

The Use of Native Hawaiian Plants by Landscape Architects in Hawaii

Laila N. Tamimi

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Chair, Lee R. Skabelund
Claudia Goetz Phillips
Duncan M. Porter

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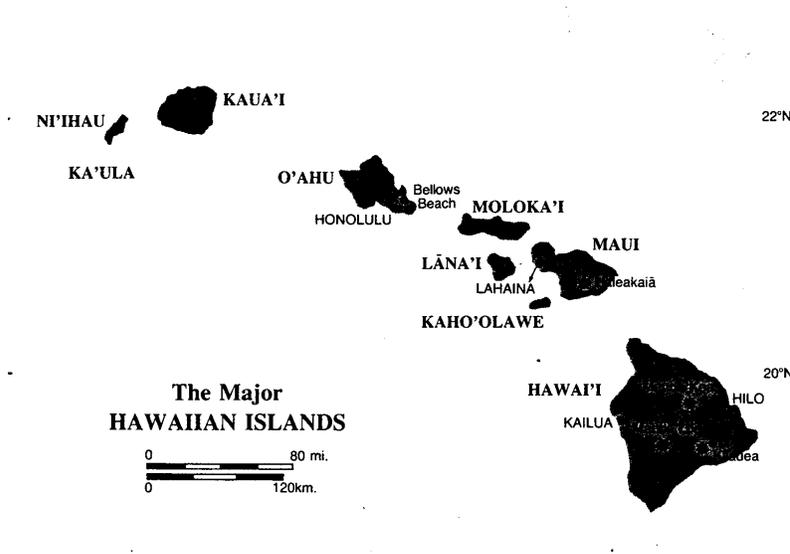
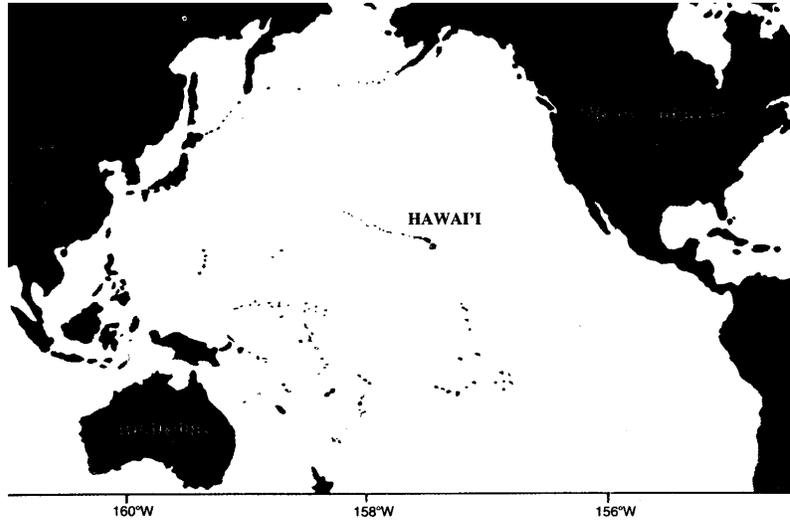
(ABSTRACT)

Hawaii has lost significant numbers of native flora and fauna resulting from introduced grazing animals, invasive flora, fire and a loss of habitat due to urbanization and agricultural use. Scientists believe that protecting these plants can be achieved by eliminating or reducing threats to native ecosystems, generating and maintaining genetic back-up and by outplanting. The Endangered Species Acts 73 and 236 (State Law requiring the use of native Hawaiian plants in State funded projects) were created to protect rare and common native plants and increase the populations and public awareness of these plants. Two surveys and case studies were conducted to determine if and why landscape architects in Hawaii use native Hawaiian plants in their planting plans and to compare use in the public and private sectors. The findings show that the majority of landscape architects use native Hawaiian plants in their planting plans as a result of Acts 73 and 236. Unavailable plant material, unestablished maintenance requirements and difficulty selecting plants for a site are constraints faced by landscape architects that may inhibit their use of native plants.

*Matter, of this is the cosmos, sun, earth and life made
Sun, shine that we may live.
Earth-home
Oceans-ancient home
Atmosphere, protect and sustain us
Clouds, rain, rivers and streams, replenish us from the sea
Plants-live and breathe that we may breathe, eat and live
Animals, kin.
Decomposers, reconstitute the wastes of life and death so that life may endure.
Man, seek the path of benign planetary enzyme, aspire to be the world's physician.
Heal the earth and thyself.*

**Ian L. McHarg
Design with Nature**

I would like to extend my deepest gratitude, appreciation and Aloha for “ya all’s” help. Professor Lee R. Skabelund--for your patience, guidance, support, editing, thoughtful input and always finding time to help me out. Professors Claudia Goetz Phillips and Duncan M. Porter--for your positive input, patience and guidance. Theresa Phipps--for all your help. Professor Janice McBee--helping to guide the methodology and analysis of the survey. Dr. and Mrs. Y.N. Tamimi and family--for your love, caring and endless support. Ann Rich and Kathleen Sherry--for taking the time to edit. Jade Moniz--for all your patient computer assistance. The late Robert Tomczak who taught me a lot about landscape architecture--he will be greatly missed. The late Dr. Will Shepherd for enlightening and instilling in me an environmental ethic and stewardship which I will keep for a lifetime. Landscape architects--Michael Chu and Mark Hughes for their time and contribution to the case studies. The State of Virginia--for allowing me to enjoy the wonderful seasons and people. And last but not least, Kalua--for being the most intelligent, loving and entertaining border collie in the world.



Source: Sohmer, S. H. and R. Gustafson. 1989. *Plants and Flowers of Hawaii*. University of Hawaii Press, Honolulu. p. 6.

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CHAPTER 1 ~ INTRODUCTION

BACKGROUND AND RESEARCH QUESTIONS

Before western contact, Hawaiians had a relatively stable relationship with the land (Abbott 1992). The well known Hawaiian phrase “UA MAU KE EA O KA AINA I KA PONO,” (the life of the land is perpetuated in righteousness) implies the Hawaiians’ responsibility and stewardship towards the land. However, “western contact accelerated the political changes” (conflicts and wars between chiefs of different islands) “already in progress when Captain Cook (the first known westerner to come to the Hawaiian Islands in 1778) arrived and precipitated a myriad of other changes affecting not only Hawaiian culture, its social organization, land use, economy, material culture, planting, but also the very flora of the islands” (Abbott 1992:131). These changes initiated the erosion of political, religious and social customs which, in turn, had a strong influence on Hawaiian attitudes towards land stewardship and resulted in the degradation of the island’s fragile ecosystems (Abbott 1992).

Hawaii has lost a large percentage of its native flora and fauna. Seventy percent of the documented extinction in the United States were from Hawaii alone (Implementation of the Endangered Species Act 1992), while Hawaii makes up only 0.20 percent of the total land mass in the United States. Currently, 161 native Hawaiian plant and animal species are listed as either threatened or endangered. Approximately 32 of the 161 listed species have recovery plans, none of which have been implemented. Of the 161 listed, only 5 have critical habitat designation (see Glossary). Although extinction is a natural process, what concerns scientists is the quick rate at which extinction is occurring in Hawaii. It is clear to scientists that the causes for these alarmingly high statistics are related to urbanization, agriculture, and intentional or unintentional introduction of invasive flora and fauna. Each of these forces has led to the degradation and loss of natural habitats (Cuddihy and Stone 1990).

The demise of native Hawaiian plants is closely related to a loss of natural habitat (Stemmermann 1989). Hampton L. Carson (Professor, University of Hawaii at Manoa), claims that the

“establishment of many relatively small preserves may serve as viable refugia for Hawaiian plants and animals...and will probably serve Hawaiian conservation needs better than a few large ones” (Carson 1989:124). If this is so, the following questions arise: Can landscape architects play a role in helping to establish many small preserves that would serve as refugia for native Hawaiian flora and fauna? Where would these preserves be, and what would they look like? What role do landscape architects currently play in this picture and what role should they play in the future? James Corner (1990) claims that landscape architects are mediators between culture and nature. As such, landscape architects have the opportunity to help preserve both natural and cultural resources by addressing issues related to societal needs and to the structure and function of the land.

Today, there are many types of efforts to help protect the remaining native plants and remnant habitats in Hawaii and around the world. The National Tropical Botanical Garden, The Nature Conservancy, the Department of Land and Natural Resources, the Fish and Wildlife Service, and Hawaii Volcanoes National Park are among the many organizations that are directly involved in protecting plants and habitats. However, if the concept of increasing the number of small preserves is a step toward protecting native Hawaiian plants, landscape architects could have a significant role to play in this cause. With this as a premise, I asked the following questions: To what extent are native Hawaiian plants being used in planting plans designed by landscape architects in Hawaii today? What reasons do landscape architects have for using native Hawaiian plants? What practical limitations are there related to using native Hawaiian plants? Are there cultural and ecological reasons for landscape architects to incorporate native Hawaiian plants in their planning and design work? These questions and related issues will be addressed in this thesis.

THESIS GOALS AND OBJECTIVES

THESIS GOALS

The overall thesis goals and objectives are:

1) To obtain an understanding

THESIS OBJECTIVES

1) To assess the extent landscape

of the reason for changes in Hawaii's ecosystems, especially the loss of native flora;

2) To understand more fully the cultural significance of native Hawaiian plants;

3) To obtain an understanding of basic definitions and guiding legislation regarding the protection and use of plants in Hawaii;

4) To understand how landscape architects can help retain the integrity of Hawaii's natural and cultural landscapes;

architects in Hawaii use native plants in their planting plans (thus uncovering information not present in current literature);

2) To understand why landscape architects in Hawaii use (or do not use) native Hawaiian plants;

3) To understand the relationship between Hawaii's Act 73 and the way that landscape architects select plants in Hawaii;

4) To understand the constraints and opportunities that landscape architects need to consider when preparing planting plans;

5) To summarize major issues and concerns related to using native Hawaiian plants in landscape designs and identify potential ways to address these issues and concerns; and,

6) To develop guidelines that landscape architects in Hawaii can follow as they select native Hawaiian plants for their planting plans.

RESEARCH METHODOLOGY

The research methods used to achieve the objectives of this thesis are a literature review, interviews, a survey, and a case study. Using multiple research methods of study reduces bias that can result from using only one method of study. Each method used “has its own bias, using several methods ought to improve chances that the bias of one is canceled by the others” (Ziesel 1981:228). A synthesis of the findings from each research method is used as the springboard for developing the guidelines. Objectives and methods of the literature review, interviews, survey and case study are listed below.

Literature Review

Information was gathered via books, journals, magazines, newspapers and newsletters. 2) The literature review is incorporated throughout the document, with Chapters 2 and 3 relying most heavily on information from the literature review.

Interviews

Interviews were documented by a cassette recorder or by handwritten notes. 2) A set of specific questions was developed prior to each interview and approval for recording the interviews was granted by the interviewees prior to each interview.

Survey

A survey was developed and targeted at members of the American Society of Landscape Architecture (ASLA) working in Hawaii. The target group was derived from the 1995 ASLA Handbook. The survey incorporated both qualitative and quantitative questions. The terminology of the survey was geared toward landscape architects practicing in Hawaii. Prior to mailing the survey, it was tested on several professors in landscape architecture and botany and then approved by the Institutional Review Board for Research Involving Human Subjects at Virginia Tech. Once approval was granted, individual surveys were sent to landscape architects in Hawaii by mail. Each respondent was also sent a copy of the official approval of the survey by Virginia Tech. The survey included a cover letter, the survey with plant list, and a return envelope.

The plant list in the survey was derived from a list provided at a 1992 “Landscaping with Native Plants Seminar,” held in Kaneohe, Hawaii and sponsored by the Hawaii Chapter of ASLA, Landscape Industry Council of Hawaii, Paul Weissich & Associates, and the University of Hawaii Sea Grant Extension Service. All plants in the plant list were available from at least one nursery in Hawaii (quantity and quality are not known); this information was verified through short, informal telephone interviews with nurseries located on different islands. The surveys that were completed and returned were divided into groups according to firm names. Each response was then treated as an individual response, although several of the participants worked at the same firm. The review and analysis of the survey began with an attempt to become as familiar with the data as possible. Professor Janice McBee assisted in developing an approach for the analysis of quantitative and qualitative survey data. The survey’s data was first sorted and compiled with similar responses to questions grouped together. This made it easy to review all responses. Quantitative and qualitative data were treated the same in terms of deriving percentages. For example, for question 8 of the survey, qualitative data was sorted and number values assigned according to the number of times a particular issue was raised per respondent. Information regarding response rates per question and overall response rates was calculated and averaged according to the actual number of responses. The survey findings, implications, and questions raised were derived by reviewing the survey responses. Once the information was reviewed and analyzed, the information was presented in charts, tables, and text.

Follow-up Survey

Ten survey participants who were involved in state funded projects were randomly selected and then interviewed over the telephone. Responses were then organized per question as was done in the original survey methods, and were incorporated into the overall survey analysis.

Case Study

Objectives

- 1) To review and analyze two sites in Hawaii (a large-scale private site and a small-scale public site) which incorporated native Hawaiian plants into their designs. The two sites selected

provide a general idea of how native plants are used in the public and private sector and demonstrate the challenges and opportunities of designing with native Hawaiian plants.

- 2) To expand on the survey by describing how two landscape architects in Hawaii use native Hawaiian plants in their planting plans.
- 3) To strengthen and refine guidelines for using native Hawaiian plants.

The selection of two landscape architects to participate in the case study was based on the survey responses. Two landscape architects were approached about participating in a case study and they agreed to participate in a telephone interview. Two telephone interviews were conducted and planting plans were provided by the landscape architect for each site. The interview questions for the case study expanded on the survey questions with a specific focus on the challenges faced when the landscape architects designed with native Hawaiian plants in the private and the public sector. The information from the case study was sorted, compiled, and analyzed using similar methods to those used for the original survey.

Synthesis and Guidelines

Information from the literature review, interviews, survey, and case studies was synthesized to bring to light the most important issues and constraints faced by landscape architects when designing with native Hawaiian plants on the islands. Information about why and how native Hawaiian plants are used by landscape architects was considered in relation to two current laws, the Endangered Species Act (U.S. Fish and Wildlife Service, 1994) and Act 73 (Session Laws of Hawaii, 1992) that seek to protect and build awareness of native plants and ecosystems. From this synthesis, guidelines were developed for the use of native Hawaiian plants in landscape designs.

CHAPTER 2 ~ NATIVE AND NON-NATIVE PLANTS IN HAWAII

DEFINITION OF PLANTS IN HAWAII

In order to begin this thesis, an understanding of botanical definitions of plants in Hawaii was necessary. This chapter will help to develop a common language, avoid misperceptions of definitions and clarify how terms are used and defined throughout the document.

Hawaii's land area is classified as follows: 50 percent of the land in Hawaii is used as cattle pasture, 30 percent is composed of urban areas and plantations (which also contain patches of native and non-native plant communities), and the remaining 20 percent contain native and non-native plant communities (herblands, grasslands, shrublands, forests and mixed communities (Wagner, Herbst and Sohmer 1990).

A native Hawaiian plant (or a plant native to the Hawaiian Islands), botanically speaking, is a naturally occurring plant in a specific area. Native Hawaiian plants arrived on the Hawaiian Islands via natural means such as wind and ocean currents or by birds. Two examples of native plants are koa and ohia lehua. Native plants are either indigenous (occurring naturally in Hawaii and elsewhere) or endemic (found only in Hawaii). Indigenous plants occur naturally in an area but also in other areas and typically have a much wider geographical range than endemic plants (Stone and Stone 1989). Endemic plants are plants that have evolved in a particular area and are found within a geographical range of less than 20,000 square miles (Stone and Stone 1989). The majority of native plants in Hawaii are endemic (Stone and Stone 1989). For example, there are about 1000 flowering plants in Hawaii that are classified as native, about ninety-one percent of which are endemic (Sohmer and Gustafson 1989), (see Table 1).

Table 1. Hawaii’s Native Flora and Fauna Population

Animal or Plant Group	Estimated Number of Colonists	Estimated Number of Native Species	% Endemic Species
Marine algae	?	420	13
Ferns and fern allies	114	145	70
Mosses	225	233	46
Flowering plants	270	1000	91
Terrestrial mollusks	24-34	1000	99
Marine mollusks	?	1000	30-45
Insects	230-255	5000	99
Mammals	2	2	100
Birds	25	135	81

Source: Sohmer, S. H. and R. Gustafson. 1987. *Plants and Flowers of Hawaii*. University of Hawaii Press, Honolulu. p. 22.

Non-native (alien, exotic, or adventive) plants have been introduced to the Hawaiian Islands with the help of humans, whether intentionally or unintentionally. Over the years, it has been documented that 4600 plants have found their way to the Islands with the help of humans (Cuddihy and Stone 1990). Of these 4600 non-native plants, 800 have become naturalized (Cuddihy and Stone 1990). Two examples of non-native plants are African tulip and eucalyptus. Polynesian introductions also qualify as non-native plants according to botanical definitions (Stone and Stone 1989) because Polynesian introduced plants were brought to Hawaii by the migrating Polynesians (see Table 2). Two examples of Polynesian introductions are taro and ulu. Twenty-nine trees, shrubs, vines, tubers and root plants were brought to the Hawaiian Islands by migrating Polynesians (Abbott 1992). These plants were brought for utilitarian purposes and are classified as Polynesian introductions or “Hawaiian Heritage Plants” (see Appendix A).

Naturalized plants are those plants which were introduced by humans and successfully survived (have been able to reproduce) in their new environment without human assistance. Several Polynesian introduced plants have become naturalized. Two examples of naturalized plants in Hawaii are kukui and niu. Naturalized plants are not necessarily invasive plants.

Table 2. Polynesian Introduced Plants

Scientific Name	Hawaiian/English Name	Principal Uses	Plant Part Used
<i>Aleurites moluccana</i>	kukui, candlenut	fuel, lighting, wood, oil, medicine, dye	fruit, stem, root
<i>Alocasia macrorrhiza</i>	ape	famine food	stem
<i>Artocarpus altilis</i>	ulu, breadfruit	food, wood, dyes, drums, surfboards	fruit, wood, bark
<i>Broussonetia papyrifera</i>	wauke, paper mulberry	fiber for tapa, cordage	stem
<i>Calophyllum inophyllum</i>	kamani	wood, oil, perfume	stem, fruit, flowers
<i>Cocos nucifera</i>	nui, coconut	food, drink, rope, drums	fruit, husk, stem
<i>Colocasia esculenta</i>	kalo, taro	food (poi, luau), medicine	stem, leaves
<i>Cordia subcordata</i>	kou	utensils, wood, dye	stem, leaves
<i>Cordyline terminalis</i>	ki, ti	food preparation, wrappers, inside thatching	leaves
<i>Corcuma longa</i>	olena, tumeric	dye, purification, medicine	stem
<i>Dioscorea alata</i>	uhi, yam	food	root
<i>Dioscorea bulbifera</i>	pioi, yam	food	root
<i>Dioscorea pentaphylla</i>	pi'a or pia, yam	food	root

<i>Syzygium malaccense</i>	ohia ai, mountain apple	food, wood, medicine	fruit, stem
<i>Hibiscus tiliaceus</i>	hau	cordage	stems
<i>Ipomoea batatas</i>	uala, sweet potato	food, medicine	stems, leaves
<i>Lagenaria siceraria</i>	ipu, gourd	containers, drums	fruit
<i>Morinda citrifolia</i>	noni	medicine, dyes, famine food	fruit, stem, root
<i>Musa acuminata</i>	maia, banana	food, cooking, cordage, inside thatching	fruit, leaves, sheath
<i>Piper methysticum</i>	awa	drink, medicine	root
<i>Saccharum officinarum</i>	ko, sugarcane	sugar	stem
<i>Schizostachyum glaucifolium</i>	ohe	lamps, water container, musical instruments, tapa, stamps	stem
<i>Tacca leontopetaloides</i>	pia, arrowroot	food (starch)	root
<i>Tephrosia purpurea</i>	ahuhu	fish poison	whole plant or root
<i>Thespesia populnea</i>	milo	wood	stem
<i>Zingiber zerumbet</i>	awapuhi, shampoo ginger	medicine, shampoo	fruit

Source: Sohmer, S. H. and R. Gustafson. 1989. *Plants and Flowers of Hawaii*. University of Hawaii Press, Honolulu. p. 17.

Invasive plants are those plants that are considered harmful to native ecosystems. These plants have the ability to aggressively dominate wide ranges of land and crowd out native species as they compete for light, nutrients and water (Cuddihy and Stone 1990). Invasive species have the ability to grow quickly and take over areas before native species can germinate. Invasive plant species have progressively raised a great deal of concern for conservation biologists in Hawaii (Stone and Stone 1989). The government and nonprofit organizations like The Nature Conservancy become actively involved in trying to maintain native ecosystems in their natural states. This concern of protecting native ecosystems in Hawaii is of great importance, especially because it has been recently documented that invasive plant species have the ability to alter undisturbed ecosystems. Botanist Linda W. Cuddihy and wildlife biologist Charles P. Stone indicate that there are 28 plant pests that are capable of invading undisturbed native systems (ecosystems which lack invasive plants) in Hawaii. Eighty-six non-native plants are considered to

be “serious problems in native ecosystems” (Cuddihy and Stone 1990:73) and have the ability of invading undisturbed native systems.

Botanically speaking, there are different classifications of plants that are important to understand in order to prevent misperceptions. Botanical definitions clearly define what a native Hawaiian plant is. However, there seems to be misperception regarding the definition of a native Hawaiian plant and a Polynesian introduced plant because of the cultural association. Plants introduced to Hawaii by the migrating Polynesians (who are presently called native Hawaiians) are botanically considered introduced plants and not native to the Hawaiian Islands. Having mutually agreed upon definitions makes communication much easier, for example with discussions between clients and landscape architects or with the public in general.

CULTURAL VALUE OF NATIVE HAWAIIAN PLANTS AND POLYNESIAN INTRODUCED PLANTS

Recently there has been a “hula renaissance” that author I. A. Abbot (1992) believes has created a reawakening of the cultural value of Hawaii’s native and Polynesian introduced plants. “Hawaiian culture depends on plants and still depends on them today ... recreating the past is impossible, but it is within our reach to stem the loss of both cultural information and traditional plants to promote genuine continuity with old Hawaii” (Abbot 1992).

Ancient Hawaiians depended upon their natural resources to provide food, shelter, clothing and all other necessities of life. The ancient Polynesians brought approximately 29 utilitarian plants and several animals during their numerous voyages to Hawaii beginning around 300 A.D. (Abbott 1992). Ancient Hawaiians had a sense of land stewardship, their “resource management in Hawaiian culture included reverence for life, appreciation for intrinsic natural values, a concept of stewardship, and a sense of place” (Kay 1994).

The ahupua’a, a system of land division in old Hawaii, was devised to help manage large areas of land. The ahupua’a are large areas of land which included land from the tops of mountains down to the coral reefs. Ridges usually served as boundary lines between each ahupua’a. The area of

an ahupua'a could range from 100 acres to 10,000 acres (Atkins et al. 1994). A chief, ali'i 'ai ahupua'a, usually ruled the ahupua'a and occasionally governed daily routines of the ahupua'a. The ahupua'a, if managed well, was capable of providing for all the utilitarian needs of the people.

