.1 through 8.3)

Section 8.2 Field Investigations of Kawai Nui Aquatic Animal Life

In a recent study of estuarine and stream life, Ecology Camp students were led by two resource specialists throughout the marsh ecosystem.⁵ Two principal study stations were set up along the water course through the marsh :

1. at Maunawili Stream, one of the major streams feeding into the marsh; and
2. at Kawainui Canal (or Oneawa Channel), the estuary end of the marsh, where water from the marsh drains down the canal into the ocean at Kailua Bay.

At these study stations, students observed and sampled the basic factors of the physical and biological environment (eg. salinity, vegetation, animal life) in order to draw comparisons, contrasts, and generalizations about the environmental capability of supporting aquatic life in these areas. (See Figure 8.1)

At Maunawili Stream, the water temperature was measured at 22.5°C and salinity at 0.⁶ One of the resource specialists, Dr. John Ford, demonstrated the use of an electro-shocker to catch fish in the stream. On a good day, aquatic life such as Louisiana crayfish and small-mouth bass are caught in this area by use of this method. These are introduced, not native species. The apparent absence of native stream fish species, such as gobies, in the upstream portions of Maunawili Stream is partly due to certain characteristics and requirements of their life cycle.

Most native stream fishes hatch in the stream where they are carried by the currents to the ocean. They spend six to seven years developing as marine plankton before re-entering the stream to live out their adult lives. The gobies have fused pelvic fins which form a sucking disc than enables them to cling to the rocks in the stream bed and slowly "walk" back upstream. However, the channelization and hence the absence of a clearly defined stream bed in Maunawili stream above the marsh prevents the fish returning from the ocean from ever returning to this stream. The presence of exotic predators such as small-mouth bass is another barrier that gobies must penetrate in the marsh water before they can reach



Figure 8.1 Artist's Rendition of Ecology Camp Students Performing Water Sampling/Quality Studies in Kawai Nui Marsh (Artist: Donna Kamahele)

upstream areas for spawning. Maunawili, despite the purity and freshness of its water, is typical of most streams on O'ahu in that native habitat alterations have occurred as urbanization has spread through most of the watershed areas, thus destroying the habitat requirements of native stream species such as gobies. Nevertheless, this study was a valuable lesson in the impact which habitat alteration can have to native, species diversity and abundance. (See Figure 8.2)

At the Kawai Nui Canal/Oneawa Channel Study Station, water salinity was measured as brackish (10-20),⁸ surface temperature was recorded at 22°C and at 23.2°C at a depth of 3.5 feet.⁸ As the marsh water drained through the vegetation and into the canal, little waterfalls were observed pouring down from the floating vegetation mat, into the canal, at low tide. This observation demonstrated how efficient the marsh vegetation is in retaining water, releasing it -- slowly -- as a sponge would do, during tidal fluctuations in the canal.⁹ Such observations are a reminder of the marsh's value as a flood control basin for the surrounding communities. The vegetation, in addition to acting as an absorptive sponge and buffer, acts as a sediment filter. Water discharged into Kailua Bay from this canal is cleaner as a result, thus retaining the high recreational swimming quality at Kailua Bay's beaches.

In order to sample aquatic life in the canal, a small boat was used to lay out crab nets which were checked periodically throughout the day. On this particular occasion, inspection of the nets yielded an 'ama-'ama, or striped mullet, and a Samoan Crab. Tilapia and rice eels also inhabit this area, but were not seen on this particular occasion.¹⁰ (See Figure 8.3)

Students were also provided with small hand nets to see what they could find along the edges of the canal, within the marsh vegetation, in the shallower water. Aquatic life found in this fashion¹¹ included the native gobies, or o'opu-wai; and the baby crustaceans--opai, and i'ao.

While the sampling was going on in the canal, the majestic, soaring frigate ('iwa) birds made several visits to the marsh, swooping down over the water so their beaks could drag along the surface, either to drink the water or -- perhaps -- to scoop up schools of i'ao. (See Figure 8.4)

This experience in the canal gave students first-hand appreciation for the physical characteristics of estuaries, their value as a fish nursery, a wildlife habitat, and also the value of the marsh as a flood control basin, storm surge buffer, and sediment filter for the communities surrounding Kailua Bay.