Due to the geological youth of the Hawaiian Islands, metal was not available for tool making. The ancient Hawaiians resourcefully created most of their needs from plant sources. Examples of their knowledge include carving canoes from large koa trees and creating medicinal remedies from an abundant choice of native plants and Polynesian introduced plants on the islands.

In the following paragraphs, authors I. Abbott (La'au Hawai'i: Traditional Hawaiian Uses of Plants: 1992) and B. Krauss (Plants in Hawaiian Culture: 1993) discuss native and Polynesian introduced plants that played a vital role in all aspects of life related to ancient Hawaiian culture. The uses of these plants are related to food, clothing, medicine, religion/spirituality, utensils, shelter, celebration/ceremony, dress, agriculture/economy, transportation and defense.

Many plants associated with food have religious affiliations. Kalo (taro) and uala (sweet potato) are considered to be the staple crops for the ancient Hawaiian diet. Other supplementary food included niu (coconut), ulu (breadfruit), maia (banana), uhi (yams), ko (sugarcane), pia (arrowroot), ti (ti leaf plant), and awa (kawa). The ancient Hawaiians were master farmers and displayed ingenuity and creativity in their agricultural practices, especially in their taro fields. Taro was prepared by men only. Men and women ate separately. Certain foods like taro and uala were prepared in an imu, an underground oven. Seaweed was also an integral part of the ancient Hawaiian diet.

Tapa (kapa) cloth was the most common clothing used by ancient Hawaiians although clothing was not necessary due to the warm tropical climate. Tapa was mostly hand made from the bark of the wauke plant. Women were responsible for preparing tapa and put various designs and scents into the cloth. Maile, laua'e fern, iliahi, 'awapuhi kuahiwi, mokihana, kamane, and hala provided a variety of scents which were incorporated into the cloth. Capes and helmets were

another form of clothing generally worn by royalty. Sandals were used when crossing glass-like lava flows or coral reefs.

The ancient Hawaiians wisely utilized a myriad of plants (see Appendix A) to create medicinal remedies usually prepared by a kahuna la'au lapa'au (medicinal specialist). This medicine practitioner combined treatment with spiritual rituals to help the patient both physically and mentally heal.

Ancient Hawaiians believed in many gods. Of these gods, Ku, Kane, Lono, Kanaloa, Hina, and Pele are thought to be very important. Shrines, temples, and heiaus are all a part of ancient Hawaiian religion. The heiau is a very religious site that serves several religious purposes, and a priest was assigned to each heiau. The heiau is designed by a kahuna kuhikuhi pu'uone (architect). Plants that were directly related to religious ceremonies are the awa, ti, limu kala, olena, uki, pala fern, and ipu.

Drums were made of niu or ulu trunks or ipu (gourd). Bamboo was made into a variety of different distinctly Polynesian instruments. Kauila and ulei were crafted into a stringed instrument that also used niu and ipu.

Food bowls were mostly made from kamani, milo, and kou wood. These bowls were specially prepared and polished with kukui nut oil that gave the bowls a longer life. Baskets made from a variety of material were used to store things. The ancient Hawaiians are known for their crafted baskets. "Twined baskets of old Hawaii were the finest in Polynesia" (Krauss 1993:28). Pillows and fans and mats were plaited from hala, makaloa, and loulu leaves.

The hale (house) of old Hawaii was framed with wood and thatched with grass, while stones were used to build walls and floors. Naio, ohia lehua, pili grass, ti, ko, niu, and amau were the most common plants associated with building structures.

Hula costumes, instruments, and spiritual affiliations are directly associated with native and Hawaiian heritage plants, both of which contain significant cultural meanings and uses. Many plants have specific meanings, uses, or manifestations. The manifestation of the hula god Laka is represented by a piece of lama wood, which is covered with tapa cloth scented with olena fragrance. Ohi'a lehua represents the god kuka ohia laka. Maile represents the Maile sisters.

Self adornment was usually accomplished by wearing a lei. Lei were given as a gesture of "aloha, the mana (power, spirit) and the trust of the person who made it" (Abbot 1992:124). Lei were made from a variety of natural products from the land and sea. Materials used were feathers, teeth, bones, flowers, seeds, leaves, coral, and shell lei. Each lei contained a spiritual purpose or meaning.

Agriculture and fishing provided a healthy diet in ancient Hawaii. The ancient Hawaiians were expert farmers and fishers. Most of their tools used for farming and fishing were derived from plant products. The o'o was a common tool used for many purposes, especially as a hoe, rake or spade. The o'o was made from kauila wood. The ancient Hawaiians were also known for their fishing ability. Fishing nets of different sizes and shapes were used for freshwater and saltwater fishing. Olena cordage was commonly used in making nets. Hand nets were made from ulei and basket nets were made from ie ie.

Canoes were usually made from koa and milo trunks. Surfboards were crafted from ulu, koa, or wiliwili wood. The root of the ti leaf plant was used to make a dye used to color the boards, which were then oiled with kukui or niu oil.

Weapons were made during wars. Spears, slings, clubs, and other weapons of war were hand crafted from various wood sources. Kauila wood (hard wood), olena thread, and shark's teeth were used to make different types of weapons. Hau and basaltic stones were used to make slings. Common plants that were associated with burials and caskets are hala leaves (to make tapa cloth), limu, hapu'u, flowers, leis, wauke, and taro.

CHANGES IN THE HAWAIIAN LANDSCAPE

One of the most significant influences leading to the degradation and loss of native Hawaiian habitats has been the influx of non-indigenous plants, some of which began when the first inhabitants arrived in the Islands. This influx of non-native plants has greatly altered natural ecosystems in various ways. The clearing of land to accommodate urbanization has allowed the destruction of native, lowland habitats. Land areas at higher elevations (which are not as heavily inhabited as the lowlands) have also begun to feel the pressures and disturbances common to the lowlands. Lowlands are dotted with residential land, golf courses, agricultural fields, ranches, hotels, malls, highways, or what we know as urbanization.

The early Polynesians brought many plants and several animals to the Hawaiian Islands as a means of survival. The Hawaiians cleared areas in the lowlands and foothills for agricultural purposes. Many native plants were harvested for utility purposes (food, clothing, shelter, tools). However, it is unknown how many native plants were extinct before Captain Cook reached the islands in 1778. The native Sandalwood tree suffered the first known commercial exploitation of a native Hawaiian plant. Land utilization by the early Polynesians damaged portions of the Hawaiian landscape, but this was nothing compared to the devastation that followed with the introduction of herbivores. Cattle, sheep, goats, deer and the European pig were introduced by early European explorers in exchange for supplies (Kimura and Nagata 1980). Because there were no natural predators, these herbivores devastated the natural ecosystems, pushing the rate of extinction (flora and fauna) to alarmingly high numbers.

ENDANGERMENT OF NATIVE HAWAIIAN PLANTS

Hawaii's original native flora, which has evolved in isolation for millions of years, at one point numbered 50,000 species and varieties (Kimura and Nagata 1980). There have been at least 5000 plants that have been introduced to Hawaii. When the Polynesians came to Hawaii, they brought 36 plant species, 25 of which became naturalized (Cuddihy and Stone 1990). It is estimated that during the 20th century, 5 plants per year have been introduced into Hawaii (Cuddihy and Stone 1990), although Eber (1994) claims that approximately 20 non-natives are introduced each year. Regardless, this has had a major impact on native Hawaiian ecosystems. Non-native plants have

contributed to the extinction of lowland and highland native Hawaiian flora (Cuddihy and Stone 1990), (see Figure 1). These extinctions are due to: (1) competition with invasive alien plants, 2) displacement by invasive alien plants, (3) alterations of ecosystems by alien plants, (4) loss of defense mechanisms by native plants (i.e., loss of thorns), (5) loss of dispersal mechanisms by native plants (i.e., seeds which have the capability to cling to animals) and (6) alien plant introduction and spread of new diseases. All of these factors increase the vulnerability of native plants to extinction.

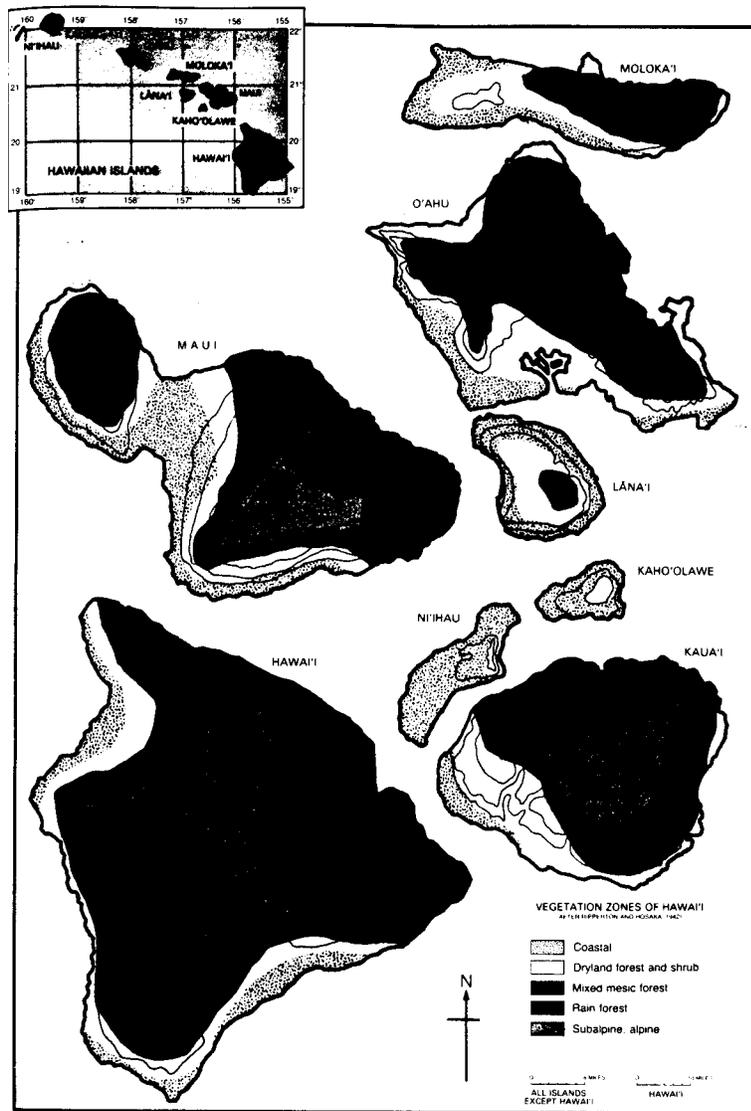


Figure 1. Hawaii's Vegetative Zones. Source: Sohmer, S. H. and R. Gustafson. 1989. *Plants and Flowers of Hawaii*. University of Hawaii Press, Honolulu. p. 41.

IMPACT OF NON-NATIVE, INVASIVE PLANTS ON NATURAL ECOSYSTEMS IN HAWAII

Hawaii's fragile island ecosystems have been damaged enormously by introduced plants. Scientists in Hawaii have used several methods to combat these pests. Manual removal of the plants and herbicides are two of the most commonly used methods. Recently, biological control has been used. "The principle upon which biological control operates is very simple: find and introduce the natural enemies of an alien plant" (Stone and Stone 1989:70). However, one must question the ramifications of biological control. What happens after biological agents are introduced? Do they eventually create problems themselves?

In the past there have been several mistakes regarding the introduction of animal species not native to Hawaii in order to biologically control other non-native/introduced species. One example occurred in 1955 with the introduction of a cannibal snail, *Euglandina rosea* (Stone and Stone 1989). The cannibal snail was brought to Hawaii to control the African snail, introduced into Hawaii for aesthetic purposes. As a predator, the cannibal snail preyed on native land and tree snails, leading to the demise of many native snails. Another tragic introduction was the mongoose (Stone and Stone 1989). The mongoose was brought to Hawaii to control the rat population, which was extensive in the sugarcane fields on most of the islands. However, there was one major flaw, rats come out at night to look for food while the mongoose looked for prey during the daylight hours. As the population of the mongoose increased, its demand for food also increased. Nene goose eggs and goslings, native bird (land and sea) eggs and forest bird chicks, as well as sea turtle eggs and baby turtles have all fallen victim to the mongoose. Many of the recent extinctions of birds and the reduction of populations of sea turtles (especially the Hawaiian hawksbills and green turtles) can be attributed to the mongoose (Parks 1994). Today, scientists are much more cautious as to what agents are introduced to combat non-native species. Hopefully, the long-term advantages of introducing a biological control will outweigh its disadvantages.

Cuddihy and Stone (1990), rated 29 species of non-native plants as being highly invasive. These species currently have a widespread distribution, and may be a serious threat to Hawaii's native ecosystems. The invasive plants which are known to invade wet habitats are banana poka, strawberry guava, common guava, clidemia, glory bush, velvet tree, oxyspora, white ginger, yellow ginger, kahili ginger, Australian tree fern, Hilo grass, palm grass and meadow rice grass. The invasive plants that are known to invade dry, mesic habitats are fire tree, silk oak, koa-haole, lantana, Christmas berry, gorse, sour bush, German ivy, nasturium, coccinea, mullein, broom hedge, molasses grass, fountain grass, and kikuyu grass. Three of these invasive species are discussed below, including highlights of their impact on native ecosystems and how they spread.

DATA ACCOUNTS OF THREE INVASIVE PLANTS

These three invasive plants were selected because of their relatively high impact on native ecosystems in Hawaii and they serve as a useful reference related to the concerns and issues associated with introducing non-native plants into the landscape. Information in the data accounts was derived from Cuddihy and Stone (1990) and Stone et al. (1992).

Banana Poka

INVADER-----Banana poka (*Passiflora mollissima*).

Introduced: Before 1921.

Reason for Introduction: Ornamental pink flowers.

Native to: Andes.

Growth Habit/Location: Vine, wet habitats.

Where sighted after its escape: Pu'uwa'awa'a Ranch, in the North Kona District.

Impact: Banana poka vines grow rapidly and cover or blanket whole trees, and therefore do not allow leaves to receive sunlight; native trees are weakened and eventually die. This cover also negatively affects the understory vegetation because of a lack of sunlight. Bird populations are affected because they have reduced access to branches, leaves, and other portions of the tree on which they depend upon for shelter.

How Spread: Non-native birds, feral pigs, naturally (wind, water).

Control: Mechanical removal of the vines and herbicides are used. Biological control is another means of control: *Cyanotricha nectyria* (blue moth) has been released. The larvae of this moth eat the leaves of the banana poka.

Lantana

INVADER-----Lantana (*Lantana camara*)

Introduced: Mid 19th century, became naturalized in 1871.

Reason for Introduction: Ornamental flower.

Native to: West Indies.

Growth Habit/Location: Shrub/dry or mesic habitat.

Where sighted after its escape: Pasture land on several islands.

Impact: The lantana shrub has a very heavy cover, which allows for the displacement of native plants. Lantana also produces a toxin, allelopathic, which is toxic to animals.

How Spread: Non-native birds, spotted dove, and common myna.

Control: Twenty-three insect species were introduced to Hawaii to combat Lantana. Eight became established. This control proved to be successful; however, as areas became free of this shrub, other non-native plants began to establish themselves where the Lantana previously thrived.

White Ginger

INVADER-----White Ginger (*Hedygium coronarium*).

Introduced: Late 1800s by Chinese immigrants.

Reason for Introduction: Fragrant flowers.

Native to: Himalayas and China.

Growth Habit/Location: Large herb/wet habitats (lowland forests).

Where sighted after its escape: Most of the islands.

Impact: White ginger forms a dense cover, not allowing any vegetation to grow in its stand, therefore displacing native plant species.

How spread: Vegetative reproduction.

Control: Mechanical removal has been used and to a certain degree has been successful. However, it is too time consuming and very expensive. Herbicides have also been used but are not 100 percent effective. Biological control via insects or diseases can be successful, but,

because there are many farmers that grow root ginger near areas of infestation, biological control was not implemented.

HOW NON-NATIVE SPECIES ARE INTRODUCED INTO HAWAII?

Non-native species are introduced to Hawaii in a number of ways:

1. Military Cargo: Which is seldom inspected upon entry to Hawaii.
2. Botanical Gardens: New species are brought to botanical gardens, although there is a program (developed by the Hawaiian Botanic Gardens Association) designed to prevent species from escaping and to capture species which have escaped.
3. University of Hawaii: The university has commonly introduced species for agricultural purposes.
4. Horticulture Industry: The horticulture industry has frequently introduced non-natives for economic gain.
5. Pet Stores: Pet stores also introduce non-natives for economic gain.
6. Immigrants: Immigrants have brought edible plants from their places of origin.
7. Biological Control Species: Biological control species have been brought in to try and control species like the mongoose and carnivorous snail.
8. Mail: There has been an influx of packages into Hawaii that may not be monitored.
9. People: Species brought by people intentionally (live or by seed) for individual ornamental gardens.
10. People and animals: Species are carried on clothing or by animals unintentionally.

Many scientists believe that solutions to the problem of introduced species (plant and animal) can be found through educating the public, setting regulations and enforcing these regulations. The current regulatory system does not seem to be very effective. Many, but not all, airlines require passengers to fill out a Plant Quarantine Paper prior to landing in Hawaii. This paper is designed to stop the influx of non-natives into the islands (although some flight attendants forget or neglect to collect them). All passengers are to declare whether or not they are carrying non-native plants with them. However, upon arrival, no baggage is checked. This is not so when people leave the islands. Prior to checking in at the airport, all baggage going out of Hawaii is checked. The

question of why are bags checked prior to departure from Hawaii, and not upon arrival to Hawaii, is one that needs to be addressed.

ORGANIZATIONS INVOLVED IN PROTECTING NATIVE HAWAIIAN PLANTS

Today, there are many organizations in Hawaii interested in conservation issues as a whole and a number of designated conservation areas (see Table 3). There are also several key conferences which take place each year. One is the newly organized Hawaii Conservation Conference, which has its annual meetings during the summer. These organizations have made large strides towards protecting Hawaii’s natural resources. Organizations include: Sierra Club Legal Defense Fund, National Audubon Society, The Nature Conservancy of Hawaii, Environmental Defense Fund, Office of Technology Assessment, USDA Forest Service, Department of Land and Natural Resources, National Biological Survey, University of Hawaii (Hilo and Manoa), U.S. Fish and Wildlife Service, Bishop Museum, National Wildlife Health Center, Kamehameha Schools, Bishop Estate, National Tropical Botanical Gardens, Protect Kaho’olawe Ohana, Life of the Land, Hawaii Volcanoes National Park, Kama’aina Ka’upulehu, The Native Hawaiian Advisory Council, and many volunteer groups.

The State Department of Agriculture has designed an initiative to stop new introductions into Hawaii. This initiative hopes to combine a multi-agency effort towards the development of an Alien Species Action Plan (ASAP). The objectives of this plan are to: (1) prevent the influx of pest species into Hawaii, (2) prevent the spread of pest species, (3) effectively respond to current pest problems and (4) curtail impacts of pests that are currently established in Hawaii. Currently, these agencies are identifying their short- and long-term goals and are beginning to implement several of these goals. Some believe that the future of Hawaii rests on the success of this plan (Eber 1994).

Table 3. Hawaii’s Designated Conservation Areas

Natural Site Name	Acreage	Number of Natural Communities	Number of Rare Natural Communities
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STATE	200,888	90	59
<u>Natural Area Reserves</u>			
(18) reserves	108,288	78	51
<u>Wilderness Preserves</u>			
Alakai Wilderness Preserve (Kauai)	9,400		
<u>State Sanctuaries</u>		24	14
Hawaii State Seabird Sanctuary (Offshore islets)	300		
Kamiloloa Ohai (Molokai)	12		
Kahuku Nene (Hawaii)	20,000		
Keauhou I Nene (Hawaii)	8,400		
Keauhou II Nene (Hawaii)	12,678		
Kipuka Ainahou (Hawaii)	38,400		
Puwaawaa Alala (Hawaii)	3,400		
Mauna Kea Silversword (Hawaii)	10		
FEDERAL	270,750	89	60
<u>National Parks (NP)</u>		76	48
Kalaupapa NP (Molokai)	10,902		
Haleakala NP (Maui)	27,350		
Hawaii Volcanoes NP (Hawaii)	217,297		
Kaloko-Honokohau NP (Hawaii)	322		
<u>National Wildlife Refuges (NWR)</u>		26	12
Hawaiian Islands NWR (NWHI)	1,740		
Kilauea Point NWR (Kauai)	33		
Hakalau Forest NWR (Hawaii)	13,106		
PRIVATE			
<u>The Nature Conservancy of Hawaii</u>		36	19
Kaluahonu (Kauai)	213		

Ihiihilauakea (Oahu)	30		
Kamakou (Molokai)	2,774		
Pelekunu (Molokai)	5,759		
Moomomi (Molokai)	900		
East Maui Lava Tube (Maui)	75		
Waikamoi (Maui)	5,321		
TOTAL	486,620	131	97

Source: Holt, A. 1989. Protection of Natural Habitat. p. 171. In C.P. Stone and D.B. Stone (eds), *Conservation Biology In Hawaii*. University of Hawaii Cooperative National Park Resources Studies Unit. University of Hawaii Press, Honolulu. 252 pp.

CONCLUSION

Public perceived definitions can be different from scientifically derived definitions. The ease of communication occurs when two parties share a common language with similar definitions that can ultimately reduce confusion and misunderstanding. Scientifically based definitions merit attention and specifically clarify differences in terminology, reducing confusion and misperceptions.

The plants of Hawaii have a unique history and are closely related to native Hawaiian culture. Native and Polynesian introduced plants in Hawaii offer significant cultural links. If landscape architects are mediators between culture and nature, we need to understand both aspects in order to make educated decisions regarding planning and design work. With the many changes presently occurring in the Hawaiian landscape, it is important to understand the issues related to and surrounding the impacts on Hawaii's ecosystems. Today more than ever, Hawaii is faced with the challenge to reduce threats to its fragile ecosystems. Cooperative efforts from various organizations can make a difference in protecting vital habitat upon which native flora and fauna depend for food and shelter. Public awareness is essential. The efforts of scientists working hard to protect native ecosystems is not enough, the public also has a responsibility in this effort.

CHAPTER 3 ~ LEGISLATION RELATED TO NATIVE HAWAIIAN PLANTS

An understanding of the Endangered Species Act allows for a fuller comprehension as to why Acts 73 and 236 (see Appendices B and C) was passed. A discussion of the Endangered Species Act followed by Acts 73 and 236 is presented in this chapter.

ENDANGERED SPECIES ACT AND NATIVE HAWAIIAN PLANTS

In 1973, the Endangered Species Act was passed “to provide a legal mechanism for the conservation of endangered and threatened species and the ecosystems upon which they depend” (Ellshoff 1992:1). The Endangered Species Act was designed to curb activities that can harm endangered and threatened species.