Figure 8.2 Artist's Rendition of Ecology Camp students Using Electroshocker to Catch Fish in Maunawili Stream Tributary to Kawai Nui Marsh (Artist: Donna Kamahele)



Figure 8.3 Artist's Rendition of Ecology Camp Students Inspecting Nets for Fish Caught in Kawai Nui Marsh at Estuary End (Artist: Donna Kamahale)

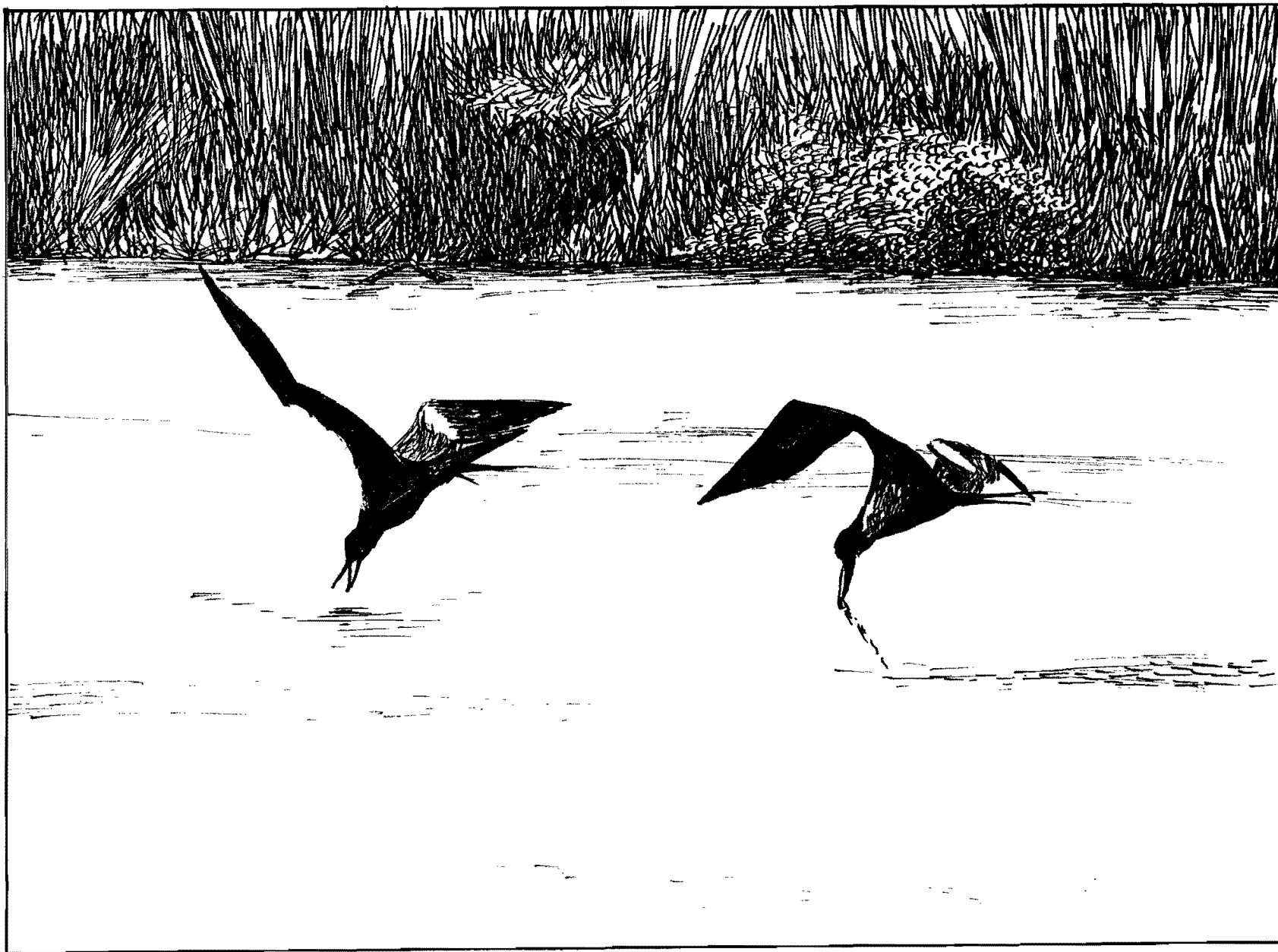


Figure 8.4 Artist's Rendition of The Great Frigatebird ('Iwa) Swooping Down Over Water at Kawai Nui Marsh
(Artist: Donna Kamahele)

FOOTNOTES FOR CHAPTER 8

Section 8.1

1. See photo by Mike Hall in Windward Sun Press of August 21, 1974, showing U.S. Senator Dan Inouye receiving special etching of Kawainui Marsh being presented to him by a member of the Ad Hoc Committee for Kawainui. The photo caption says: "The Senator recalled his childhood days when he fished at Kawainui and said he supports the committee's efforts to keep Kawainui from being developed into a shopping center".
2. Seubert, Jennifer and Malia Denis. "Kawainui's Value", a Letter to the Editor, reprinted in The Honolulu Advertiser, May 13, 1981, p. A-15.
3. Conant, Sheila. A Survey of the Waterbirds of Kawainui Marsh (Honolulu: University of Hawaii, October 1981), prepared for the Hawaii State Department of Planning and Economic Development, p. 36.