The U.S. Fish and Wildlife Federal Register of Endangered and Threatened Wildlife and Plants (August 23rd, 1993) lists 104 Endangered and Threatened Hawaiian plants. Over 80 percent of these plants were listed between 1991 and 1992. According to the critical habitat listing column in the 1993 Federal Register, the majority of these plants lack the critical habitat “essential to the conservation of the species” (U.S. Fish and Wildlife Endangered Species Act of 1973). The August 20th, 1994 U.S Fish and Wildlife Federal Register of Endangered and Threatened Wildlife and Plants lists 161 Endangered and Threatened Hawaiian plants. This is an increase of 57 plant species in just one year. The 1994 U. S. Fish and Wildlife Federal Register contains approximately 471 listings of Endangered and Threatened plants in the United States and several other countries. Thus, Hawaii makes up 34 percent of the total listings of the 1994 Federal Register which is a relatively high number.

Habitat conservation plans were designed to “reduce and mitigate” incidental take (see glossary) of an endangered species on privately owned land (Implementation of the Endangered Species Act for Native Hawaiian Wildlife and Plants 1992:115). Private landowners are allowed to obtain “incidental take permits for purely private activities, in return for developing habitat conservation plans that would reduce and mitigate that take” (Implementation of the Endangered Species Act

for Native Hawaiian Wildlife and Plants 1992:115). The Habitat Conservation Plan “provides promise for resolving conflicts by ensuring long term survival of endangered species while allowing some development to proceed” (Implementation of the Endangered Species Act for Native Hawaiian Wildlife and Plants 1992:137). Currently in Hawaii, no organizations, private or public have applied for or received a permit for incidental take.

Federal spending for Endangered and Threatened species in the United States has decreased tremendously, from \$85,000 per species in the early 1980s to \$49,000 in the early 1990s (Implementation of the Endangered Species Act for Native Hawaiian Wildlife and Plants 1992). It was estimated that the cost (to inventory and go through legal processes of getting species listed) for listing one species on the Endangered and Threatened Species list ranged between \$60,000 and \$500,000 (Stemmermann 1989). “Over one million dollars has been spent simply on Federal recognition of the rarity of a handful of Hawaiian plants” (Stemmermann 1989:52).

Listing species in the Federal Register of Endangered and Threatened Wildlife and Plants does not always mean the species will survive. According to Stemmermann, in some cases, the listing process may actually have had adverse effects on the endangered species by making them an attractive target for collectors. However, listing fosters “public awareness of the threats to the Hawaiian biota” (Stemmermann 1989:52).

Public awareness of the cultural and ecological significance of native Hawaiian and Polynesian plants was a major reason for the passage of Acts 73 and 236, which mandates the use of native Hawaiian and Polynesian introduced plants in State funded projects. Hawaii has State laws that protect endangered and threatened species. “Laws of the state of Hawaii are more stringent than Federal regulations” (Stemmermann 1989:52). In Hawaii, it is illegal to export, take, possess, process, sell, offer to sell, deliver, carry, transport, ship and to harass endangered species on public or *private* land. “Though legislation is provided to enforce the law, to date there have been no prosecutions, even though there have been violations” (Stemmermann 1989:52).

In light of the obstacles faced by conservationists in Hawaii, solutions to these situations begin with an understanding of the causes. Endangered plants in Hawaii have reached their fate due to four main reasons: (1) fires; (2) grazing animals; (3) land conversion (forest to pasture, coastal areas to hotels and golf courses); and (4) loss of native pollinators such as birds, bees, and moths (Stemmermann 1989). Stemmermann (1989:53) believes that “rare plants evolved in native communities and can only be preserved in native communities ... we cannot rely on botanical gardens to save species since other members of their communities may be required for their survival ... the preservation of intact ecosystems and the processes occurring within them, will provide the protection of rare and threatened species dependent upon those systems.”

Protecting native Hawaiian plants involves three important tasks: (1) reducing and/or eliminating the threats to native ecosystems, (2) generating and maintaining genetic backup, and (3) putting endangered plants back into the wild (outplanting). Many organizations play vital roles towards the protection of native plants. It seems that much damage has already transpired in native ecosystems due to both external pressures on these systems and the narrow and awkward reactive approaches to the problem at hand. Rather than targeting one species, the entire community with which the species is associated needs to be protected. Protection of community ecosystems is essential and vital to the survival of all its inhabitants. Education and awareness about the significance of native ecosystems and their inhabitants should continue to exist. Additional research and wise management related to the conservation of viable plant communities will allow future generations the opportunity to experience native ecosystems as we have.

LANDSCAPE ARCHITECTS AND ACTS 73 AND 236

Acts 73 and 236 are laws which encourage landscape architects in the State of Hawaii to use “indigenous” and “Polynesian introduced ” plants in State funded projects (see Appendices B and C). According to these laws the definition of indigenous is “any aquatic life, wildlife, or land plant species growing or living naturally in Hawaii without having been brought to Hawaii by humans”. Polynesian introduced plants are defined as “plant species brought to Hawaii by Polynesians before European contact (in Hawaii), such as kukui, noni, and coconut” (Session Laws of Hawaii 1993). Acts 73 and 236 originally required the use of indigenous plants but was changed to

include the use of both indigenous and Polynesian introduced plants. Botanically speaking, indigenous refers to plants with a wide range of distribution and excludes endemics (which are highly endangered in Hawaii). However, the use of the term native Hawaiian plants refers to both indigenous and endemic plants.

The Landscaping Industry Council of Hawaii encourages the use of native plants because it “recognizes the importance and urgent necessity of active intervention to prevent the further decline of Hawaii’s unique native flora, and supports the use of native plants in landscaping where appropriate” (Hawaii Landscape Industry News 1992). The Department of Land and Natural Resources (DLNR) of Hawaii was responsible for the rules and enforcement of Acts 73 and 236. Extension landscape specialist David Hensley (1992:18) believes that Acts 73 and 236s approach is “progressive ... realistic ... and refreshing.”

Acts 73 and 236 were passed into law in 1992 and 1993, respectively. According to the “draft” copy of the administrative rules pertaining to Acts 73 and 236, the law mandates the use of indigenous and Polynesian introduced plants but does not specify how. Under this policy: (a) “when possible, all plans, designs, and specifications for new or renovated landscaping of any building, complex of buildings, facilities, or housing developed with public moneys by the State or its several counties shall incorporate indigenous and Polynesian introduced plants;” (b) “when possible, indigenous plants shall be used for landscaping on the island or islands on which the species originated;” (c) “plants or groups of plants used for landscaping shall be clearly identified with signs for the general public;” (d) “provided that suitable cultivated plants can be made available for this purpose of this section without jeopardizing wild plants in their natural habitat;” and (e) “threatened or endangered species shall not be used for this purpose” (State Procurement Office 1996). The procedures pertaining to Acts 73 and 236 state that “the head of the purchasing agency providing landscape architectural services for construction projects shall coordinate with the using agency and ensure when possible indigenous and Polynesian introduced plants are included in the bid specifications” (State Procurement Office 1996). These administrative rules also include an “Exhibit” that lists 116 trees, shrubs, ground covers, and vines. This “Exhibit” includes both indigenous and Polynesian introduced species; however, the

guideline for plant selection is not limited strictly to this list. The procedures encourage “landscape designers” to use other plant materials which are considered “indigenous” and/or “Polynesian introductions” while adhering to the “procedures” of the administrative rules of Acts 73 and 236. At this time there are no indications of penalties or incentives pertaining to the use of indigenous or Polynesian introduced plants. Neither Acts 73 and 236 nor the draft administrative rules require the use of specified plants. In large measure, the basis for Acts 73 and 236 is for educational value; the law intends to foster public awareness and appreciation of indigenous and Polynesian introduced plants in Hawaii and to encourage the propagation of Hawaii’s indigenous and Polynesian introduced plant species in State funded projects (Session Laws of Hawaii 1992).

Those who wrote Acts 73 and 236 have reason to believe that protecting native plants is very important. Acts 73 and 236 reflects this concern. The original text in 1992 of Acts 73 and 236 states that “the legislature is firm in its commitment to protect Hawaii’s indigenous plant species and is prepared to take affirmative action *to ensure their survival.*” The act expresses an awareness of the dangerous position that native plant ecosystems are put in because of the effects of urbanization, grazing animals and the loss of pollinators. This recognition has led the State to devise measures, including Acts 73 and 236, to try to mitigate further extinctions which are occurring at rates far beyond those that are considered natural. The legislature believes in and is committed to protecting these unique species and continues to believe that “these indigenous plant species are an important component of Hawaii’s native ecosystems and part of Hawaii’s living heritage ... native Hawaiian culture, to a significant degree, is intertwined and dependent on certain indigenous plants, many of which have unique scientific, medicinal, educational, environmental, and economic value” (Session Laws of Hawaii 1992:109). This legislature also believes that “carefully monitored release of Hawaii’s indigenous land plant species for use in landscaping will heighten public awareness and promote public appreciation of the impending horticultural holocaust ... use in landscaping will also promote needed research on care and propagation” (Session Laws of Hawaii 1992:109).

CONCLUSION

In the time between August 1993 and August 1994, 57 plants in Hawaii were added to the Federal Register of Endangered and Threatened Wildlife and Plants. There are laws in Hawaii to protect native Hawaiian plants, but are these laws enough to ensure the survival of these plants? The Endangered Species Act protects endangered and threatened plants and animals but many endangered plants in Hawaii lack critical habitat essential for their survival. Acts 73 and 236 mandates the use of native Hawaiian and Polynesian introduced plants in State funded projects with the intention of fostering public awareness but lacks incentives or penalties. Are these laws enough to protect native Hawaiian plants? Perhaps we won't know for a while; however, if the listing of 57 new plant species in one year is any indication of the future, perhaps conservation efforts may need to be reevaluated.

The State legislature is convinced of the educational potential of this law, as are many local landscape architects. The survey discussed in the next chapter indicates that this law has influenced and increased the use of native and Polynesian introduced plants in landscaped areas funded by the State, including educational facilities, state buildings, convention centers, and other highly visible sites. So what does all this mean in terms of the "protection" of native Hawaiian plants? It is obvious that these plants should grow in numbers whereby their populations will increase. However, botanists are concerned about this increase in populations because many cultivated plants are clones from one "mother plant", creating drastic reductions in genetic diversity. Cloning allows the production of many plants that are uniform in their appearance as well as in their genetic makeup.

Reducing threats to native ecosystems, generating and maintaining genetic backup, and putting native plants back in the wild are essentially what botanists believe can be done to protect native plants. So where do landscape architects fit into this picture? In essence, using native plants in State funded projects (of which most will be in or near the urban fabric), is basically creating mini-botanical gardens, or "plants existing only in cultivation", which are scientifically "considered functionally extinct"(Stemmermann 1989:53). However, by creating "mini-botanical gardens", landscape architects can play a significant role in filling the need for genetic back-up in the event

of a disaster like a hurricane or tsunami; however, the issue of genetic diversity in nursery produced stock needs to be addressed, especially if landscape architects depend upon them for plant material.

If these sites designed by landscape architects with native plants are scientifically considered to be “functionally extinct”, then is it not possible that by studying native ecosystems in Hawaii, designed landscapes could attempt to “recreate” as much as possible a “native ecosystem” with whatever that site allows? For example, attempting to place “community plants” together as they would be found in a native forest? Perhaps these associations today are not fully understood by scientists, but their success in their native ecosystem is proof of their survival. Using naturally associated plants together, landscape architectural designs may be closer to being biologically and culturally linked to their native landscapes than designs which strictly rely on “exotic” plant material that are not biologically or culturally linked to Hawaii. Some of these questions will be addressed in Chapters 4, 5, and 6.

CHAPTER 4 ~ LANDSCAPE ARCHITECTS' USE OF NATIVE HAWAIIAN PLANTS

SURVEY REVIEW AND ANALYSIS

The survey was designed with the intent to: (1) Discover information not available in current literature. (2) Understand how, why, where, and to what extent landscape architects in Hawaii use native plants in their planting plans. (3) Develop a list of most commonly used native Hawaiian plants by landscape architects in Hawaii. (4) Understand the constraints, opportunities, issues, and concerns surrounding the use of native Hawaiian plants. The information from above will be used to develop an approach and guidelines that landscape architects can use as a guide when they design with native Hawaiian plants.

Survey questions were developed and sent to landscape architects in Hawaii who were ASLA members. The survey responses were sorted and reviewed and analyzed. A discussion of concerns and issues faced by landscape architects were synthesized. Guidelines for using native Hawaiian plants by landscape architects in Hawaii were derived from the survey data responses and synthesis (see Appendices D, E and F).

The follow-up survey was designed with the intent to clarify responses to the questions asked during the original survey. Follow-up survey questions were developed and eight participants who were involved in State funded projects were randomly selected and then interviewed via telephone. Responses were then organized by question, as was done in the original survey methods, and were incorporated into both survey review and survey analysis. A discussion and synthesis of concerns and issues faced by landscape architects and guidelines for using native Hawaiian plants by landscape architects in Hawaii were derived from survey data responses.

Survey Findings, Questions Raised, Answers and Implications

Question #1. My working definition of a native Hawaiian plant is: a plant that is either endemic or indigenous to the Hawaiian Islands. Native Hawaiian plants may have arrived at the Islands via natural means: carried by jet streams, ocean currents and birds. Non-

native plants (exotics) are those plants that do not fit this definition of “native plant”. Do you agree with these two definitions? Yes___ No___? Please explain.

Findings: All respondents agreed with the definitions except for one respondent. The one respondent believed that the definitions were not universally accepted, therefore disagreed with botanically based definitions.

Questions Raised: Does this mean that not everyone shares the same definition of native Hawaiian plants? If they do not, doesn't this make it difficult to be on the same “wavelength” when discussing issues related to native plant use? Should we assume information to be correct because it was published in a book, article, or other form of documentation? What are the most commonly accepted definitions of the terms “native Hawaiian plant” and “non-native plant”? Is it possible to obtain a universally accepted definition? Before one can claim a definition to be true, must the entire world recognize it?

Answers and Implications: Generally speaking, definitions are assumed to be correct (until proven otherwise by scientific data) because they are discussed, tested, debated and published in peer reviewed scientific and/or commonly accepted documents which presumably give the definitions credibility, validity and reliability. However, there will always be differences of opinion and interpretation. Seeking common ground regarding definitions is important if we are to understand what the issues are and how to address concerns related to the use of native plants, whether these concerns are perceived or real.

Question #2. In your opinion, are plants brought to Hawaii by the Hawaiians “native plants”? Yes___ No___; Please explain.

Findings: Fifty five percent (16 respondents) consider Polynesian introduced (also known as Hawaiian heritage) plants to be native Hawaiian plants, although botanically speaking they are considered to be introductions, which qualifies them as non-natives to the Hawaiian Islands. Forty five percent (13 respondents) consider Polynesian introductions to be non-native plants. Most of the respondents that said “no” to this question indicated acceptance of the definitions given in the survey. However, two of the respondents who answered “no” to question #2

indicated that they consider Polynesian introductions to be native, possibly qualifying their answers as “yes” rather than “no.”

Questions Raised: Do respondents that answered yes to question #2 consider both native Hawaiian and Polynesian introduced plants to be “native plants,” when botanically speaking Polynesian introductions are non-native introductions? Why would respondents consider Polynesian introductions to be native? Perhaps there is some confusion about the definitions? Perhaps there are cultural implications? Should Polynesian introduced plants be considered native because they “offer an important link to the past,” as one respondent said?

Answers and Implications: Some landscape architects view Polynesian introduced plants as native plants, probably for a number of different reasons. Botanically speaking, Polynesian introductions are not native. This does not mean that Polynesian introduced plants are worse than native Hawaiian plants, but simply different as a group or class of plants. The same may be said for all non-native plant species. Each group of plants and each plant species plays a role (or several roles) and has an effect on ecological systems and upon landscapes molded by humans. Classifications (for example, definitions), if correctly used, can help us recognize and understand the distinct roles and effects of various groups of plants as well as individual plant species. With understanding, we can communicate more clearly and accurately and be in a position to use plants in ways that can preserve or regenerate ecological systems and serve as places for teaching and learning (or educating).

Question #3. Have you noticed an increase in the use of native Hawaiian plants by Landscape Architects in the past several years? Yes___ No___; If so, why do you think there has been an increase?

Findings: Ninety three percent (an overwhelming majority) of respondents have noticed an increase in the use of native Hawaiian plants (some of whom consider Polynesian introductions to be native) by Landscape Architects in Hawaii. The two respondents who answered with a “no” did not give a reason for their answer. The four most common reasons were awareness, the law, availability and low water requirement.

REASONS FOR INCREASE IN USE	NUMBER OF RESPONDENTS
An increase in awareness (environmental, cultural, educational and general interest)	13
Laws	9
Increase in availability	7
Low water requirements	5

Questions Raised: Generally speaking, it appears that many Landscape Architects are aware of an increase in the use of native plants and have varied reasons as to why the increase has occurred. Could this high response towards an increased use of native plants be related to Act 73, which is a state law passed in 1992, requiring state funded projects to incorporate indigenous plants in public landscaping? Or, could it be related to an increase in awareness related to cultural or ecological issues? Could an increase in availability in nurseries be related to the cumulative effects of both increased awareness and Act 73? Perhaps awareness was a precursor to the law, which in turn affected the availability of these plants due to an increase in demand?

Answers and Implications: Native Hawaiian plants are used to a greater degree because of a combination of factors, including: increased awareness, passage of environmental laws (particularly Hawaii’s Act 73), the desire to create less water demanding landscapes and the availability of native plant species. To determine the extent Act 73 and other factors have influenced the use of native plants, follow-up survey questions were required (see follow-up survey review and analysis, questions, 2a, 2b, and 4).

Question #4. Do you use native Hawaiian plants in your planting designs? Yes___ No___?
Why?

Findings: Ninety six percent of the respondents who answered question #4 indicated that they use native Hawaiian plants in their planting plans. The most common reasons are listed below:

REASON FOR INCREASED USAGE	NUMBER OF RESPONDENTS
Laws	10
Low maintenance	5
Use of appropriate with design intent/scheme	5
Client's interest/request	4

The survey results indicate that the driving force behind the present use of native plants seems to be directly related to Act 73. This is followed by low maintenance, which could be related to economics and client's desire. Design intent could be related to a particular theme desired by a landscape architect or his/her client and/or increasing awareness of plants or site needs. Client's interest/request could be related to personal preferences of the client for whatever reason (environmental, cultural, economical), all of which could somehow tie in with the noticeable increase in the awareness about native plants as indicated by question #3 (where awareness was listed as the number one reason why Landscape Architects noticed an increase in the use of native plants). Several respondents indicated that there was a lack of availability of native plants. However, in question #3, a high number indicated otherwise. Perhaps the lack of availability could be related to the need for large quantities of a particular species with a need for a certain size. Perhaps requests for large quantities of native plants are frequently unmet, therefore making that plant "unavailable."

Questions Raised: It appears that "use" is directly related to a process that begins with "awareness." If Act 73 was nonexistent, would native plants be considered? What would the results of this survey look like if it had been done prior to Act 73? Is the role of protecting Hawaiian culture and native plants in the hands of politicians? Perhaps a grassroots effort sparked awareness that eventually materialized into Act 73 (as suggested by Abbot 1992). If awareness = law = use = protection then should the law be expanded to all sectors?

Answers and Implications: Certainly politics and laws influence awareness and laws are created when there is enough attention given by the public, special interest groups, and/or the media on an issue or set of issues. Sometimes, however, laws can create opposition to a desired policy when applied too absolutely or in areas where they are perceived as inappropriate. Government interference with private property is one area where opposition may quickly gather strength.

Education may be a much more effective way to encourage the use of native Hawaiian plants on private property.

Question #5. What types of projects are native Hawaiian plants being used on?

Findings: The types of projects where native plants are used include the range of work typically undertaken by landscape architects. A large number of respondents (11) indicated that they use native Hawaiian plants on “all” projects or for “all sorts” of project work. Twelve respondents indicated that they used native Hawaiian plants on “government,” “state,” and/or “public” projects. In addition, two respondents used “nonprofit” to describe types of projects they used native Hawaiian plants for.

PROJECT TYPE	NUMBER OF RESPONDENTS
Public projects	12
All projects	11
Residential	8
Commercial	5
Resort	3

Questions Raised: Which type of work incorporates the most native plants?

Answers and Implications: From a review of questions # 4, # 5 and # 6, it seems likely that most (and perhaps all) respondents who are involved in public work use at least some native Hawaiian plants for these projects. This may suggest the influence of Act 73 on landscape architects’ plant choice being that, if the project is state funded, native plants should be used.

Question #6. What area of practice are you involved in? Private (residential, resort, other) and/or Public (federal, state, local, nonprofit, other).

Findings: Ninety seven percent responded to question #6. Residential design is the most common type of work according to the survey. P1, P2, and P3 firms do both private and public work. P4 firms do only private type of work. All firms do some sort of private type work, while not all firms are involved in public type work. P4 (design/build) firms are not involved in public type work. The degree of involvement in different types of work cannot be generalized into one

type of firm alone (except for P4 firms). Three firms, ranging from a one person firm to a 17-person firm, each do seven different types of work, therefore, the size of a firm does not indicate specific involvement in any one type of project work alone.

Questions Raised: Why was federal work done least while residential was done most?

Answers and Implications: Most firms in the survey do not specialize in a particular type of work (except for P4 firms). This indicates an interest in diversification for economic design or other reasons. Federal work was done least while residential was done most, perhaps because there is a high demand for residential work.

Question #7. For the planting plans you prepare, estimate the percentage of total planting budget that is allocated for the use of native Hawaiian plants. Public & Private (0-9%, 10-24%, 25-74%, 75-99%, 100%).

Findings: The most common percentage of a budget allocated to native plants according to the survey was between 10 to 24 percent followed by 0 to 9 percent.

Questions Raised: A large majority of respondents indicated that they used 10 percent or more of their planting budget on native Hawaiian plants. Could the effects of Act 73 have influenced the amount of money budgeted for native Hawaiian plants? Could Act 73 also be related to an increase in the availability and awareness of native Hawaiian plants noted by responses to question # 3?

Answers and Implications: It is possible that Act 73 has had a positive effect on increasing availability, awareness, and use. However, as noted in the responses to question # 4 in the follow-up survey, lack of availability is still a major concern, and concerns about use, particularly because of the inability to properly maintain native plants, are issues that may limit the extent to which native Hawaiian plants are budgeted into project work.

Question #8. How would you describe your philosophy to planting design? Please be as specific as possible.

Findings: Aesthetics (read as “color” or “appearance”) seemed to be the most important issue related to philosophy of planting design, followed closely by “maintenance considerations.” “Function,” “adaptability” or the appropriateness to site, and client’s needs were also used to describe a philosophy, although the precise meaning of these terms was not generally spelled out.

ISSUES RELATED TO PHILOSOPHY	NUMBER OF RESPONDENTS
Aesthetics	10
Maintenance concerns	8
Function	6
Adaptability to site	6
Client’s needs	4

Questions Raised: Landscape architects are concerned with the aesthetics of a plant or the visual and artistic aspects of a plant. This makes sense given their role as designers. However, the precise meaning of the issues related to philosophy (aesthetics, maintenance concerns, function, adaptability to a site and client’s needs) were unclear.