4. On the weekend of February 12-14, 1982, the Sierra Club's Highschool Hiker's Program sponsored an educational "Ecology Camp" for interested high school students from throughout the Island of O'ahu, in cooperation with the Hawaii Science Teacher's Association, The Kamehameha Schools, and with the assistance of University of Hawaii Environmental Studies faculty and students.

Section 8.2

5. These aquatic resource specialists were Dr. John Ford, U.S. Fish and Wildlife Service, and Mr. Todd Hendricks, a teacher at Kailua High School.
6. Kurosawa, Iris (high school student field assistant). Estuarine and Stream Life Study, Kawainui Marsh Field Study Report (February 14, 1982).
7. Ward, Lori (University of Hawaii Environmental Studies student, field assistant), Report on Ecology Camp Field Trip, Estuarine and Stream Life Study, February 14, 1982.
8. Kurosawa, Iris, op. cit., note 6.
9. Ward, Lori, op. cit., note 7.
10. Ibid.
11. Ibid.

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The Honolulu Advertiser

The Honolulu Star-Bulletin

Ka Hoku O Hawaii

Ka Na'i Aupuni

Ka Nupepa Kuokoa

Kuokoa

The Native Hawaiian

The Pali Press

The Windward Sun Press

The WindWORD

MULTI-MEDIA MATERIALS

Congress of the Hawaiian People, The.

An Unedited Videotape of a three-day educational workshop on Kawai Nui Marsh, available through the Windward Community College, Hawaiian Studies Program office.

Kreuger, Keith, Producer of ECO-NEWS (a locally-broadcasted radio program).