Answers and Implications: Maintenance concerns may be related to short- and long-term financial and physical commitments to the site (although the exact definition of maintenance is unclear from the survey). Function may be related to the physical need of the site, i.e., erosion prevention/reduction, or to create shade, or other functional needs particular to a site (although the exact definition of function is also unclear from the survey). Adaptability to a site may possibly refer to a plant’s short and long-term survival in a site’s micro-climate. Adaptability concerns designers because it does not make sense to use plants that are not able to adapt to a site, for example, to salt spray of the ocean. Finally, clients’ needs may be related to individual client preferences, for a particular aesthetic interest or other function, and maintenance concerns. Definitions of function and maintenance were clarified through the follow-up survey (see questions 2a, 2b, and 4).

Question #9. When preparing planting plans, which of the following criteria do you use to select plants? Please list your top three criteria (1 being the most important), and list the

two least important criteria (L as the least important and 2L as the second least). Feel free to clarify or add to these criteria.

Findings: “Aesthetics” is ranked highest for the private sector, while “uniqueness” is ranked the lowest. In the public sector, “maintenance” is ranked the highest while “uniqueness” ranked the lowest. The ranking points were tallied by assigning numbers to each respondent’s answer, for example, 1 = (+3), 2 = (+2), 3 = (+1), 2L = (- 1) and L = (- 2).

PRIVATE SECTOR RANKING	TOTAL POINTS	PUBLIC SECTOR RANKING	TOTAL POINTS
<i>highest</i>			
aesthetics	61	maintenance	30
ecological compatibility	22	aesthetics	23
availability	20	availability	18
maintenance	19	ecological compatibility	13
<i>lowest</i>			
uniqueness	-27	uniqueness	-17
cost	-7	cost	-4
habit/uniformity	-5	habit/uniformity	-4

Questions Raised: As in question #8, aesthetics is said to be very important. Uniqueness was ranked as the least important criterion when selecting plants, perhaps indicating the “designer’s” ability to create areas of interest via other means rather than depending upon the uniqueness of a particular plant. Cost does not seem to be an important issue in selecting plants. Ecological compatibility, availability, and maintenance are each very important criteria when selecting plants. Why is maintenance seen as most important in the public sector?

Answers and Implications: According to the follow-up, the lack of trained maintenance personnel (workers who know how to care for native plants) on public projects is a major concern. This implies a lack of funds for maintenance or training in new ways of maintaining planted landscapes. For private work, skilled maintenance workers may be a little easier to find or train, although maintenance remains an important criterion for the use of plants.

Question #10. In what arena is the use of “native plants” considered more appropriate: public sector or private sector? Please explain.

Findings: Sixty-four percent consider both private sector and public sector to be appropriate venues for the use of native plants. Eighty-eight percent claimed that the private sector is a more appropriate arena for the use of native plants. Seventy-six percent indicated that the appropriate arena for the use of native plants is primarily in the public sector.

Questions Raised: Why was the use of native plants in the public sector less appropriate than in the private sector?

Answers and Implications: Considering Act 73, which mandates the use of native plants in the public sector, respondents indicated that it was more appropriate to use of native plants in the private sector. One respondent indicated, “the public sector lags in accepting a more open, less manicured look.” This could explain why use of native plants could be more common in the private sector than the public sector as indicated in the survey.

Plant List

Plants were ranked according to familiarity, aesthetic appeal, availability and frequency of use (see Appendices D, E, and F).

Findings: Ti seems to be popular. Ti is very familiar, is used a lot, it is very available, and has a high aesthetic appeal.

Most Familiar Plants

PLANTS	% RESPONDENTS
maile	96%
taro	96%
milo	96%
wiliwili	96%
hala	91%
ti	91%

Plants with High Aesthetic Appeal

PLANT	% RESPONDENTS
hapu’u	100%
loulu lelo	100%
ti	100%
’akia	100%

a'ali'i	100%
koki'o	100%
kukui	100%
kou	100%

Plant Availability

MOST AVAILABLE PLANTS	%	DIFFICULT PLANTS TO OBTAIN	%	UNAVAILABLE PLANTS	%
ti	100%	maile	64%	koki'o	20%
kou	100%	koki'o	60%	maile	18%
kukui	100%	loulou lelo	45%	loulou lelo	10%
hala	95%	ohia lehua	39%	naupaka kahakai	10%
milo	90%	noni	33%	koa	10%

Frequency of Use

OFTEN	%	SELDOM/NEVER	%
ti	100%	koki'o	100%
kou	90%	pohuehue	59%
wiliwili	86%	maile	59%
'akia	78%	taro	59%
ilima	75%	'ohi'a lehua	56%
kukui	71%	loulou lelo	55%
naupaka kahakai	70%	a'ali'i & noni	53%

Questions Raised: What influences familiarity, aesthetic appeal, availability, and frequency of use?

Answers and Implications: Factors leading to landscape architects' familiarity and use of native Hawaiian plants are likely related to location of site (coastal areas require different plants compared to montane, wet sites). The type of work a person is involved in certainly makes a difference in how familiar he/she is with certain species; for example, if a designer commonly does projects located on coastal areas then it will be likely that he/she is familiar with coastal plants. Knowledge of particular plants could also be related to whether a plant is "culturally significant." The numbers obtained from the survey may also be influenced by a designer's "plant pallet" from which he/she selects most of their plant material. Two tables above (Plant Availability and Frequency of Use) show that plants which are not available are not frequently used (for example, maile and koki'o). Ti, kou and wiliwili are plants with high aesthetic appeal and are used often. Being familiar with a plant doesn't mean that the plant will be used (as in the case of taro, which, as one respondent indicated, has a high water requirement). If there are many projects in coastal areas (which often have dry, desert-like conditions) it would make sense to avoid water-loving plants. Also, being familiar with a plant could also relate to a specific plant's cultural significance (although all plants listed on the chart are closely tied to Hawaiian culture). Taro, ti, kukui, and kou are all Polynesian introduced plants, also known as Hawaiian heritage plants. Plant characteristics can also play a role in plant selection. Koa drops its leaves and would likely create a maintenance problem, especially in an urban setting. However, koa trees are considered to be aesthetically pleasing and so the designer must decide between aesthetics and maintenance. Noni, which is seldom or never used, is possibly avoided because its fruits are messy, and thus it is a high maintenance plant.

Follow-Up Survey Findings, Additional Questions Raised, Answers and Implications

Question # 1a. I wanted to clarify if you believe that "native Hawaiian plants" include plants brought to Hawaii by the ancient Polynesians?

Findings: All respondents except one believe that native Hawaiian plants include plants brought to Hawaii by the ancient Polynesians.

Additional Questions Raised, Answers and Implications: When referring back to the original survey, question #2 finds 55 percent consider Polynesian introduced plants to be native while 45 percent consider them to be introduced. Why is this? When comparing the follow-up survey findings to the data in the original survey question #2, it was first thought that because there was no consensus on the definition of a native Hawaiian plant that perhaps there was a problem with the clarity of the question, but the follow-up survey proved that wrong. Some respondents in the follow-up survey indicated that the general public perceives Polynesian introduced plants to be native and that they find it easier to go along with that perception although many understand the technical definition of what is actually native (botanically speaking). Several landscape architects believe that Polynesian introduced plants are native because these plants came with the migrating Polynesians, who are now known as native Hawaiians, and so this association or connection allows for the perception that Polynesian introduced plants are native. Perhaps landscape architects should educate themselves, their clients, and the general public on the differences between perceived definitions and scientific definitions.

Question # 1b. What is your response to the first question based on?

Findings: Most respondents indicated their response was based on their own personal experience, while several indicated both experience and professional training had an influence on their response.

Additional Questions Raised, Answers and Implications: Is there a right definition pertaining to native Hawaiian plants? If the public perceived definition of what is native works for landscape architects and their clients, is there a need to clarify this definition to be botanically correct? In the follow-up survey, it seems that the landscape architects are aware of the cultural association of Polynesian introduced plants and the native Hawaiian culture. This connection groups the two (Polynesian introduced and native Hawaiian plants) as being closely related, and so as one landscape architect responded: “Polynesian plants came with the native Hawaiian culture, it came with the culture I consider them to be native” and “the general perception of what I believe the public believes is native included Polynesian introduced plants.” Two landscape architects indicated that they were not purists, which may have influenced their responses. Landscape

architects should educate themselves, their clients, and the general public on the differences between perceived and scientific definitions.

Question # 2a. In the context of planting design, what is your understanding of the term “function”?

Findings: Most landscape architects indicated that the function of a plant serves a purpose. For example, function may be interpreted as a plant’s ability to provide shade, barriers, and visual effects, etc. The responses to this question have helped to clarify the meaning of function.

Question # 2b. How important is function in planting design? Please give an example.

Findings: Every respondent said that function is a very important part of planting design and serves a purpose. The examples of function ranged from safety screens, shade, buffers, creating color, and erosion control.

Additional Questions Raised, Answers and Implications: Function is very important and serves a purpose in terms of planting design. In question #8 of the survey data responses, function was ranked as the third most important issue related to philosophy of planting design. If function is very important and serves a purpose, can function influence plant choice? Also, the relationship between function and native Hawaiian plants may lead to some answers regarding plant selection and use.

Question # 3a. What do you understand Act 73 (relating to the use of indigenous and Polynesian introduced plants in state funded projects) to mean to Landscape Architects? Please give an example.

Findings: All respondents are familiar with Act 73 as being a law which encourages landscape architects to use indigenous and Polynesian introduced plants in State funded projects.

Additional Questions Raised, Answers and Implications: Considering this is a law passed in 1992 and that the respondents are involved in State projects, it should be expected that the

respondents are aware of this law. What is interesting to ask is whether landscape architects use native plants because of the law or have they already been using native plants regardless of the law? If landscape architects were not using plants prior to the law, what factors prevented them from using native plants?

Question # 3b. How does Act 73 influence your work?

Findings: Three of the eight respondents had prior knowledge and used native plants and claimed they were not influenced by Act 73, because as one respondent said: “we are already cognizant of using native plants.” The majority of the respondents indicated that Act 73 has had an influence on their work. One respondent said that, “we need to conform to it, it took a special effort.” The law appears to have a good effect because it encourages landscape architects to “use more native plants and promotes the profession to be sensitive to native plants and their environment in general is a good thing,” as one respondent indicated.

Additional Questions Raised, Answers and Implications: The majority of respondents indicated that Act 73 influenced their work, which probably means that they use or have increased the use of native Hawaiian plants, at least in State funded projects. Had this law not been passed, would the use of native plants still remain limited?

Question # 3c. What does Act 73 mean to you and do you believe in it?

Findings: All respondents believe in Act 73. One respondent said: “The concept of using natives works because these plants are adapted to their environment.” Another respondent said, “I believe in it because there are so many introduced plants in Hawaii. Native plants maintain a sense of place. Native plants are unique plant material and it is wise to incorporate and use them in design.” Another respondent touched upon the practical issues of using native plants by saying “Yes the concept (referring to Act 73) is good but very few native plants on the list (Exhibit) will survive in landscape areas without proper maintenance. More research in application of native plants is needed.”

Additional Questions Raised, Answers and Implications: Although all landscape architects believe in the use of native plants, there seems to be practical limitations regarding use, as indicated by one respondent: “I believe in its (Act 73) principle but not in its practice.” This introduces the issue of the practical application of the use of native Hawaiian plants. It could be true that landscape architects are just not comfortable using plants that they are not familiar in regard to the plant’s maintenance and care, the areas to which the plants are acclimatized and adapted, and all the other important factors that will determine the success of the plant’s survival. Is it fair to say that if landscape architects do not have the needed information and experience as to where these plants will survive, they will avoid the use of a plant? Is there sufficient information on native Hawaiian plant material for landscape architects to reference in order to create a successful planting plan?

Question # 4. What are the challenges and constraints to designing with native Hawaiian plants?

Findings: Most of the respondents indicated that availability was the greatest challenge and constraint they have to deal with. A few indicated that maintenance was a problem: “maintenance crews do not know how to properly maintain native plants.” And another respondent said that: “unqualified maintenance is a problem especially in State projects.” Availability and quantity also appeared to be a problem as “native plants are hard to get ... nurseries dictate what to use and specimen plants are expensive.” Another respondent believes that “in the next five years, the supply for native plants will become automatic and it will be easier to get.” Another issue raised was the use of endangered plants, as one respondent said: “some native plants are endangered and there are regulations against the use of these plants, we want to use some endangered plants but we can’t because of the regulations.”

Additional Questions Raised, Answers and Implications: Availability and quantity and maintenance are constraints that landscape architects have to deal with. What can be done to address this problem? One respondent believes that availability will not be an issue in the next five years, perhaps due to Act 73, which could have possibly increased the demand for native Hawaiian plants, forcing nurseries to address their needs. Maintenance may not be as clear as

availability (supply and demand). How can maintenance issues be addressed? Education? Do maintenance crew training and education involve the care of native Hawaiian plants or are education and training limited to non-native plants? Should landscape architects be allowed to use endangered plants (which were produced in nurseries) in their planting designs?

Question # 5a. Do you have a plant palette (or a specific set of plants) that you use on most of your projects?

Findings: Most respondents said that they do not have a plant palette, while several did.

Additional Questions Raised, Answers and Implications: Having or not having a plant palette could mean several things. If a landscape architect has a plant palette with which he/she is comfortable, it may be difficult to adjust to changes in plant material, especially because of something like Act 73. And if a landscape architect does not have a plant palette, does it mean that he/she is more open to new using new plant material?

Question # 5b. What influences your plant palette?

Findings: Many respondents indicated that their plant palette is site specific and changes with each project according to several things like function, availability, maintenance, site characteristics, taste, the design needs, and the design at hand.

Additional Questions Raised, Answers and Implications: There are many factors that influence a plant palette and it can be very difficult if issues like availability and maintenance are a constraint to the use of native Hawaiian plants. If these two issues were resolved, would landscape architects be more likely to use native Hawaiian plants?

Question # 5c. What portion of your plant palette are native plants?

Findings: The responses ranged from 100 to 10 percent, and 32 percent was the average of native Hawaiian plants in a typical plant palette.

Additional Questions Raised, Answers and Implications: Thirty-two percent average may not mean much because as indicated by one of the respondents: “it varies, it could be 100 percent or sometimes between 30 and 60 percent,” all of which are influenced by clients, plant adaptability to the site, and other factors like availability, maintenance, and function.

CASE STUDY REVIEW AND ANALYSIS

The case studies were conducted because they were able to get at questions and issues that could not be fully understood and addressed by the surveys.

When landscape architects Michael S. Chu and Mark Hughes were approached about the idea for the case studies, both suggested their respective projects (Kewalo Basin Park and The Takehana Residence) because of the significant use of native Hawaiian plants (see Figures 2, 3, and 4). The case studies were done to look at how landscape architects in Hawaii use native Hawaiian plants. The objective of the case studies was to compare the challenges, constraints, and opportunities of designing with native Hawaiian plants in a public and private small scale sector project. By comparing a small scale public project with a small scale private project, the issues related to the use of native Hawaiian plants are discussed.

Approach and Analysis of the Case Studies

Once the two projects were lined up as case studies, two phone interviews were conducted with Mr. Chu and Mr. Hughes. Prior to the phone interviews, a specific set of questions was prepared that focused on the challenges, constraints, and opportunities of designing with native Hawaiian plants in the respective projects (Kewalo Basin Park and The Takehana Residence). A copy of the planting plan for each project was obtained. The answers to the specific questions were recorded via hand written notes and eventually transferred to the format used in this section. Once the data were organized, a comparison of the two sites was conducted as it relates to the use of native Hawaiian plants in public and private sector projects.

Kewalo Basin Park Project: Landscape Architect ~ Michael S. Chu

Kewalo Basin Park, located on water front State property near downtown Honolulu, was designed by Michael S. Chu, a landscape architect practicing in Honolulu. The park is less than one acre in size and is considered to be a small scale urban park. The park offers access to the ocean for surfers or swimmers, a promenade overlooking the Pacific Ocean, sculptures, and creative and artistic landscape design work with a Polynesian theme throughout the park. The park contains a pergola/observation deck, a parking area and many beautiful plants located throughout. Attention to detail in the materials and all other aspects of the design can easily be seen throughout Kewalo Basin Park.

Kewalo Basin Park is a dry and sometimes windy site with occasional salt spray due to the dynamics of the wind and ocean water. The soil has the potential to be very saline due to the proximity of the ocean. Because of these site conditions, it would make sense to select plants tolerant of these harsh conditions. This set the premise for plant selection. Several native Hawaiian and Polynesian introduced plants can tolerate this sort of environment because they are adapted to similar environments, especially naupaka and coconut. The native Hawaiian, Polynesian introduced, and naturalized plants used in this project (plant origin derived from Wagner et al. 1990) were: coconut (Polynesian introduced), hau (Polynesian introduced or possibly indigenous), laua'e (naturalized), milo (Polynesian introduced or possibly indigenous), naupaka (indigenous) and wiliwili (endemic).

The State of Hawaii funded the Kewalo Basin Park Project, which began in 1989 and is still in different phases of development at present. The objective of the project was to design an aesthetically pleasing park that the public could enjoy. The State administrator overseeing this project left many decisions to the landscape architect especially, the plant selection of which landscape architect Michael Chu had full control.

Case Study-Small Scale Public Park

Participant: Michael S. Chu
Landscape Architect
81 South Hotel Street, Suite 312
Honolulu, Hawaii 96813

Project: Kewalo Basin Park & Facilities Preferred Plan

Location: Kewalo Basin Park (waterfront), Honolulu, Hawaii.

Area of site: Less than one acre, surrounded by Ala Moana Park to the east, Kakaako Peninsula to the west, the Pacific Ocean to the south, and Ward Avenue to the north.

Site conditions: Dry, windy coastal condition with heavy salt spray.

Client: Hawaii Community Development Authority, State of Hawaii.

Year: 1989 to present due to different phases of development.

Plants used
on the site: Milo, wiliwili, hau, coconut, naupaka, laua'e.

Questions Pertaining to the Kewalo Basin Park Project:

~ 1. What is your approach to designing with native Hawaiian plants?

I never approach a project with the idea to use a particular plant.

~ 2. Is your design approach different when you deal with the private sector versus the public sector?

No.

~3. What influence does the client have on your decision to use native plants?

Not much. Some clients have strong feelings about some plants but usually agree with me on what plants to use.

~ 4. Which sector (public or private) allows more flexibility in planting design decisions?

The government sector provides far greater flexibility because of the lack of personal attachment that occurs in private projects (for example a private residence).

~ 5. Are there any specific criteria that the public and private sector look for in selecting plants?

Maintenance. Both don't like maintenance problems.

~6. What was your approach to using native plants in this project?

Function. I did the project without the idea of using natives. Plant selection was based on environmental conditions of the site.

~ 7. What made you select the native plants used in this project?

Plant choice was based on site conditions. Many of the native plants on this project are drought tolerant and can withstand salt spray.

~ 8. What influence did the client have on your decision to use native plants on this project?

None.

~ 9. What purpose did native plants serve in this project?

Naupaka served well, it looks good, I used a lot and it has a low maintenance requirement and can withstand salt spray. Milo was selected for its tolerance to coastal conditions as well as the other natives on this project. Native plants can also serve other purposes; for example, their educational value and the plants on this project are individually identified so

that the public can see the name and origin of the native plant. However, the main objective of this project was “redevelopment” and aesthetics is important for this project.

~ 10. What were the challenges related to the use of native plants in this project?

Availability and watering requirement. I wanted to use plants with the same watering requirements. The use of many drought tolerant plants on this project allowed for an inexpensive irrigation system.

Mr. Chu’s approach to designing with native Hawaiian plants is “I never approach a project with the idea to use a particular plant”, plant selection is dependent upon looking at the site conditions and carefully selecting the appropriate plant to serve a particular function, while selecting a plant that will have the capability to successfully adapt to the site. Several native Hawaiian plants were selected because they fit the criteria needed to make the planting design a success, although as Mr. Chu mentions there were many problems to overcome after the initial implementation of the project. Mr. Chu’s design approach is not different when dealing with the private and public sectors. Mr. Chu explains that clients usually do not have much influence on his decision to use native Hawaiian plants and says, “some clients have strong feelings about some plants but usually agree with me on what plants to use.” Mr. Chu also believes that the public sector (especially the government) allows for more flexibility “because of the lack of personal attachment” to a particular project. When selecting plants, using low maintenance plants is one of the most important criteria both private and public sectors look for. Plants with low maintenance needs are cheaper to maintain in the long run and so they are attractive choices, especially economically, in both public and private sectors.

Mr. Chu’s approach to designing with native Hawaiian plants on the Kewalo Basin Park Project was based on function: “I did the project without the idea of using natives, plant selection was based on environmental conditions of the site.” When he was asked why he used native Hawaiian plants in this project, Mr. Chu said, “many natives on this project are drought tolerant and can withstand salt spray.” The plants on this project served many purposes. The naupaka is aesthetically pleasing, has a low maintenance requirement, and can tolerate salt spray. Milo was selected for its tolerance to coastal conditions, and the other plants were selected for similar

reasons. The native plants also served as an educational opportunity for all visitors to the park. Each plant has a special plaque with its name and distribution (endemic, indigenous, naturalized, or Polynesian introduced).

The challenges and constraints of using native plants on this project: Mr. Chu indicates that the greatest challenge to overcome in this project was the lack of availability of the plants he needed and the watering requirement of the plants as a whole. “I wanted to use plants with the same watering requirement and the use of many drought tolerant plants allowed for an inexpensive irrigation system.”

The benefits and opportunities of using native Hawaiian plants on this project were:

(1) functionality; (2) aesthetically pleasing; (3) due to site location these plants have a significant opportunity for their educational value and awareness; (4) they require low maintenance; (5) because of the low maintenance requirement, the plants require less economic input; (6) they are well adapted to the site conditions, which could ultimately reduce non-point source pollution because there will be minimal use (or none at all) of fertilizers, herbicides, pesticides, and other potential pollutants that will not have the opportunity to pollute our environment; (7) they create a potential link to other, near-by vegetated areas (Ala Moana Park) and possibly create a temporary habitat site for highly mobile creatures like insects and birds.

The Takehana Residence: Landscape Architect ~ Mark Hughes

The Takehana Residence is located on Hawaii Loa Ridge, in the upper mountainous ridges of Honolulu. The Takehana Residence is surrounded by sloping terrain, which is designated as a conservation area. The condition of the site is wet and windy with occasional dry conditions. The Takehana family were the clients that Mr. Hughes worked with on this project. The many native Hawaiian and Polynesian introduced plants used on the site (plant origin derived from Wagner et al. 1990) were: a’ali’i (indigenous), ulei (indigenous), ilima (indigenous), ohi’a lehua (endemic), wiliwili (endemic), koki’o (endemic), laua’e (naturalized), hapu’u (endemic), ti (Polynesian introduced), taro (Polynesian introduced), olena (Polynesian introduced), akia (endemic), and ‘awapuhi (Polynesian introduced).

Case Study-Small Scale Private Residence

Participant: Mark Hughes

Hughes & Hughes

Landscape Architects

Grosvenor Center, Suite 1290

Makai Tower, P.O. Box 3312

Honolulu, Hawaii 96801

Project: Takehana Residence

Location: Hawai'i Loa Ridge, Honolulu, Hawaii

Area of Site: Less than one acre. This site is surrounded by a sloping terrain designated as a conservation area in the upper mountainous ridges of Honolulu.

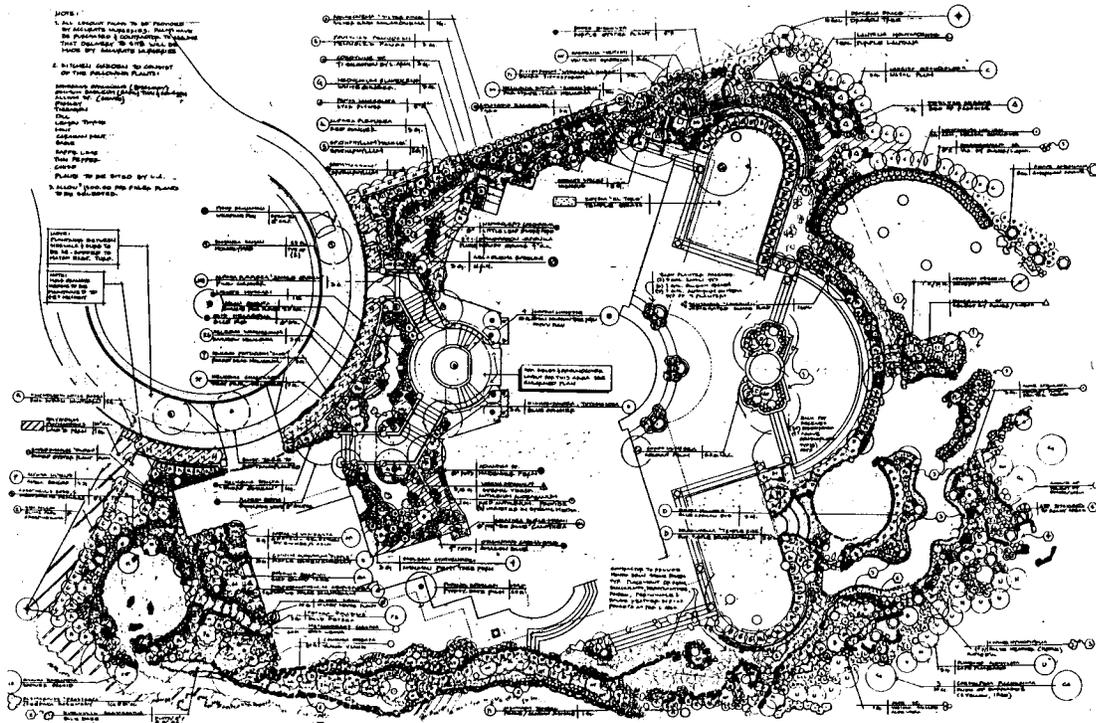
Site conditions: Wet and windy with occasional drought like climate.

Client: The Takehana Family

Year: 1995

Plants used

on the site: A'ali'i, ulei, ilima, alahee, ohi'a lehua, wiliwili, koki'o, laua'e, hapu'u, ti, taro, olena, akia, and awapuhi. Some of these plants existed on the site and were incorporated into the planting design, which was intended to blend into the near-by environment.



Takehana Residence Planting Plan

Figure 4. Takehana Residence Planting Plan.

Questions Pertaining to the Takehana Residence Project:

~ 1. What is your approach to designing with native Hawaiian plants?

I consider the design at hand. I consider where the material originates from, how well it will do. Some natives do well in harsh conditions but are not attractive. I also consider function.

~ 2. Is your design approach different when you deal with the private sector versus the public sector?

Yes. Standards of design specifications are different for each project. Private projects are more informal.

~3. What influence does the client have on your decision to use native plants?

I let them know these are the reasons for doing what I am doing; it's usually not a problem.

~ 4. Which sector (public or private) allows more flexibility in planting design decisions?

Private sector. In smaller gardens, clients are more apt to use different plants.

~ 5. Are there any specific criteria that the public and private sector look for in selecting plants?

Both want a good deal. They want something that is attractive and functional.

~6. What was your approach to using native plants in this project?

First, I look to using native plants that were in evidence. Second, I use plants that are suitable for the project at hand.

~ 7. What made you select the native plants used in this project?

I looked for what was available at the nursery, and the cost.

~ 8. What influence did the client have on your decision to use native plants on this project?

Not a lot.

~ 9. What purpose did native plants serve in this project?

Function. The intent of the design was to blend the landscape with its natural surrounding. Drought and wind tolerant plants were needed.

~ 10. What were the challenges related to the use of native plants on this project?

Getting the owner to accept it. Availability and quantity of native plants was another challenge.

Mr. Hughes' approach to designing with native Hawaiian plants is as follows: he considers the design at hand and he considers where the material originates from and how well it will do in the design. He also considers function. Mr. Hughes' design approach is different when he deals with the private and public sector: "Standards of design specifications are different for each project" and the private sector is less formal than the public sector. The client has an influence on his decision to use native Hawaiian plants but, "I let them know these are the reasons for doing what I am doing, and it's usually not a problem" (the use of native Hawaiian plants). The private sector allows for more flexibility in terms of the use of native Hawaiian plants, as Mr. Hughes says, and "in smaller gardens, clients are more apt to use different plants." The criteria the public and private sector look for, as indicated by Mr. Hughes: "they both want a good deal, they want something that is attractive and functional." Mr. Hughes' approach to using native Hawaiian plants on the Takehana Residence Project was "first I look to using native plants that were in evidence" (on the site), second, I use plants that are suitable for that project at hand." Cost and availability were two important factors in plant selection for this project. The native Hawaiian plants served a function on the project, "the intent of the project was to blend the landscape with its natural surroundings" and "drought and wind tolerant plants" were best suited for the site. The greatest challenge related to the use of native Hawaiian plants on this project was getting the owner to accept them; the availability and quantity of plant material were also a challenge.

The challenges and constraints of using native plants on this project: (1) getting the clients to go with the planting design; (2) availability and quantities of plant material; (3) selecting the appropriate plant material to achieve the objective of the design; (4) cost of plant material, or a limited budget; (5) having a limited plant palette of native Hawaiian plants to choose from is a challenge especially if aesthetics is a concern, Mr. Hughes points out that "some natives do well in harsh conditions but are not attractive."

The benefits and opportunities of using native Hawaiian plants on this project were: (1) educational value on a small scale; (2) many of the native Hawaiian plants are adapted to the site and so after the plants are established, they may require a minimum of maintenance; (3) the

designed landscape of this residence may offer some form of habitat or link to other habitats for wildlife in the conservation district adjacent to the residence.

Comparison of the Case Studies

- (1) Each designer had his own personal approach to designing with native Hawaiian plants.
- (2) Mr. Chu's approach to designing with native Hawaiian plants at the Kewalo Basin Park, a small scale public park, was function; he did not approach the project with any specific plants in mind. His plant selection was based on site conditions, which probably were altered (physically) more than the residence Mr. Hughes dealt with. Mr. Hughes looked for native plants that already were present on the site and worked those plants into the design. Mr. Hughes also used plants that were suitable for the project (client's interests, aesthetical purposes, and plants adaptable to the site).
- (3) Mr. Chu's plant selection for the site was based on site conditions and several native Hawaiian plants sufficed for that need. This project is a State funded project which mandates the use of "indigenous" (as defined by the law includes endemic and indigenous) or Polynesian introduced plants, although the law was not an issue in this project because of the year this project began (1989), and Mr. Chu's approach to selecting plants based on site conditions led to the use of native Hawaiian plants because of their adaptability to the harsh site conditions. Mr. Hughes' plant selection was based on availability and cost. Mr. Chu made no mention of the cost of plants. However, it is assumed that cost is an important factor in both the public and private sector.
- (4) Mr. Chu's clients did not influence his plant selection, while Mr. Hughes had a slight challenge in "getting the owner to accept it." This may indicate that there is greater flexibility in plant choice in the public sector and less flexibility in the private sector.
- (5) In the public sector, native Hawaiian plants served many purposes: their educational value, their low maintenance needs and maintenance cost, their aesthetic value, their functionality, and they reduce the need for fertilizers, herbicides, and other potential pollutants, and the potential link to other vegetative areas. In the private sector, the native Hawaiian plants served similar purposes, create links to other vegetative areas, adaptable to the site, which could reduce maintenance requirements, and their educational and aesthetic value.

(6) The challenges in using native Hawaiian plants in the public sector were availability and maintenance (watering requirement). Selecting plants that are available and suitable or adapted to the site was the main challenge. Private sector challenges for using native Hawaiian plants were gaining the client's approval, availability, and obtaining the necessary quantity. Availability was a common challenge in using native Hawaiian plants in both the private and public sectors. Gaining the client's approval will likely be an issue although the public sector can be a more difficult arena in which to gain approval because of the nature of the constituency involved.

(7) In the case studies, more native Hawaiian plants are used in the private sector, as indicated by the number of plants used in the Takehana Residence in comparison to Kewalo Basin Park. This may be related to the amount of care and maintenance the plants may receive by the owners of the residence and money allocated to purchase plants. It may be likely that plants in the private sector, especially in private homes, are able to be taken care of more often than in a public park that may depend on a routine schedule of maintenance of perhaps once a month, while home owners may be more apt to care for their plants on a weekly basis, especially on the weekends. However, native Hawaiian plants may not be difficult to maintain, as indicated by the survey responses. The indication of improper maintenance may be due to two factors: (1) maintenance crews may not be educated on proper maintenance procedures, and (2) there may be a lack of information regarding native Hawaiian plant care and maintenance.

DISCUSSION AND SYNTHESIS OF CONCERNS AND ISSUES

A discussion and synthesis of the initial survey and follow-up survey are combined with the objective of expanding upon important issues derived from responses to both surveys.

Public Perceived Definitions

Although 97 percent of the respondents to the original survey agreed with the definition of a native Hawaiian plant as stated in the question #1 of the survey, there was no consensus on the definition of a Polynesian introduced plant. One of the reasons for this is indicated in the follow-up survey. Several respondents indicated that they knew Polynesian introduced plants were technically not native to the Hawaiian Islands but overlooked that fact because of the publicly perceived definition of a Polynesian introduced plant as being native due to the plants connection to the native Hawaiian culture. I believe that landscape architects have a responsibility to educate the public (especially their clients) on issues related to public perceptions of definitions related to landscape architecture. Definitions of scientific terms are a part of the body of knowledge that scientists have developed and merit attention. By educating the public and clients on scientifically obtained definitions, the public and clients will have a better opportunity to make educated decisions in regard to their needs. Educating the public on various definitions makes it easier to discuss ideas because the public's terminology will be based on the same or similar definitions and there won't be a need for landscape architects to clarify each word used during a discussion with a client.

Reasons for Using Native Hawaiian Plants

Ninety-three percent of survey respondents have noticed an increase in the use of native Hawaiian plants. The four most common reasons for using native Hawaiian plants are awareness (environmental, cultural, educational, and general interest), Act 73, increased availability, and low water requirement. These combined issues, as indicated by the respondents, created an increase in the use of native Hawaiian plants. Ninety-six percent of the respondents use native Hawaiian plants in their designs for various reasons like Act 73, low maintenance, appropriate with design intent, and because of client's interest. Act 73 and low maintenance are the common reasons for

using native Hawaiian plants. In question number 4 of the original survey, Act 73 was listed ten times as the reason landscape architects use native Hawaiian plants, while low maintenance was indicated only five times. It is interesting to note what an impact Act 73 makes when this law only encourages use and presently lacks enforcement and incentives for the use of indigenous and Polynesian introduced plants. Personal experience and training of landscape architects may play a role in plant selection because, as several landscape architects indicated, the law did not influence them because they already were committed to the use of native plants. One landscape architect indicated that his approach to designing with native Hawaiian plants is influenced by Jens Jensen (landscape architect who extensively used native plants in his design work), only transferred to the tropics. So this may indicate that the law impacts landscape architects who did not necessarily believe in the use of native plants or were uncomfortable with using them due to the lack of information regarding care and maintenance, or the client's interests were far from considering the idea of using native plants in their gardens.

Types of Projects which Incorporate Native Hawaiian Plants

The survey indicates that respondents use native Hawaiian plants on all of their projects, followed by residential, commercial, and resort projects. The last three listed are a part of the private sector, which as parts of the survey indicate is able to take proper care of plants as a whole in comparison to the public sector. There may be more funds for proper maintenance in the private sector and that may be related to landscape architects being asked to address client's aesthetic needs especially in resorts or commercial establishments. Appropriateness of native Hawaiian plant use appears to be found in both sectors as seen in the survey, although 24 percent indicated that the private sector is the appropriate place to use native Hawaiian plants, while 12 percent said the public sector is the appropriate sector to use native Hawaiian plants.

Maintenance was the overriding reason for private use and appropriateness. Improving maintenance in the public sector may increase appropriateness and use of native Hawaiian plants by landscape architects in Hawaii. Maintenance may be improved via several modes: (1) increase money allocated to the care of plants; (2) improve education of maintenance crews, especially in terms of the care of native Hawaiian plants; (3) increase research on native Hawaiian plant care

and maintenance in order to produce material available to the public, for example books, manuals, etc. Protection of native Hawaiian plants may play a larger role in residential areas as compared to urban areas because residential areas are sometimes linked to natural areas. By using native Hawaiian plants, a link may be created between a designed yard and a natural habitat.

Area of Practice Respondents Involved In

Most firms participating in the survey are strictly landscape architecture firms. The most common type of work done according to the survey is residential design; this is followed by other (private) and local (public) and resort (private). If these firms do a lot of private residential work, according to the survey, maintenance is not a constraint to reckon with because the survey indicates that the private sector offers better maintenance. However, according to the survey, maintenance appears to be an overriding issue in all sectors including the private sector.

Percentage of Planting Budget Allocated to Native Hawaiian Plants

The average percentage of a budget allocated to native Hawaiian plants is between 10 to 24 percent which is followed by 0 to 9 percent. According to the survey the four main reasons that influence use of native Hawaiian plants are (1) Act 73; (2) low maintenance needs; (3) appropriateness with design intent; and (4) client's interest. The most significant factor encouraging the use of native Hawaiian plants is Act 73. This act may go further to protect native Hawaiian plants if it is amended to include not only State funded projects. The survey results have strongly indicated that this law has greatly influenced the use of native Hawaiian plants. Why stop at just State funded projects? If several constraints are addressed and alleviated, like a lack of maintenance skills and limited availability, then perhaps landscape architects won't be shy of using native Hawaiian plants.

Issues Related to Philosophy of Planting Design

There are five main issues related to the philosophy of planting design, which are listed in order of importance: (1) aesthetics; (2) maintenance concerns; (3) function; (4) plant adaptability to the site; and (5) client's needs. Aesthetics is the most important issue of concern philosophically in relation to planting design. Aesthetics is closely followed by maintenance concerns. Several

landscape architects indicated that many native Hawaiian plants are not as aesthetically pleasing as they would like them to be and therefore they do not use them. This is one of the few constraints, that may be difficult to address. One approach to using unaesthetically pleasing plants could be to educate the public of their particular significance, for example, their cultural or ecological links. It may be possible to think that plants should not be judged by their appearances, but that plants should be considered for their other fine contributions to the environment (human and non-human). Here again, public perception is the issue. This concern is similar to the issue related to organically produced products. Organically produced products are easy on the environment and safer (in terms of human consumption) than chemically dependent products that appear polished and refined. A growing number of consumers are becoming aware of their options and choosing a more environmentally conscious methods of producing products because of the benefits to their health and the environment. If people are more informed about their choices, they have the potential to make educated decisions about their lives and the environment in which they live. Public awareness and perception about native Hawaiian plants and their benefits are the issues which need to be addressed, and addressing these issues needs to begin, whether it's from a landscape architect to a client or a law to its abiding citizens (as in Acts 73 and 236).

Criteria Respondents Used to Select Plants

In the private sector, the four most important criteria used to select plants were (1) aesthetics, (2) ecological compatibility, (3) availability, and (4) maintenance. The least important criteria for selecting native Hawaiian plants in the private sector were (1) uniqueness, (2) cost, and (3) habit/uniformity. I think it is fair to say that many of Hawaii's native plants are unique and special. Many of Hawaii's plants are endemic (found no where else in the world), and this may justify why the lowest criterion in both the private and public sector was uniqueness. The four most important criteria used to select plants in the public sector were (1) maintenance, (2) aesthetics, (3) availability, and (4) ecological compatibility. The least important criterion for selecting plants in the public sector were identical to that of the private sector criterion. Criteria used to select plants in the public and private sector were quite similar. It was interesting to note that aesthetics is the most important criterion in the private sector, which could reflect a client's need for a visually pleasing landscape, especially in a resort or residential project. A client's needs for a

design which aesthetically reflects his/her establishment is understandable. However, the challenge for the landscape architect who wishes to incorporate native Hawaiian plants into a resort design, for example, is to find plants that are aesthetically pleasing and adaptable to the site conditions. Landscape architects' choices of plant material are limited for several reasons, including availability, quality of maintenance, limited information on plant maintenance and care, native Hawaiian plants' landscape use, and native Hawaiian plants' water and sun requirements. There are many native Hawaiian plants lacking information about their horticultural and landscape use, propagation, water requirement, and care and maintenance. Landscape architects can find this type of information very useful in making decisions regarding use of native Hawaiian plants. There are several references that describe this information; however, they are limited because of only recent interest in the use of native plants (Nagata 1992, Bornhorst and Rauch 1994 and Bornhorst 1996).

Maintenance was the most important criterion in terms of plant selection according to the survey. This may be the indication of a lack of proper maintenance in the public sector. Perhaps further studies could be conducted regarding why maintenance crews are not properly trained. Further studies could uncover or get at the reasons for such concerns related to maintenance. These constraints need to be addressed in order for landscape architects to be more inclined to use native Hawaiian plants. It may be wishful thinking to believe that once all the constraints are eliminated, use of native Hawaiian plants will increase. However, it may be a start to reduce significant constraints like availability and maintenance.

Most Familiar Plants

Over 90 percent of the respondents are familiar with these top ten plants: hala, hapu'u, koa, kou, loulu lelo, maile, milo, taro, ti, and wiliwili. Half of these plants are Polynesian introduced, while the other half are native Hawaiian plants. All of these plants play a significant role in Hawaiian culture. When looking at the survey results, most of these plants are available, all are aesthetically appealing, all are frequently used and all are extremely familiar. What influences familiarity? Perhaps exposure via cultural links? It is possible to think that because Polynesian introduced plants are closely intertwined with Hawaiian culture, the public may be exposed to these plants

more readily than other plants that did not play a significant role in Hawaiian culture. For example, taro (which is made into poi) was the staple food of the ancient Hawaiian diet. Generally, the public in Hawaii and elsewhere is aware of the significance of taro and poi, making this plant publicly well known. On the other hand, a plant like 'ekaha (fern) has a cultural link but not to the degree that taro has, which quite possibly renders 'ekaha as a not so familiar native Hawaiian plant. Plant familiarity may be strongly linked to a plant's cultural significance. There also appears to be more information on plants that are considered very familiar in the survey. If more research is focused on plants that are not so familiar and which lack information like landscape use, maintenance and care, and water and sun requirements, then perhaps landscape architects' choices of plant material will improve.

Plants with High Aesthetic Appeal

There are ten plants which most respondents of the survey indicated have a high aesthetic appeal. These plants are ti, hala, hapu'u, kou, loulou lelo, milo, wiliwili, koa, naupaka kahakai, and akia. Most of these are native Hawaiian plants. What makes these plants aesthetically appealing to landscape architects? Generally, aesthetic appeal is a personal preference. However, could aesthetic appeal be related to frequency of use? According to the survey, most of these plants have a high frequency of use, which could indicate that frequency of use is related to aesthetic appeal. Also, most of these plants with a high aesthetic appeal are very familiar and easily available.

Plant Availability

The top ten most available plants as indicated in the survey are ti, hala, kou, milo, taro, wiliwili, kukui, naupaka kahakai, akia, and hapu'u. Several of these plants are Polynesian introduced, they are used frequently, they are very familiar, and most have a high aesthetic appeal. The availability of native Hawaiian and Polynesian introduced plants could be because of a cultural/utilitarian need for these plants in relation to Hawaiian culture. Kukui, hala, and ti are used to make lei, hats, and other items to which there is a market in Hawaii. The top ten plants which are considered not available are maile, ohelo, ihi, ihi, koki'o, naupaka kauhiwi, amaranth, awa, ho'awa, and iliahi. These ten plants have a medium aesthetic appeal, they are relatively familiar, and are not used

very often. Plants which are used frequently may create a high demand, and nurseries or other plant material sources may not be able to keep up with the demand. The lack of availability of plants could reduce their use by landscape architects. For example, koko'i, which has a relatively high aesthetic appeal, is difficult to obtain; possibly because of a lack of availability it is seldomly used. This makes availability and frequency of use closely related. Another reason related to a lack of plant availability could be that nurseries may not be in touch with what landscape architects need per project. Perhaps there could be better communication between the needs of landscape architects and the nurseries. Methods of communication could occur on the internet or in a weekly or monthly newsletter. An improvement in communication between landscape architects and nurseries can solve problems related to plant availability.

Frequency of Plant Use

'Akia, ilima, hala, hapu'u, kou, kukui, naupaka kahakai, ti, milo, and wiliwili are the top ten most used plants as indicated by the survey. What makes these plants so popular? All of these plants are highly available, very familiar, and are aesthetically appealing, all of which possibly makes these plants popular and used frequently. It seems that all these factors cumulatively encourage landscape architects to use native Hawaiian plants. Landscape architects have an influence in improving availability of plants due to supply and demand. If landscape architects make nurseries more aware of their needs perhaps availability won't be an issue and the frequency of using native Hawaiian plants could improve.

The Definition of Function and Its Importance in Planting Design

Landscape architects responding to the follow-up survey define function as solving a specific need or serving a specific purpose. Examples of function include plants that can create a buffer, shade, screen, or prevent erosion. The function of a plant could also be the deliberate use of plant material for an effect, aesthetically or functionally. Function is very important according the respondents. I believe that native Hawaiian plants are very functional because they are naturally and culturally linked to the Hawaiian Islands and Hawaiian culture. Native Hawaiian plants have a special link to the land where they have lived for many centuries. Plants that

lack cultural or ecological links to Hawaii may have an aesthetic appeal but lack substance in terms of a ecological, spiritual, or cultural link to Hawaii. Native Hawaiian plants have evolved and adapted to Hawaii's climate. Some plants have developed symbiotic relationships within their naturally occurring communities, something that many non-native plants have not yet developed due to their relatively recent introductions. If a native Hawaiian plant fits the functional needs of the site, it should be considered because it can serve a function(s) and offer a cultural or spiritual link to Hawaii.

Act 73's Influence on Landscape Architects in Hawaii and Their Perceptions of This Law

All landscape architects participating in the follow-up survey are familiar with Act 73 as being a law that encourages the use of native Hawaiian and Polynesian introduced plants in State funded projects. Seventy percent of the respondents of the follow-up survey indicated that they are influenced by this law. The landscape architects who were not influenced by this law claimed that they have always been cognizant of using native Hawaiian plants. Results of the follow-up survey indicate a strong impact on the landscape architects who were not previously cognizant of using native Hawaiian plants. The use of native Hawaiian and Polynesian introduced plants by landscape architects in Hawaii has apparently increased because of the influence of Act 73, as is shown in the survey and follow-up survey.