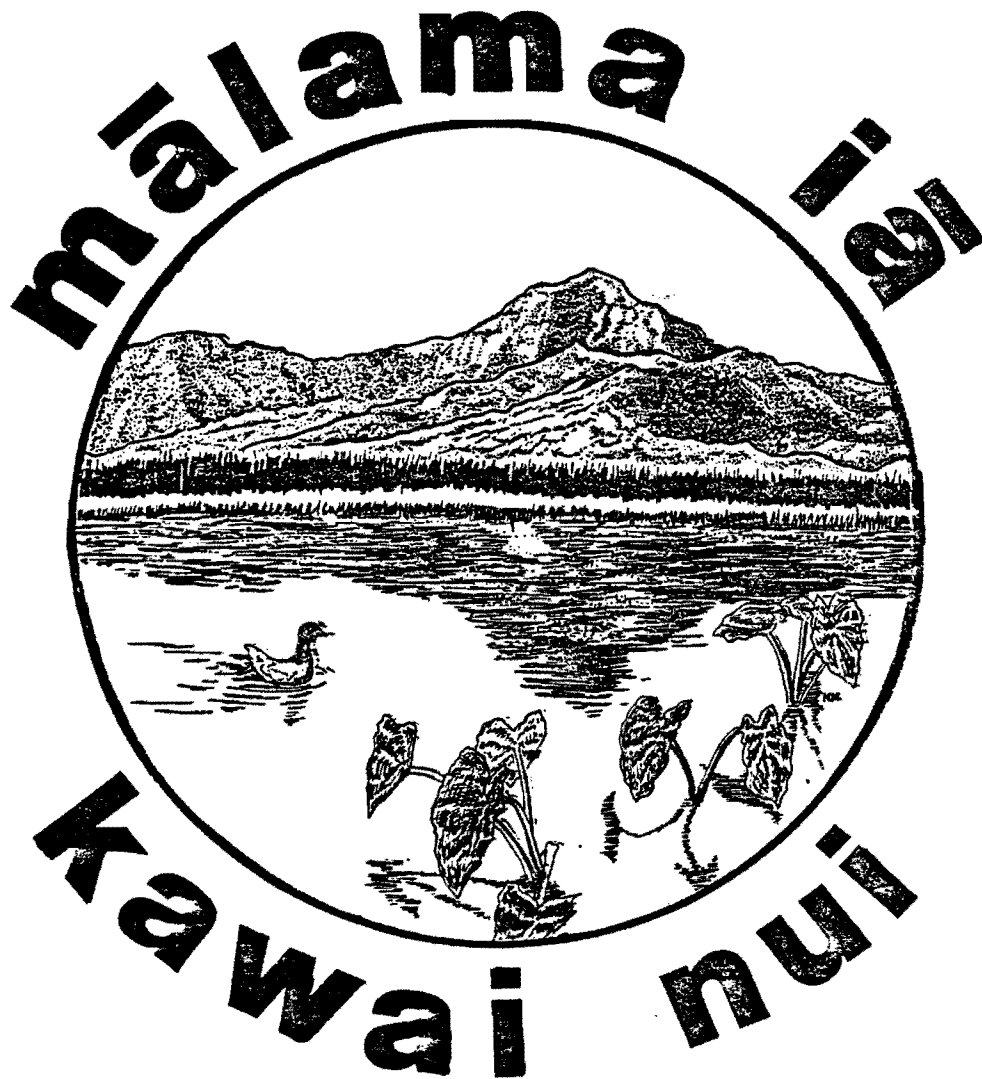
"What's So Special About Kawai Nui?" - a 30-minute taped interview of three local experts on the cultural and ecological values of Kawai Nui Marsh, for humans and other lifeforms: "Auntie" Thelma Kalehuaople Sproat Bugbee, a Hawaiian kupuna; Muriel B. Seto, Historic Sites Chair, the Congress of the Hawaiian People, and John Agard, President, The Congress of the Hawaiian People. Available through ECO-NEWS, P.O. Box 61038, Honolulu 96822.

Shallenberger, Robert, Producer.

"Makana 'O Kawai Nui (Kawai Nui - The Treasure)" - a 22-minute sound/slide show produced in 1974 by Ahuimanu Production. Produced for and available through the Lani-Kailua Outdoor Circle, P.O. Box 261, Kailua, Hawaii 96734.

Sierra Club High School Hikers' Program, Sponsor.

"Ecology Camp at Kawai Nui Marsh" - a 30-minute slide show/script production by Dr. Diane Drigot and Dr. Charles Burrows, and the Kamehameha School and their students, and available through the Sierra Club Hawaii Chapter, P.O. Box 22897, Honolulu, Hawaii 96822.



Design by
Keith Kreuger
ECO-NEWS Producer

Comments on the content and utility of this guide are welcomed from the users. Also, it is possible to order a copy, at cost, while the supply lasts. Please direct comments/inquiries to Dr. Diane Drigot, via The Environmental Center, University of Hawaii, Honolulu 96822