Do landscape architects believe in this law and its intentions? Most of the landscape architects in the follow-up survey believe in this law and support its intent. One respondent indicated prior to this law not much attention was placed on learning about native Hawaiian and Polynesian introduced plants, especially by the public, and this law increases the opportunity for the public and landscape architects to learn more about the cultural and ecological value of these plants. Several respondents indicated their belief in the potential of this law by saying that the concept of using native plants works because these plants are adapted to their environment, they maintain a sense of place, they are unique plant material, and it is wise to incorporate and use them in design. However, more research in the application of native Hawaiian plants is needed.

Although most landscape architects believe in the use of native Hawaiian and Polynesian introduced plants, there are several practical limitations which need addressing in order to create a successful planting plan. Is there enough literature available for landscape architects to be comfortable enough to use native Hawaiian plants? Practical application information like horticultural and landscape use, water requirements, and care and maintenance are crucially needed by landscape architects in order to make educated decisions regarding plant use in a specific site. They can make a difference between the success or failure of a planting plan.

The Challenges and Constraints of Designing with Native Hawaiian Plants

Two of the most challenging issues related to the use of native Hawaiian plants are availability and maintenance. Plant availability falls into the hands of local nurseries and landscape architects. The importation of plants into Hawaii is restricted unless permission is granted by the State. In this case landscape architects must depend upon local nurseries to produce plant material to fulfill their needs rather than hiring nurseries from abroad. Why is availability such a problem? Are native Hawaiian plants difficult to propagate? Are nurseries aware of this availability problem? If there is a need for more native Hawaiian plants surely nurseries could benefit from an economic standpoint. Could the problem possibly be that there are one or two nurseries that produce sufficient plant material, but these nurseries are located on the same island making it difficult to acquire these plants on different islands? Because many of Hawaii's native plants are endemic, Acts 73 and 236 encourages using plants that are found on a specific island rather than shipping plant material to a different island. Restricted movement of plants from island to island is a challenge to landscape architects who want a certain plant that is only available at a nursery on a different island. One potential solution would be to establish different nurseries on each island. Once nurseries are aware of the needs of landscape architects and landscape architects make nurseries aware of their needs, issues related to availability of plant material may no longer be a problem.

Several landscape architects indicated that maintenance crews in the public sector are not qualified or do not know how to properly maintain native Hawaiian plants. This situation may be resolved with proper training of maintenance crews through seminars sponsored by the State and the

landscape industry in Hawaii. Community colleges or universities could offer classes or sections within courses specifically focused on native Hawaiian plant maintenance and care. Educating maintenance crews should be addressed if this issue is to be resolved.

Influences on Landscape Architects' Plant Palette and the Portion of Native Hawaiian Plants in a Typical Plant Palette

Most respondents claimed not to have a plant palette because plant selection is site specific. The selection of plants is based on the site characteristics, and it would be impossible to use a specific set of plants on all projects due to Hawaii's range of ecological zones. Thirty-two percent was the average portion of native Hawaiian plants found in a typical plant palette; however, this number may not mean much considering that use of native Hawaiian plants is site specific and influenced by the availability, maintenance, function, client's needs, and the design at hand. Perhaps if several factors that influence plant selection were addressed by the whole industry, the range of plant choices could increase allowing landscape architects to have an abundant choice of plants without feeling the constraint of availability.

GUIDELINES FOR USING NATIVE HAWAIIAN PLANTS

The guidelines listed below (A-N) should be considered in relation to plant selection while bearing in mind that plant choice is extremely dependent upon site conditions. These guidelines are sensitized to the following objectives: (1) Increasing the population of native Hawaiian plants in the Hawaiian landscape. (2) Improving the cultural awareness of these plants. (3) Protecting and perpetuating the genetic diversity of native Hawaiian plant species. (4) Creating the potential to connect or link developed areas to natural areas with the intention of increasing habitats for native flora and fauna. (5) Educating the public and clients on the importance of using native Hawaiian plants. Landscape architects need to thoroughly understand that the use of native Hawaiian plants is not just a trend and they need to be convinced of the long term benefits of using these plants. If landscape architects are not convinced of this how are they going to convince clients to use these plants?

- A)** Select endemic and indigenous plants while avoiding endangered and threatened plants and without jeopardizing wild plants in their natural habitats.
- B)** Select native Hawaiian plants that are adapted to a project's particular site conditions.
- C)** Select genetically diverse native Hawaiian plants from growers or nurseries.
- D)** Select plants on the island(s) where they are naturally found.
- E)** Select plants from the "Exhibit," while not being limited to this list.
- F)** Select plant combinations based on naturally occurring plant communities found among Hawaii's wide range of ecological zones.
- G)** Do not avoid use of native Hawaiian plants due to nurseries' lack of uniform plant material, rather consider ways to use non-uniform plants in landscape designs.
- H)** Choose native Hawaiian plants because of their cultural and ecological links as well as their functionality, and choose Polynesian introduced plants rather than other non-native plants to meet cultural needs.
- I)** Avoid using invasive plant species and use non-native plants sparingly and with great care. If you can, use a native Hawaiian plant to meet your functional or aesthetic planting plan needs or desires to do so.
- J)** Inform clients of the benefits of using native Hawaiian plants in order to secure the sustainability of the site by perpetuating the use of these culturally and ecologically significant plants. Use of these plants on a long term basis is just as important as the initial implementation of the project.
- K)** Seek to understand the structural and functional relationships of native Hawaiian ecosystems so as to recognize the ways to create appropriate associations between different plants and between plants and the environmental conditions of a site, especially soil type, moisture, and microclimates.
- L)** Avoid using native Hawaiian plants as simple specimens, rather use these plants in ways that reflect natural ecosystem structure and function.
- M)** Where appropriate, select the same native Hawaiian plant in a variety of sizes so as to reflect the dynamics associated with natural succession.
- N)** Consider many possible ways to educate the client and the public about the use of native Hawaiian plants at a project site during the process of planning and design, during

implementation, and following installation of a planting plan. In particular, consider ways to teach the importance of protecting and perpetuating the genetic diversity of native Hawaiian plant species by connecting or linking old (preserved) and new (created) habitats with one another and of highlighting the cultural values of both native Hawaiian and Polynesian introduced plants.

CONCLUSION

The use of native Hawaiian plants benefits native Hawaiian flora and fauna, clients, homeowners, nurseries, and the public as a whole. Native Hawaiian plants are a unique and special resource Hawaii cannot afford to lose. Native Hawaiian plants offer links to the past and promise for the future of Hawaii's people as well as its natural environment. The use of native Hawaiian plants plays a significant role in the protection of these plants. Landscape architects in Hawaii are creative designers who can make a difference in protecting Hawaii's precious flora and fauna by designing with native Hawaiian plants.

CHAPTER 5 ~ RECOMMENDATIONS

This chapter reviews thesis goals, methodology, findings/results, conclusions/recommendations/so what (which explores the landscape architect's role in relation to that particular thesis goal).

GOALS

#1 ----- >
To obtain an understanding
of the reasons for changes in
Hawaii's ecosystems,
especially the loss of native
flora

METHODOLOGY

Literature Review

OBJECTIVES

Literature Review
of Information
Pertaining to Goal #1

FINDINGS/RESULTS

Summary of Literature Review

Causes

- 1) Fires.
- 2) Grazing animals.
- 3) Land conversion (forest to pasture, coastal areas to resorts, etc.).
- 4) Loss of native pollinators.
- 5) Introduction and spread of invasive plants.

CONCLUSIONS/RECOMMENDATIONS

Protection Vs. Extinction

Potential Solutions

- 1) Reduce or eliminate threats to native ecosystems.
- 2) Generate and maintain genetic back-up.
- 3) Outplanting (put endangered plants back into the wild).

SO WHAT

Landscape Architects Role

What Can Landscape Architects Do?

- 1) Landscape architects should avoid the use of invasive plants.
- 2) Landscape architects should use genetically diverse native plants.
- 3) Landscape architects should create links to natural habitats by connecting such areas with designed areas with the use of native plants.

GOALS

METHODOLOGY

OBJECTIVES

#2 ----- >
 To understand more fully the
 cultural significance of native
 Hawaiian plants

Literature Review

Literature Review
 on Information
 Pertaining to Goal #2

FINDINGS/RESULTS

Summary of Literature Review

- 1) Polynesian introduced plants and native Hawaiian plants are both culturally significant.

CONCLUSIONS/RECOMMENDATIONS

How Do We Deal With Cultural Species?

1) We need to be aware and sensitive of culturally significant plants because they offer cultural links to the past and are essential for the future of native Hawaiian culture.

SO WHAT

Landscape Architects Role

- 1) Landscape Architects need to understand Hawaiian culture and the plants upon which they depend in order to make wise decisions regarding planning and design work.
- 2) By designing with these plants, landscape architects play a role in perpetuating Hawaiian culture and religion through education and awareness.
- 3) Designing with native Hawaiian plants and Polynesian introduced plants are essentially creating mini-botanical gardens which will help to protect these plants and perpetuate Hawaiian culture.

GOALS

3 ----- >

To obtain an understanding of basic definitions and guiding legislation regarding the protection and use of plants in Hawaii

METHODOLOGY

Surveys, Interview, and Literature Review

OBJECTIVES

3

To understand the relationship between Hawaii's Act 73 the way that landscape architects select plants in Hawaii

FINDINGS/RESULTS

Surveys, Interviews, Scientific Definitions

1) A lack of clarity in definitions is evident from the surveys and Act 73, especially the words native and indigenous.

2) There are 161 Endangered and Threatened plants in Hawaii and they presently lack critical habitat.

3) Act 73 mandates the use of indigenous and Polynesian introduced plants in State-funded projects, but there are no incentives or penalties for not abiding by this law. However, the surveys showed that Act 73 had a strong influence (increased use) on the use of native Hawaiian plants by landscape architects.

CONCLUSIONS/RECOMMENDATIONS

*Accuracy In Using Words, Important to Discuss and
Come to Common Ground, Interpreting Laws/Policies*

1) Finding a common ground in terms of definitions of commonly used words is very important in order to avoid confusion and misunderstanding. Scientifically based terms merit attention, help to clarify misperceptions, and improve communication as a whole.

2) Threats to endangered plants needs to be understood in order to understand what role landscape architects play in terms of reducing the threats.

3) Incentives and penalties should be created for Act 73, which could increase the use of these plants by landscape architects

SO WHAT

Landscape Architects Role

1) Landscape architects should educate the public, their clients, and themselves on definitions which are closely related to their profession. Perhaps a dictionary pertaining to landscape architectural terms should be derived to help reduce the confusion.

2) Once landscape architects understand the role they play in protecting endangered plants, they can take steps towards reducing the threats to these plants, such as avoiding the use of invasive plants and using genetically diverse native plants.

3) Regardless of the law, landscape architects should be sensitive to the issues regarding protecting Hawaiian culture and Hawaii's fragile ecosystems. By using native Hawaiian and

Polynesian introduced plants, landscape architects can have a positive impact on the future of Hawaii's ecosystems and Hawaiian culture.

GOAL

#4 ----- >

To understand how landscape architects can help retain the integrity of Hawaii's natural and cultural landscapes

METHODOLOGY

Survey's, Interviews and Case Studies

OBJECTIVES

#1, #2, #4, #5, #6

- 1) To assess the extent to which landscape architects in Hawaii use native plants in their planting plans
- 2) To understand why landscape architects in Hawaii use (or do not use) native Hawaiian plants
- 4) To understand the constraints and opportunities that landscape architects need to consider when preparing planting plans;
- 5) To summarize major issues and concerns related to using native Hawaiian plants in landscape designs and identify potential ways to address these issues and concerns;
- 6) To develop guidelines that landscape architects in Hawaii can follow as they select native

Hawaiian plants for their
planting plans.

FINDINGS/RESULTS

Surveys, Interviews and Case Study

1) Ninety six percent of the respondents to the survey use native Hawaiian plants in their planting plans mostly because of Act 73, the most common percentage of a budget allocated to native plants is between 10 – 24 percent.

2) Landscape architects use native Hawaiian plants because of three important factors: a) Act 73; b) increased awareness (environmental, cultural, educational, and general interest); and c) low maintenance, especially in terms of water and fertilizer. Landscape architects do not use native plants because of three main factors: a) lack of availability, b) unqualified maintenance crews, and c) unfamiliar with a plant itself and especially its landscape use, maintenance and care, and water and sun requirements. All of these factors influence, use and if one aspect is missing landscape architects may be reluctant to use the plant.

4) Again, availability and maintenance are the most constraining issues related to native plant use, While educational value, native plant adaptability, the opportunity to link designed areas with natural areas, the low water and fertilizer requirement, and creating a sense of place are all opportunities in designing with native Hawaiian plants.

5a) There are public perceived definitions and scientifically derived definitions, that ultimately creates confusion if the same term means something different scientifically vs. publicly.

5b) Landscape architects are faced with challenges and constraints related to designing with native Hawaiian plants.

6) See guidelines

CONCLUSIONS/RECOMMENDATIONS

Constraints, How Do We Make them Less of a Constraint, Guidelines

1) Almost all landscape architects in the survey use native Hawaiian plants in their planting plans although certain plants were used more often due to availability, familiarity, aesthetic appeal and

maintenance requirements. The common planting budget is between 10-24 % due to factors like lack of availability and maintenance concerns.

2) Because Act 73 had a large influence in the use of native plants, and as a result, it should be extended to include other sectors, ultimately increasing awareness and protection of these plants. Improving availability can start with communication between landscape architects and nurseries. Maintenance crews should be reeducated on the proper care of native plants through seminars, manuals, and other educational venues. Plant familiarity is partially in the hands of the landscape architects themselves. They should seek out educational opportunities to learn about Hawaii's native plants and communicate with the many resources they have, especially the universities and colleges in the State.

4) In order to improve the opportunities for using native Hawaiian plants, the constraints need to be addressed. Again, availability can be improved through communication between landscape architects and nurseries. Maintenance can be improved through educating the maintenance crews on proper ways to maintain native plants.

5a) landscape architects need to know the differences between these definitions in order to make educated decisions as a whole.

5b) landscape architects are faced with challenges and constraints of designing with native Hawaiian plants, which are: 1) lack of availability, 2) unestablished maintenance requirements, 3) difficulty in selecting plants adapted to the projects site due to a lack of information, and 4) getting the client, public, and or the designer to accept the use of native plants.

6) see guidelines

SO WHAT

Landscape Architects Role

1) The whole issue of availability needs to be addressed by landscape architects and nurseries.

Landscape architects should communicate with nurseries and inform them of their needs.

2) Landscape architects should seek out information needed to learn more about plants native to Hawaii. By doing this, landscape architects may become more familiar with the plants and more prone to using them.

4) Landscape architects need to communicate with nurseries and inform them of their plant needs. If landscape architects continue to request native plants, availability of these plants should increase due to supply and demand. Also, landscape architects could request that maintenance crews be educated and possibly certified on native plant care and maintenance.

5a) landscape architects should educate themselves and the public on scientifically derived terms so that there is a common understanding during communication, especially with clients and among themselves. It is important that landscape architects understand the differences between these terms because they are closely related to the profession of landscape architecture and will help landscape architects make educated decisions.

5b) Availability can be addressed through communication between designers and nurseries. Maintenance issues can be addressed through routes that will educate crews to proper care and maintenance like seminars, classes, books, manuals, etc. Selecting plants adapted to the site can be addressed through manuals, books, or contacting researchers at the University of Hawaii at Manoa who have experience on this issue. Such information may not exist on many native plants; however, if a manual, guidebook or educational video could be created or developed with information like: 1) plant maintenance and care, 2) a photo of the plant, 3) natural plant community associations, 4) watering requirements, 5) cultural and ecological significance of the plant, 6) the natural range of the plant, etc., all of which could touch upon information that landscape architects could use to make educated decisions on the use of native Hawaiian plants. This manual, guidebook, or educational video may have a positive impact on the use of native Hawaiian plants and may encourage landscape architects to use these plants because most of the information they need would be provided in one source. Acceptance of the use of native plants can occur through educating the public, clients, and landscape architects themselves on the benefits (ecological, cultural, and practical or functional) of using native Hawaiian plants. Also, the creation of cultural gardens (gardens which incorporate plants related to Hawaiian culture) and demonstration gardens (which show how to use native plants) could help educate the public, clients, and landscape architects on the significance of these plants and perhaps encourage them to use native and Polynesian introduced plants.

6) See guidelines

CHAPTER 6 ~ SUMMARY AND CONCLUSIONS

Hawaii's native plants have been through hundreds, thousands, or perhaps millions of years of evolutionary processes in isolation. When migrating Polynesians settled in Hawaii, their need for food, shelter, and clothing had an impact on native Hawaiian plants and ecosystems, but this impact was nothing compared to the impacts of the introduction of herbivores by early European explorers along with the introduction of invasive, non-native plants and the processes of rapid urbanization that followed. Human populations in Hawaii continue to increase while native Hawaiian plant populations decrease. One major factor contributing to the demise of native Hawaiian plants is the introduction of invasive plants. Invasive plants have the capability of crowding out native Hawaiian plants in various ways, some to the point of extinction. Today, there are many efforts underway to help preserve one of Hawaii's most treasured assets, its flora, upon which Hawaii's native culture and natural ecosystems depend.

There are 161 endangered and threatened plants in Hawaii. Scientists believe that in order to protect native Hawaiian plants, three issues need to be understood and addressed: 1) eliminate or reduce threats to native ecosystems, 2) generate and maintain genetic backup, and 3) put native Hawaiian plants back in the wild. Landscape architects can and do play a role in relation to each of these issues. For example, landscape architects can avoid the use of invasive plants, which have the potential to threaten native ecosystems. Landscape architects can use genetically diverse native Hawaiian plants. And landscape architects can create links to natural habitats by connecting such areas with designed environments.

Public perceived definitions can be different from scientifically derived definitions. The ease of communication occurs when two parties share a common language with similar definitions that can ultimately reduce confusion and misunderstanding. Scientifically based definitions merit attention and specifically clarify differences in terminology, reducing confusion and misperceptions.

The plants of Hawaii have a unique history and are closely related to native Hawaiian culture. Native and Polynesian introduced plants in Hawaii offer significant cultural links. If landscape architects are mediators between culture and nature, we need to understand both aspects in order to make educated decisions regarding planning and design work. With the many changes presently occurring in the Hawaiian landscape, it is important to understand the issues related to and surrounding the impacts on Hawaii's ecosystems. Today more than ever, Hawaii is faced with the challenge to reduce threats to its fragile ecosystems. Cooperative efforts from various organizations can make a difference in protecting vital habitat upon which native flora and fauna depend for food and shelter. Public awareness is essential. The efforts of scientists working hard to protect native ecosystems is not enough, the public also has a responsibility in this effort.

Currently there are laws in Hawaii that are geared towards educating the public on the cultural significance of native Hawaiian plants, particularly Acts 73 and 236. These two laws help landscape architects and other designers focus on using native Hawaiian and Polynesian introduced plants in State-funded projects in an effort to promote public awareness about the cultural and ecological significance of these plants. Acts 73 and 236 have gone beyond these expectations, especially in terms of attempting to protect native Hawaiian plants via use and public education.

In the time between August 1993 and August 1994, 57 plants in Hawaii were added to the Federal Register of Endangered and Threatened Wildlife and Plants. There are laws in Hawaii to protect native Hawaiian plants, but are these laws enough to ensure the survival of these plants? The Endangered Species Act protects endangered and threatened plants and animals but many endangered plants in Hawaii lack critical habitat essential for their survival. Acts 73 and 236 mandates the use of native Hawaiian and Polynesian introduced plants in State funded projects with the intention of fostering public awareness but lacks incentives or penalties. Are these laws enough to protect native Hawaiian plants? Perhaps we won't know for a while; however, if the listing of 57 new plant species in one year is any indication of the future, perhaps conservation efforts may need to be reevaluated.

The State legislature is convinced of the educational potential of this law, as are many local landscape architects. The survey discussed in the next chapter indicates that this law has influenced and increased the use of native and Polynesian introduced plants in landscaped areas funded by the State, including educational facilities, state buildings, convention centers, and other highly visible sites. So what does all this mean in terms of the “protection” of native Hawaiian plants? It is obvious that these plants should grow in numbers whereby their populations will increase. However, botanists are concerned about this increase in populations because many cultivated plants are clones from one “mother plant”, creating drastic reductions in genetic diversity. Cloning allows the production of many plants that are uniform in their appearance as well as in their genetic makeup.

Reducing threats to native ecosystems, generating and maintaining genetic backup, and putting native plants back in the wild are essentially what botanists believe can be done to protect native plants. So where do landscape architects fit into this picture? In essence, using native plants in State funded projects (of which most will be in or near the urban fabric), is basically creating mini-botanical gardens, or “plants existing only in cultivation”, which are scientifically “considered functionally extinct”(Stemmermann 1989:53). However, by creating “mini-botanical gardens”, landscape architects can play a significant role in filling the need for genetic back-up in the event of a disaster like a hurricane or tsunami; however, the issue of genetic diversity in nursery produced stock needs to be addressed, especially if landscape architects depend upon them for plant material.

If these sites designed by landscape architects with native plants are scientifically considered to be “functionally extinct”, then is it not possible that by studying native ecosystems in Hawaii, designed landscapes could attempt to “recreate” as much as possible a “native ecosystem” with whatever that site allows? For example, attempting to place “community plants” together as they would be found in a native forest? Perhaps these associations today are not fully understood by scientists, but their success in their native ecosystem is proof of their survival. Using naturally associated plants together, landscape architectural designs may be closer to being biologically and culturally linked to their native landscapes than designs which strictly rely on “exotic” plant

material that are not biologically or culturally linked to Hawaii. Some of these questions will be addressed in Chapters 4, 5, and 6.

The surveys undertaken as a part of this thesis show that a significant number of landscape architects in Hawaii use native Hawaiian plants in their planting plans as a result of these laws. Using native Hawaiian plants in designed projects is a form of protection because by creating mini-botanical gardens, landscape architects are generating genetic back-up. By avoiding invasive plant species, landscape architects are reducing threats to native ecosystems. And, landscape architects can create links between natural and designed areas by using native Hawaiian plants. Landscape architects are making a difference in the protection of native Hawaiian plants by using them in their projects.

What are the factors that prevent or discourage landscape architects from using native Hawaiian plants in their projects? The surveys indicate several constraints that landscape architects in Hawaii face when designing with native Hawaiian plants: 1) lack of availability and quantity of plant material, 2) unestablished maintenance requirements, 3) difficulty in selecting plants adapted to the project site due to a lack of information about plants and plant-microclimate requirements, and 4) getting the client, public, and/or designer to accept the use and aesthetic of native Hawaiian plants. All of these issues can be addressed and potentially solved with time, perseverance, and cooperation among landscape architects, the landscape industry in Hawaii, plant nurseries, maintenance crews, researchers, universities, politicians, and the public in general.

Using native Hawaiian plants in designed projects: 1) offers a sense of place; 2) offers a link to Hawaii's cultural past, present, and future; 3) offers an ecological link to (and may begin to restore) native habitats; 4) offers the ability to provide many specific site (or functional) needs; 5) requires low maintenance once plants are established on a site; 6) provides an aesthetically pleasing designed environment; 7) provides educational opportunities; 8) supports local nurseries; and 9) helps to protect and preserve native Hawaiian plants and Hawaii's fragile ecosystems as well as the native (non-human) inhabitants.

The Nature Conservancy of Hawaii has come up with twelve guidelines for people to follow in order to help curb the influx of non-native plants and animals, as well as tips to help preserve Hawaii's natural resources: 1) look out for non-native flora and fauna and if you find any, report them to the Department of Agriculture, 2) avoid release of pets into the wild, 3) do not introduce non-native flora or fauna into Hawaii, 5) keep four-wheel drives on marked roads, 6) clean hiking boots/shoes before entering native forests or when traveling to other Islands, 7) avoid taking native species from the wild, 8) properly dispose of fishing lines and six-pack plastic rings, 9) support organizations working on conservation issues, 10) support legislation which leads to conservation, 11) educate yourself on Hawaii's natural heritage, and 12) educate others.

Hawaii is a special and unique place. Its native plants have evolved in isolation for millions of years. It is an important challenge to retain the integrity of Hawaii's natural and cultural landscapes and restore its built landscape. Tourism is an important component of Hawaii's economy. When tourists come to Hawaii, they usually land in Honolulu and may be impressed by the lush landscapes of the city. Honolulu's lush landscapes designed with plants, many of which are not native to Hawaii, may give tourists the wrong image of what Hawaii is really about. Unfortunately, some tourists never leave the city of Honolulu. However, if a tourist really wants to capture the true essence of Hawaii, he or she probably has to fly to another island or visit a remote area on Oahu, which is less inhabited and developed. Is it possible that Honolulu may eventually develop into a generic city that is identical to a city in Southern California, Florida or somewhere else. I believe that by starting to consciously design with native and Polynesian introduced plants in the public and private sectors, landscape architects can begin to restore the true meaning and image of what Hawaii is through its native and Polynesian introduced plants.

The use of native Hawaiian plants in design projects has a number of significant benefits. As stated in the introduction of this thesis, the establishment of many small reserves can help to serve Hawaii's conservation needs. Landscape architects need to be aware of the potential benefits that using native Hawaiian plants has on Hawaii's natural ecological systems. What can landscape architects lose by using and helping to protect these precious plants? We are now beginning to understand what we have lost by not protecting them. Landscape architects can make a positive

difference in the future of native Hawaiian plants and ecosystems. Landscape architects can have a direct role in protecting native Hawaiian plants, if they are committed to it and believe in it and understand the implications of it. Landscape architects can decide which plants to use in their planting plans, where to obtain the plants, how to present these plants in order to educate the public of their cultural and natural value, and do all that is within their power to protect these plants. Future generations depend upon our proactive efforts.

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APPENDICES

APPENDIX A ~ PLANTS ASSOCIATED WITH HAWAIIAN CULTURE

Plants associated with <i>food and drink</i>			
Hawaiian name	Common name	Scientific name	Origin
'aheahea		Chenopodium oahuense	endemic
'akala	Hawaiian raspberry	Rubus hawaiiensis	endemic
'aku 'aku	native lobelia	Cyanea platyphylla	endemic
'ama'u	tree fern	Sadleria spp.	endemic
'ape	elephants ear	Alocasia macrorrhiza	Hawaiian heritage plant
'awa	kava	Piper methysticum	Hawaiian heritage plant
'awapuhi	shampoo ginger	Zingiber zerumbet	Hawaiian heritage plant
hapu'u	tree fern	Cibotium spp.	endemic
hoi	bitter yam	Dioscorea bulbifera	Hawaiian heritage plant
hoiokula	Hawaiian oak fern	Thelypteris stegogrammoides	endemic
kalo	taro	Colocasia esculenta	Hawaiian heritage plant
ki	ti leaf plant	Cordyline fruticosa	Hawaiian heritage plant
kikawaio	fern	Christella cytheoides	endemic
ko	sugarcane	Saccharum officinarum	Hawaiian heritage plant
koali 'ai	wild morning glory	Ipomoea cairica	possibly naturalized
ko 'oko 'olau		Bidens spp.	endemic
kukui	candlenut tree	Aleurites moluccana	Hawaiian heritage plant
lama	native persimmon	Diospyros sandwicensis	endemic
limu	fresh water or marine algae, lichens, liverworts, mosses or soft coral		
loulu	native fan palm	Pritchardia spp.	endemic
mai 'a	banana	Musa acuminata hybrids	Hawaiian heritage plant
mamaki		Pipturus spp.	endemic
naupaka kahakai	beach naupaka	Scaevola sericea	indigenous
nioi	bird pepper	Capsicum frutescens	naturalized
niu	coconut	Cocos nucifera	Hawaiian heritage plant
noni	Indian mulberry	Morinda citrifolia	Hawaiian heritage plant
'ohelo		Vaccinium spp.	endemic
'ohi'a 'ai	mountain apple	Syzygium malaccense	Hawaiian heritage plant
pala	fern	Marattia douglasii	endemic
pepeiao akua	fleshy fungus	Auricularia auricula	
pia	Polynesian arrowroot	Tacca leontopetaloides	Hawaiian heritage plant
pi'a	yam	Dioscorea pentaphylla	Hawaiian heritage plant
popolo	glossy nightshade	Solanum americanum	possibly indigenous
'uala	sweet potato	Ipomoea batatas	Hawaiian heritage plant
uhaloa		Waltheria indica	indigenous
'ulei	Hawaiian rose	Osteomeles anthyllidifolia	indigenous
'ulu	breadfruit	Artocarpus altilis	Hawaiian heritage plant
Plants associated with <i>food and drink preparation</i>			
Hawaiian name	Common name	Scientific name	Origin
'ahu 'awa	sedge	Mariscus javanicus	indigenous
'akala	Hawaiian raspberry	Rubus hawaiiensis & macraei	endemic
hala	screw pine	Pandanus spp.	possibly indigenous
hau		Hibiscus tiliaceus	Haw'n herit. pl. or indig.
kalo	taro	Colocasia esculenta	Hawaiian heritage plant
ki	ti leaf plant	Cordyline fruticosa	Hawaiian heritage plant
kukui	candlenut tree	Aleurites moluccana	Hawaiian heritage plant
ma'a	banana	Musa acuminata hybrids	Hawaiian heritage plant
mamaki		Pipturus spp.	endemic

APPENDIX B ~ SESSION LAWS OF HAWAII: ACTS 73 AND 236

ACT 73: Hawaii Revised Statutes (1992): Act 73, Section 1 and 2, Chapter 103

Section 1. Pursuant to chapter 195D, the legislature recognized that many plant species indigenous only to Hawaii have become or are in danger of becoming extinct primarily because of increased land use resulting in disturbance of native ecosystems. These indigenous species are a component of Hawaii's culture, to a significant degree, is intertwined and dependent on certain indigenous plants, many of which have unique scientific, medicinal, educational, environmental and economic value. The legislature is firm in its commitment to protect Hawaii's indigenous plant species and is prepared to take affirmative action to ensure their survival. In this regard, the legislature finds that carefully monitored release of Hawaii's indigenous land plant species for use in landscaping will heighten public awareness and promote public appreciation of the impending horticultural holocaust. Use in landscaping will also promote needed research on care and propagation. The purpose of this Act is to encourage the propagation of Hawaii's indigenous species of land plants by requiring that they be employed, where feasible, in the landscaping of public buildings, facilities, and housing projects developed by the State. In so doing, it is also the purpose of this Act to foster public awareness and appreciation of these land plants through labeling and identification in the landscaped environments.

Section 2. Chapter 103, Hawaii Revised Statutes, is amended by adding a new section to be appropriately designated and to be read as follows: **indigenous plants: use in public landscaping.** (A) Wherever and whenever feasible, all plans, designs, and specifications for new or renovated landscaping of any building, complex of buildings, facility, complex of facilities, or housing development by the State with public moneys shall incorporate indigenous land plant species, as defined in section 195D-2; provided that suitable species can be transplanted or otherwise made available for this purpose without jeopardizing other species or any natural habitat; and provided further that wherever and whenever possible, indigenous land plants shall be used for landscaping on the island or islands on which the species originated. (B) Each

indigenous plant or group of plants used pursuant to subsection (A) shall be clearly identified with appropriate signs for the edification of the general public.

ACT 236: Hawaii Revised Statutes (1993): Act 236 Section 1, 2 and 3, Chapter 103-24.6.

Indigenous and Polynesian introduced plants; use in public landscaping. (A) Wherever and whenever feasible, all plans, designs, and specifications for new or renovated landscaping of any building, complex of buildings, facility, complex of facilities, or housing development by the State with public moneys shall incorporate indigenous land plant species, as defined in section 195D-2[:], and plant species brought to Hawaii by Polynesians before European contact, such as the kukui, noni, and coconut: provided that suitable [species] cultivated plants can be [transplanted or otherwise] made available for this purpose without jeopardizing [other species or any] wild plants in their natural habitat; and provided further that wherever and whenever possible, indigenous land plants shall be used for landscaping on the island or islands on which the species originated. (B) Each [indigenous] plant or group of plants used pursuant to subsection (A) shall be clearly identified with [appropriate] signs for edification of the general public.

ACT 236: Hawaii Revised Statutes (1994): Chapter 103-24.6.

Indigenous and Polynesian introduced plants; use in public landscaping. (A) Wherever and whenever feasible, all plans, designs, and specifications for new or renovated landscaping of any building, complex of buildings, facility, complex of facilities, or housing development by the State with public moneys shall incorporate indigenous land plant species, as defined in section 195D-2, and plant species brought to Hawaii by Polynesians before European contact, such as the kukui, noni, and coconut; provided that suitable cultivated plants can be made available for this purpose without jeopardizing wild plants in their habitat: and provided further that wherever and whenever possible, indigenous land plants shall be used for landscaping on the islands or islands on which the species originated, (B) Each plant or group of plants used pursuant to subsection (A) shall be clearly identified with signs for the edification of the general public.

APPENDIX C ~ DRAFT COPY OF HAWAII ADMINISTRATIVE RULES PERTAINING TO ACTS 73 AND 236.

HAWAII ADMINISTRATIVE RULES
TITLE 3
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
SUBTITLE 11
PROCUREMENT POLICY BOARD
CHAPTER 133
PUBLIC LANDSCAPING

Purpose: The purpose of these rules is to incorporate indigenous and Polynesian land plant species into all landscape projects developed with public moneys by the State or the several counties.

Definitions: As used in these rules: Endangered Species means any species whose continued existence as a viable component of the State's indigenous fauna or flora is determined to be in jeopardy and has been so designated pursuant to section 195D-4, HRS. Indigenous land plant species means any species of the plant kingdom, including seeds, roots and parts thereof, except freshwater or marine plants, growing or living naturally in the State without having been brought to the State by humans. Polynesian introduced plants means any plant species brought to Hawaii by Polynesians before European contact, such as kukui, noni, and coconut. Species means and shall include any subspecies of land plant which appears likely, within the foreseeable future, to become endangered and has been so designated pursuant to section 195D-4, HRS.

Policy: (A) When possible, all plans, designs, and specifications for new or renovated landscaping of any building, complex of buildings, facilities, or housing developed with public moneys by the State or its several counties shall incorporate indigenous and Polynesian introduced plants. (B) When possible, indigenous plants shall be used for landscaping on the island on which the species originated. (C) Plants or group of plants used for landscaping shall be clearly identified with signs for the general public. (D) Provided that suitable cultivated plants can be

made available for this purpose of this section without jeopardizing wild plants in their natural habitat. (E) Threatened or endangered species shall not be used for this purpose.

Procedures: (A) The head of the purchasing agency providing landscape architectural services for construction projects shall coordinate with the using agency and ensure when possible indigenous and Polynesian introduced plants are included in the bid specifications. (B) The exhibit titled “Indigenous and Polynesian Introduced Plants” dated () shall be used in preparing bid specifications for landscaping projects. Selection by landscape designers are not restricted to this exhibit for there are other plant materials which can be used. However, before selecting materials not on the exhibit, the using agency shall consult with the appropriate landscape architect.

EXHIBIT: INDIGENOUS AND POLYNESIAN INTRODUCED PLANTS

TREES

<i>Genus and Species</i>	<i>Common Name</i>
Acacia koa	Koa
Aleurites molocana	Kukui, Candlenut tree
Artocarpus altilis	Ulu, breadfruit
Broussonetia papyrifera	Wauke
Callophyllum inophyllum	Kamani
Canthium oderatum	Alahe’e
Cheirodendron trigynum	‘Olapa
Cibotium splendens	Hapu’u, Tree fern
Cocos nucifera	Niu, Coconut palm
Cordia sebastana	Kou haole
Diospyros hillebrandii	Lama
Diospyros sandwicensis	Lama, Native persimmon
Dodonaea viscosa	‘A’ali’i
Erythrina crista-galli	Coral tree
Erythrina sandwicensis	Wiliwili
Hibiscus arnottianus	Koki’o ke’oke’o
Hibiscus tiliaceus	Hau
Metrosideros polymorpha	‘Ohi’a, ‘Ohi’a lehua
Morinda citrifolia	Noni, Indian mulberry
Morinda sandwicense	Naio, Bastard sandlewood

Myrsine lessertiana	Kolea lau nui
Nototrichium sandwicense	Kulu'i
Pandanus tectorius	Screw pine, Hala
Pipturus albidus	Mamake, Hawaiian tea
Pisonia sandwicensis	Aulu, Papala kepau
Pittosporum hosmeri	Ho'awa
Pritchardia beccariana	Loulu, Fan palm
Pritchardia glabrata	no common name
Pritchardia hillebrandii	Loulu lelo
Pritchardia martii	Loulu hiwa
Pritchardia minor	no common name
Pritchardia remota	Loulu
Psychotria hawaiiensis	Kopiko 'ula
Reynoldsia sandwicensis	'Ohe, 'Ohe makai
Santalum paniculatum	'Iliahi, Sandlewood
Sapindus oahuensis	Lonomea, Aulu
Sapinidus saponaria	A'e, Manele, Soapberry
Scaevola gaudichaudiana	Mountain naupaka, Naupaka kuahiwi
Sophora chrysophylla	Mamane
Tetraplasandra oahuensis	'Ohe mauka
Thespesia populnea	Milo, Portia tree

SHRUBS

Genus and Species

Common Name

Argemone glauca	Pua kala, Hawaiian poppy
Artemisia australis	'Ahinahina
Artemisia kauaiensis	'Ahinahina
Asplenium nidus	'Ekaha, birds nest fern
Astelia menziesiana	Kaluaha
Bidens sandwicensis	Ko'oko'olau
Cathium odoratum	Alahe'e
Chamasyce degeneri	Maiapilo, Native caper
Cibotium chamissoi	Hapu'u i'i, Black tree fern
Coprosma waimeae	'Olena
Cordyline fruticosa	Kou
Dodonaea viscosa	A'ali'i
Ganaphalium sandwicense	'Ena'ena
Gunnera petaloidea	'Ape'ape
Hedyotis spp	Au, Pilo
Hibiscus arnottianus	Koki'o ke'oke'o
Hibiscus calyphyllus	Rock's Kauai hibiscus
Hibiscus tiliaceus	Hau

Hibiscus waimeae	Koki'o ke'o ke'o
Lipochaeta succulenta	Nehe
Lythrum maritimum	Pukamole
Metrosideros polymorpha	'Ohi'a, 'Ohi'a lehua
Mordina citrifolia	Noni, Indian mulberry
Nototrichium sandwicense	Kulu'i
Osteomeles anthyllidifolia	U'ulei, 'Ulei, Hawaiian rose
Piper methysticum	'Awa, Kava
Pipturus albidus	Mamake, Hawaiian tea
Plectranthus parviflorus	'Ala'ala wai nui
Plumbago zeylanica	'Ilie'e
Rubus hawaiiensis	'Akala, Hawaiian raspberry
Saccharum officinarum	Ko, Sugar cane
Sadleria cyathroides	'Ama'uma'u
Scaevola gaudichaudiana	Mountain naupaka, Naupaka kuahiwi
Scaevola gaudichaudii	Naupaka kuahiwi
Scaevola sericea	Beach naupaka, Naupaka kahakai
Senna gaudichaudii	Kolomona
Sida fallax	'Ilima
Sophora chrysophylla	Mamane
Stephelia tameiameia	Pukiawe
Tribulus cistoides	Nohu
Vitex rotundifolia	Pohinahina, Beach vitex
Wilkesia gymnoxiphium	Iliau
Zingiber zerumbet	'Awapuhi, Shampoo ginger

GROUND COVERS

<i>Genus and Species</i>	<i>Common Name</i>
Artemisia australis	'Ahinahina
Artemisia kauaiensis	'Ahinahina
Colocasia esculenta	Kalo, Taro
Coprosma ernodeoides	Kukainene
Dianella sandwicensis	'Uki uki
Fimbristylis cymosa	Mau'u 'aki'aki
Heliotropium anomalum	Hinahina, Beach hiliotrope
Heliotropium anomalum var argenteum	Hinahina ku kahakai
Ipomoea pes-caprae ssp brasiliensis	Pohuehue, Beach morning glory
Jacquemontia ovalifolia	Pa'ouhi,iaka
Lepidium bidentatum	'Anaunau
Lipochaeta integrifolia	Nehe
Lipochaeta succulenta	Nehe
Marsilea villosa	'Ihi'ihii

Microlepia strigosa	Palapalai
Nephrolepis exaltata	Kupukupu lau li'i, Native sword fern
Osteomeles anthyllidifolia	U'ulei, 'Ulei, Hawaiian rose
Peperomia leptostachya	'Ala'ala wai nui, Hawaiian peperomia
Plumbago zeylanica	'Ilie'e
Portulaca spp.	'Ihi
Psilotum nudum	Moa, Moa kula
Sesuvium portulacastrum	'Akulikuli, Sea purslane
Sida fallax	'Ilima
Sphenomeris chinensis	Pala'a
Tribulus cistoides	Nohu
Vaccinium reticulatum	'Ohelo
Vitex rotundifolia	Pohinahina, Beach vitex
Wikstroemia uva-ursi	'Akia, Molokai osmanthus

VINES

<i>Genus and Species</i>	<i>Common Name</i>
Alyxia oliviformis	Maile
Freycinetia arborea	'Ie 'ie
Ipomoea pes-caprae ssp. brasiliensis	Pohuehue, Beach morning glory
Jacquemontia ovalifolia spp. sandwicensis	Pa'uohi'iaka

APPENDIX D ~ SURVEY DATA RESPONSES

This survey was designed with the intent to: 1) discover information not available in current literature; 2) understand how, why, where, and to what extent landscape architects in Hawaii use native plants in their planting plans; 3) develop a list of most commonly used native Hawaiian plants by landscape architects in Hawaii; 4) understand the constraints, opportunities, issues, and concerns surrounding the use of native Hawaiian plants; and 5) develop an approach and guidelines that landscape architects can use as a guide when they design with native Hawaiian plants.

Survey questions were developed and sent to landscape architects in Hawaii who were ASLA members. The survey responses were sorted and analyzed (see chapter 4). A discussion and synthesis of concerns and issues faced by landscape architects and guidelines for using native Hawaiian plants by landscape architects in Hawaii was derived from the survey data.

Firm Information: General questions began with firm name, firm location, number of years in practice, field of specialization, and whether they are certified landscape architects and ASLA members. There were 29 respondents to the survey, with 25 different firms represented.

*firm location: 18 or 62% (Honolulu, Oahu), 3 (Kaneohe, Oahu), 2 (Kaaawa, Oahu), 2 (Kapaa, Kauai), 2 (Kailua, Hawaii), 1 (Hilo, Hawaii), and 1 (Kurtistown, Hawaii).

*number of years in practice: 3 to 45 years; average years in practice is 17 years.

*certified landscape architects: yes - 23 (79%) and no 6 - (21%)

*ASLA members: all 29 (100%) respondents were ASLA members

*the survey was sent out on September 28, 1995 and most respondents returned surveys by the suggested deadline of October 25, 1995.

*eighty one surveys were sent; however, 8 were not at the address surveys were sent to, making the new number of surveys 73 (81 - 8 = 73).

Total survey response rate	#	%

individual response rate (out of 73 individuals)	29	40%
firm response rate (out of 41 firms)	25	61%

*field of specialization (as written by respondents):

private sector of landscape architecture;
 site planning, landscape/irrigation design;
 landscape design;
 civil engineering and landscape architecture;
 landscape design;
 none;
 ?;
 environmental planning;
 golf course design;
 site analysis, housing;
 residential;
 construction design, administration;
 none;
 landscape architecture;
 broad;
 residential, light commercial, resort;
 landscape architecture, planning;
 landscape architecture, planning, urban design;
 landscape design;
 resort, commercial;
 resort, commercial, residential, landscape design;
 landscape architecture, planting and irrigation design;
 landscape architecture in the private sector;
 golf course design;
 resort;
 general construction, custom homes;
 native planting design;
 landscape architecture;
 urban planning, landscape architecture;

<i>firm size</i>	<i># of firms</i>	<i>%</i>	<i>firm type</i>	<i># of firms</i>	<i>%</i>
1 person firm	18	72%	P1 (Landscape Arch.)	18	72%
2 person firm	2	8%	P2 (Multi Discipline)	2	08%
3 person firm	1	4%	P3 (Other Private Firm)	2	08%
6 person firm	1	4%	P4 (Design/Build)	3	12%
7 person firm	1	4%			
8 person firm	1	4%	total	25	100%
17 person firm	1	4%			
total	25	100%			

Question # 1. My working definition of a native Hawaiian plant is: a plant which is either endemic or indigenous to the Hawaiian Islands. Native Hawaiian plants may have arrived at the Islands via natural means: carried by jet streams, ocean currents and birds. Non-

**native plants (exotics) are those plants which do not fit this definition of “native plants.”
Do you agree with these definitions? Yes___ No___ ; Please explain.**

# (%) responding to Q #1	response	reasons
28 (97%)	agree	*definitions are generally and widely accepted *agree from a scientific aspect *general definition used by laymen to professionals
1 (3%)	disagree	*definitions are not universally accepted, the term is often used to be politically correct without a botanical definition

Question # 2. In your opinion, are plants brought to Hawaii by the Hawaiians “native plants?” Yes___ No___; Please explain.

	#	%	reasons
yes	16	55%	*considers Hawaiian heritage plants to be native *considered native by public *arrived one hundred years ago and became indigenous
no	13	45%	*originated from South Pacific or South East Asia and introduced by ancient Polynesians *plants that arrived via natural means are considered native *considers naturalized Hawaiian heritage plants to be native *considers plants brought to Hawaii by ancient Polynesians not native *considers plants brought to Hawaii by Hawaiians as “Heritage Plants” *Polynesian introduced plants offer important link to the past and people and considers them to be native, perhaps pre-European plants should be considered as native? *they are classified as Polynesian introduction *plants brought by humans are considered non-native

Question # 3. Have you noticed an increase in the use of native Hawaiian plants by landscape architects in the past several years? Yes___ No___; If so, why do you think there has been an increase?

	#	%	reasons
no	2	7%	no reasons
yes	27	93%	*educational programs, interest in Hawaiian culture/heritage *law dictates that landscape architects have to use native plants for any public project

- *law says to use native plants where ever possible in public projects
- *environmentally appropriate
- *appropriate in Hawaii to use native Hawaiian plants
- *increased availability in nurseries, more information on their requirements, lower H2O requirements
- *law (state) mandates use of Polynesian introduced or indigenous plants for all state jobs
- *low H2O requirements, increased appreciation, decrease risk of extinction
- *general interest, developer interest, public interest, availability, adaptability to marginal areas
- *law, Act 73
- *increased availability at nurseries
- *public, nursery, professional awareness of the value of native plants, adaptability to difficult sites
- *availability, knowledge, education
- *availability and awareness of native plants
- *increased awareness and availability
- *law, interest in native plants(personal preference)
- *ecological and political correctness
- *increased awareness and appreciation by Landscape Architects and the public, clients preference, all of which may parallel renaissance of the Hawaiian culture
- *increased awareness from the media
- *awareness, law, low H2O requirement
- *environmental awareness (xeriscape), low H2O requirement, consciousness raising by the Nature Conservancy, National Tropical Botanical Garden, Foster Garden and Lyon Arboretum
- *law, ecotourism
- *law, awareness, low H2O requirement
- *increased public awareness of value of native Hawaiian plants
- *law, increased availability

**Question # 4. Do you use native Hawaiian plants in your planting designs? Yes ___
No ___; Why?**

# responding to Q #4	# that use native plants	% that use native plants
28	27	96%

respondents' reasons for the use of native plants

- *good idea
- *appropriate, use = protection
- *low maintenance, personal preference
- *law, design intent, location of site (site condition) may call for native plants
- *law

- *law
- *low maintenance, low water requirements
- *conservation/preservation concern
- *law, increased availability
- *public and client interest, availability, adaptability to harsh conditions
- *law, availability, client's interest
- *law, aesthetically pleasing
- *adaptability to difficult sites
- *appropriate in some design schemes, client's request
- *low maintenance, preservation, educational value
- *personal preference, law
- *ecological and political correctness, native plants are resilient
- *law, use if appropriate with design scheme
- *client's request
- *use if appropriate with design scheme
- *aesthetically pleasing, low maintenance, use if appropriate with design intent
- *law
- *law, awareness, low maintenance
- *use native plants to promote public awareness

respondent reasons for not using native plants

- *local nurseries do not grow or promote native plants to landscape architects
- *native plants are not available
- *native plants are inappropriate in certain projects
- *native plants have minimal ornamental value
- *clients prefer "exotic" look in which some natives do not provide

Questions # 5. What type of projects are native Hawaiian plants being used on?

100% response rate to Q #5;

Type of projects native Hawaiian plants are used on:

- *high rainfall or dry-coastal projects
- *residential
- *projects requiring "natural look or re-naturalized" condition
- *residential
- *golf courses
- *commercial, government, resort
- *public and private
- *public and private
- *resort, commercial, public parks, residential, industrial, roadways
- *state, county, private demo/interpretative gardens
- *all sorts, residential, government, commercial, federal, state, schools, local
- *residential, institutional projects
- *all types, resorts, residential, commercial, non-profit, local

- *all projects, resort, commercial, residential, state, local, non-profit
- *all projects that can blend into the natural landscape
- *all projects from resort, to commercial, to residential
- *commercial, residential, municipal
- *residential, commercial, golf courses
- *shoreline stabilization, commercial, civic, residential
- *public projects, state and county, private projects
- *all sorts/types
- *residential
- *state projects
- *coastal, resort, residential
- *shoreline projects, government buildings and facilities
- *all projects
- *all projects
- *state projects
- *coastal projects

Question # 6. What area of practice are you involved in? Private (residential, resort, other) and Public (federal, state, local, non-profit, other).

# responding to Q #6	% responding
private 28	97%
public 20	69%
total	97% response rate to Q #6 as a whole, with 69% of respondents indicating that they work in both the private and public sector.

	Private			federal	Public				total	firm type
	residential	resort	other		state	local	non-profit	other		
1.	1	1	0	0	1	1	0	0	4	P2, 17per
2.	1	0	1	0	0	0	0	0	2	P1, 1per
3.	1	1	1	0	1	1	1	0	6	P1, 1per
4.	1	1	1	0	1	1	1	0	6	P1, 6pers
5.	1	1	0	0	1	1	1	0	5	P1, 6pers
6.	1	1	1	0	0	0	0	0	3	P4, 1per
7.	0	1	0	1	0	0	1	0	3	P3, 1per
8.	1	1	1	0	0	0	0	0	3	P1, 3pers
9.	1	1	1	1	1	1	1	0	7	P1, 1per
10.	1	1	0	0	0	0	0	0	2	P1, 1per
11.	1	0	1	0	0	0	1	0	3	P1, 1per
12.	1	1	1	0	0	0	0	0	3	P1, 6pers
13.	0	1	0	0	0	0	0	0	1	P4, 1per
14.	1	1	1	1	1	1	1	0	7	P2, 17per
15.	0	1	1	1	1	1	1	0	6	P2, 17per
16.	0	0	1	0	0	1	1	0	3	P1, 1per
17.	1	0	1	0	1	1	0	1	5	P1, 1per
18.	1	1	1	1	1	1	1	0	7	P1, 8per
19.	1	0	1	0	0	1	1	0	4	P1, 1per

20.	1	1	1	0	1	1	0	1	6	P2, 1per
21.	1	0	0	0	0	0	0	0	1	P4, 1per
22.	1	0	1	1	0	1	1	0	5	P1, 7pers
23.	1	0	0	0	0	0	0	0	1	P1, 1per
24.	1	0	0	1	1	1	0	1	5	P1, 2pers
25.	1	0	1	0	1	0	0	0	4	P3, 1per
26.	1	1	0	0	1	1	0	0	4	P1, 1per
27.	0	1	1	1	1	1	1	0	6	P1, 2pers
28.	0	0	1	0	1	1	0	0	3	P1, 1per
29.	# 29 did not respond to question #6									P1, 1per

total	22	17	19	8	15	17	13	3	
%	79%	61%	68%	40%	75%	85%	65%	15%	

*note: percentage calculations used 28 as the total number of respondents for private practice and 20 as the total number of respondents for public practice. Twenty respondents said they did at least some type of “public” work.

Question # 7. For the planting plans you prepare, estimate the percentage of the total planting budget that is allocated for the use of native Hawaiian plants. Public & Private (0-9%, 10-24%, 25-49%, 50-74%, 75-99%, 100%).

# responding to Q #7	% responding
private 26	90%
public 16	55%
total	90% response rate to Q #7 as a whole

	0-9%		10-24%		25-49%		50-74%		75-99%		100%	
	#	%	#	%	#	%	#	%	#	%	#	%
Private	7	27%	16	62%	1	4%	1	4%	1	4%	0	0%
Public	5	31%	8	50%	1	6%	1	6%	0	0%	1	6%

Four respondents (of 42) indicated they used between 50 and 100 percent of the budget on native Hawaiian plants. Two respondents said that they used between 25 and 49 percent of the budget on native Hawaiian plants. Twenty four respondents used between 10 and 24 percent of the budget on native Hawaiian plants while twelve respondents used between 0 and 9 percent.

Question # 8. How would you describe your philosophy to planting design? Please be as specific as possible.

	#	%
no response	4	14%
response	25	86%

*design intent should define and compliment chosen area spatially around a structure. Use of color/texture to create dimensional aspect to please and intrigue the eye;

- *colorful, low maintenance, with simple irrigation design;
- *look for plants with right size and visual characteristics (color, shape, texture, leaf density). Then find plants that are adaptable to site (grow well in the micro-climate of site). If a native plant fits these two categories and client is interested, then will use native plant;
- *understand use of area (function). Factors in plant selection determined by use of area, maintenance needs, ecology of site, “theme” of design;
- *melding site constraints with client’s vision via companies’ preferences for appropriate design and material;
- *informal, natural theme works best on golf courses;
- * “design with nature”, every plant can tell you where it should or wants to be, one must listen;
- *massing of plantings with similar requirements (light, water, drainage). Contrast in texture. Color scheme.
- *design process yields garden’s form. Design is the birthing process of combining site analysis with program analysis. Design solves basic site problems. Design creates outdoor spaces for people to use. Plants and planting design are the materials and ideas which make all this process possible;
- *planting design is dependent upon client’s needs;
- *planting designs address’s projects concepts and criteria;
- *simplicity, mass planting, lots of color and specify natives when/where appropriate;
- *function is first. Accent with color, etc. to satisfy aesthetics and function. Use plants with natural form and low maintenance requirements;
- *plants should respond to 1) program and functional requirements 2) site adaptability 3) long term maintenance considerations;
- *plants as well as other items are used to create or articulate space. It’s a mistake to embark on a design through the eyes of “plant designer.” Know the space, know its function and allow usage of plants to come naturally and appropriately. Successful planting design relies on good understanding of basic principles of design (harmony, proportion, unity, rhythm, accent, balance), architectural and engineering uses of plants and understanding of the environmental, climatic conditions of the site. Massing and spatial definition are the backbone to successful planting design. Secondary details may add “decoration” and interest but should not be confused as the design;
- *fullfillment of the concept of vision and selection based on appropriateness of site;
- *plant selection should blend with existing environment, surroundings, be aesthetically pleasing, functional, compliment architectural features;
- *client’s needs, budget, site considerations, maintenance, soil, irrigation, micro-climates, desired appearance, character. Planting plan needs to address these concerns;
- *public project: design need to be simple and bullet proof or else complaints regarding maintenance; Private project: use plants to create spaces or outdoor rooms that define activities that occur within these rooms. Plant size, color, shape is more important than specific species;
- *natural design of appropriate plants combined creatively. Maintenance considerations are important in plant selection;
- *sense of place, simplicity, low maintenance plants are considered. Native plants don’t always do well in large masses and are often not a good choice;
- *creation of a spiritual connection to the landscape through gardens of fertility and magical floral beauty;

- *organized simplicity;
 - *based on works of Jens Jensen-translated to the tropics;
 - *creating a sense of place and order through a planned approach to placing plant materials.
- Functionality, aesthetics and environmental concerns are important;

Question # 9. When preparing planting plans, which of the following criteria do you use to select plants? Please list your top three criteria (1 being the most important), and list the two least important criteria (L as the least important and 2L as the second least). Feel free to clarify or add to these criteria. (Note: criteria are listed below beginning with aesthetics).

	#	%
no response	4	14%
response	25	86%

	Private Sector	Public Sector
Aesthetics	1=18x, 2=4x, 3=1x, L=1x	1=4x, 2=5x, 3=1x
Viability/Health	2L=3x	2L=2x, 1=1x
Availability	1=2x, 2=8x, 1L=1x	1=2x, 2=6x
Cost	2=1x, 3=2x, L=2x, 2L=7x	2=1x, 3=4x, L=3, 2L=4x
Ecological Compatibility	1=4x, 2=5x, 3=2x, 2L=2x	1=4x, 2=1x, 2L=1x
Uniqueness	L=12x, 2L=3x	L=7x, 2L=3x
Maintenance Requirements	2=3x, 3=13x	1=7x, 2=1x, 3=7x
Habit/Uniformity	2=1x, 3=2x, L=4x, 2L=1x	3=1x, L=2x, 2L=1x
Rate of Growth & Ease of Estab.	1=1x, 2=2x, 3=2x, L=1x, 2L=4x	2=2x, 3=2x, L=1x, 2L=1x
Other		2=1x

Question # 10. In what arena is the use of “native plants” considered more appropriate: public sector or private sector? Please explain.

	#	%
no response	4	14%
responses	25	86%

Appropriateness of using native plants in Public vs. Private Sector

	#	%
Public Sector	3	12%
Private Sector	6	24%
Both Sectors	16	64%

Reasons for Public use

- *mandated by law
- *mandated by law

Reasons for Private use

- *private provides better maintenance;

- *maintenance requirements;
- *better maintenance;
- *many natives not suited for urban/public landscape. Natives require more maintenance in urban/public landscapes. Private sector offers more opportunity to replicate the “natives environment”;
- *owner will give plants proper care that they need;
- *public sector lags in accepting a more open, natural, less manicured look despite possible cost effectiveness regarding maintenance;

Reasons for Both

- *dependent upon site
- *depends on individual plant and how plant is adaptive to job at hand. Private sector use is most prevalent as specimens may be used and cost, size, availability, and rate of establishment are less critical when only a few are needed;
- *mandate for public
- *public projects have good visual exposure but get low level of attention. Private projects are successful due to proper care;
- *considering the threat to Hawaiian ecosystems from invasive exotics.
- *public sector can educate public on native plants/Hawaiian history, etc., private sector has better care;
- *private sector provides more care to plants than public;
- *dependant upon client’s interest;
- *public exposure encourages private use;
- *if use results in lower maintenance and H2O requirement will use in public sector. For private use “to make a statement;”

Plant List: See Appendix F for plant list data.

	#	%
no response	6	21%
responses	23	79%

Follow-Up Survey Data Responses

This survey was designed with the intent to clarify responses to the questions asked during the initial survey. Survey questions were developed and ten survey participants who were involved in state funded projects were randomly selected and then interviewed via phone. Responses were then organized per question as was done in the original survey and were incorporated into the overall survey analysis. A discussion and synthesis of concerns and issues faced by landscape architects and guidelines for using native Hawaiian plants by landscape architects in Hawaii were derived from both the surveys’ data.

Question # 1a. I wanted to clarify if you believe that “native Hawaiian plants” include plants brought to Hawaii by the ancient Polynesians?

1. Yes, I consider them to be native. I am not a purist and these plants are native to the South Pacific. Technically they are not native plants but for everyday purposes, I consider them to be native.
2. No.
3. Yes.
4. Yes.
5. Yes.
6. Yes.
7. Yes.
8. Yes.

Question # 1b. What is your response to the first question based on?

1. My professional training and experience.
2. Experience.
3. Professional training and I saw it elsewhere.
4. Experience
5. The general perception of what I believe the public believes is native includes Polynesian introduced plants.
6. My own experience. Native plants are associated with Hawaiian culture.
7. From personal experience. Some people are more purists.
8. Its a general term. Polynesian plants came with the native Hawaiian culture, if it came with the culture I consider them to be native.

Question # 2a. In the context of planting design, what is your understanding of the term “function?”

1. Use by man of the plant for whatever uses. Function serves many different purposes.
2. Function solves a specific need. For example, parking screening. Function of plants needs to address the problem.
3. It defines spaces, for example, safety reasons.
4. Function is what plants are used for. Plants provide shade, barriers, and visual effects like flowers.
5. Plant material has a purpose. Plants can be used for their color, texture, or as a screen.
6. Plants provide a function. Function serves a purpose. Plants are not just visual, but can screen or buffer the sun or noise.
7. Function pertains to an engineering term. I select a plant to achieve a specific purpose and then aesthetics is considered.
8. Deliberate use of plant material for an effect.

Question # 2b. How important is function in planting design? Please give an example.

1. Very important. It is as important as aesthetics. In golf course design, safety screens are created to protect people from golf balls. Dense trees can block out noise. Overhead canopy creates shade. Dense plantings reduces exhaust fumes from near by traffic.
2. Very important, it needs to serve a purpose.
3. Very important, it's number one and just as important as aesthetics.
4. Very important.
5. It is very important. Plant material can act as shade or take on more than one role that the plant can do. Plants can add color, accent, or a break between two different things.
6. It is very important because it serves a purpose.
7. Extremely important. I look for the function of a plant, for example for erosion control or screening.
8. Pretty darn important. It helps reinforce the landscape in design to integrate plants in various conditions like wet or dry areas.

Question # 3a. What do you understand Act 73 (relating to the use of indigenous and Polynesian introduced plants in state funded projects) to mean to Landscape Architects? Please give an example.

1. Nothing. I am not familiar with Act 73. Please refresh my memory, I know that law.
2. The mandate encourages and promotes the use of Hawaiian plants. Public awareness and designer awareness is important.
3. It is to introduce with planting composition a minimum of Hawaiian plants.
4. The law is important. Native plants provide a practical answer and some do not. Some plants are not available or are too expensive.
5. It provides a broad awareness of what plant material are in terms of being native or not.
6. Landscape Architects have to use what is on the list ("Exhibit") on every State project.
7. It means the profession looks forward to implement the intent of this act.
8. Landscape Architects need to incorporate what we believe is native plants in State funded projects. The definition of what is native is different (unclear).

Question # 3b. How does Act 73 influence your work?

1. It doesn't influence my work. We've always used native plants on most or all of our projects.
2. We need to conform to it, it took a special effort.
3. Makes us all aware that not all plants qualify for "tropical-ness." Nurseries do not promote the incorporation of indigenous plants.
4. Somewhat. Its not practical in some cases.
5. Most are already cognizant of using native plants.
6. It is difficult to use native plants in high quantities due to availability.
7. It has a significant influence. Using more native plants or promoting the profession to be sensitive to native plants and their environment in general is a good thing.
8. Not a whole lot. It's good out there because it reinforces the whole movement.

Question # 3c. What does Act 73 mean to you and do you believe in it?

1. Yes, I believe in it because there are so many introduced plants in Hawaii. Native plants maintain a sense of place. Native plants are unique plant material and it is wise to incorporate and use them in design.
2. Yes, I believe in it. The concept of using natives works because these plants are adapted to their environment.
3. Yes, I believe in it. In the long run, it will preserve native plants, people (and the profession) will become sensitive to indigenous history.
4. I believe in its principle but not in practice.
5. It helps to document and perpetuate use of native plants.
6. Yes, the concept is good, but, very few native plants on the list will survive in landscape areas without proper maintenance. More research in application of native plants is needed.
7. Yes, prior to this law, not much attention was placed on learning what plants are, especially by the public. With the adoption of this act, it forces Landscape Architects to pay attention to these issues and the plants themselves.
8. Yes, I believe in it and support it. However it has some flaws.

Question # 4. What are the challenges and constraints to designing with native Hawaiian plants?

1. Native plants are hard to maintain. They have low water requirements and low fertilizer requirements. Some native plants change their natural form if given too much water and or fertilizer. Native plants do not do well in mass plantings. The way we use them in landscape design is different than the way they are found in nature. The maintenance of native plants is difficult especially in making the plant “look good.” Maintenance crews do not know how to properly maintain native plants.
2. Availability. Lack of material is a problem. Some native plants are endangered and there are regulations against the use of these plants. We want to use some endangered plants but we can’t due to the regulations.
3. To make native plants blend in where its not isolated or unusual. The designer needs to know what’s available. Availability. Supply for native plants will (in the next five years) become more automatic and it will be easier to get. It will help to preserve Hawaii. Landscape Architects are a part of “whole evolution” of making Hawaiian history a part of today.
4. Native plants are hard to get. Nurseries dictate what to use and specimen plants are expensive.
5. Availability, getting the client or public to believe in them because some look like weeds. Learning about natives is like trial and error, we sometimes hire a consultant.
6. Maintenance considerations. Appropriate selection for the site, there are few to choose from. Unqualified maintenance is a problem especially in State projects.
7. Availability and maintenance and selecting appropriate (adaptable) plants for each site.
8. Getting the client to accept the use of native plants. Availability and quantities are a problem.

Question # 5a. Do you have a plant palette (or a specific set of plants) that you use on most of your projects?

1. No.
2. Yes.
3. Yes.
4. Yes, we have a book full of plants.
5. Not really, there are favorites but plants are usually project dependent like a coastal project.
6. No. Plant selection is project specific.
7. Not really.
8. No, we avoid that.

Question # 5b. What influences your plant palette?

1. --
2. Many factors. How it applies to function related to form, texture, scale. Also, availability and maintenance aspects.
3. Taste, site condition, function, or aesthetics.
4. We collect photos with descriptions and when we see something we like, we put it in the book.
5. It is project dependent.
6. --
7. Use of plants are site specific.
8. Site characteristics, design needs, and the design at hand influence the plant combinations.

Question # 5c. What portion of your plant palette are native plants?

1. Between 15 to 80 percent. Usually about 30 percent. Site and client/owner has large influence on plant selection. For example, foreign clients want lots of colorful flowers and most native plants can't provide that need. Local clients, people with appreciation or some cultural link to native plants are more likely to request native plants.
2. 20-25% are natives. We always use natives.
3. 10-15%.
4. 25%
5. It varies, it could be 100% or sometimes between 30 to 60%.
6. --
7. --
8. --

APPENDIX E ~ PLANT RANKINGS

Plant Familiarity		Aesthetic Appeal						Plant Availability (ability to obtain)				
plant	# familiar	plant	# high	plant	# low	plant	easy	plant	difficult	plant	not available	plant
maile	22	ti	21	maile	6	ti	21	maile	14	maile	4	ti
milo	22	hala	20	noni	6	hala	20	koki'o ke'oke'o	10	ohelo	4	wiliwili
taro	22	hapu'u	20	taro	5	kou	20	hinahina	9	ihi	3	kou
wiliwili	22	kou	20	ma'o	4	milo	20	koki'o	9	ihi	3	milo
hala	21	loulou lelo	20	olena	4	taro	18	loulou lelo	9	koki'o	3	akia
ti	21	milo	20	kolomona	3	wiliwili	18	ala'ala wai nui	8	naupaka kuahiwi	3	hala
hapu'u	20	wiliwili	20	ko'oko'olau	3	kukui	17	ihi	7	amaranth	2	naupaka kahakai
koa	20	koa	19	wauke	3	naupaka kahakai	17	koki'o ke'oke'o	7	awa	2	ilima
kou	20	naupaka kahakai	19	ala'ala wai nui	2	akia	15	ohi'a lehua	7	ho'awa	2	kukui
loulou lelo	20	akia	18	ekaha	2	hapu'u	14	pa'uohi'iaka	7	iliahii	2	hapu'u
naupaka kahakai	20	kukui	17	milo	2	ilima	14	ulei	7	koa	2	koa
noni	19	ohi'a lehua	17	nehe	2	koa	14	awa	6	kopiko	2	a'ali'i
akia	18	taro	17	nehe	2	pohuehue	12	halapepe	6	lama	2	ohi'a lehua
ohi'a lehua	18	maile	16	olopua	2	a'ali'i	11	ko'oko'olau	6	lama	2	pohuehue
kukui	17	a'ali'i	15	pa'uohi'iaka	2	a'e a'e	11	maiapilo	6	loulou lelo	2	a'e a'e
pohuehue	17	ilima	15	pohuehue	2	noni	11	mamane	6	mamaki	2	akia
ilima	16	koki'o	15	wiliwili	2	ohi'a lehua	10	mao	6	naupaka kahakai	2	noni
a'ali'i	15	pohuehue	15	a'e a'e	1	loulou lelo	9	mokihana	6	noni	2	kolokolo kahakai
koki'o	15	ihi	13	ala'ala wai nui	1	akia	8	nehe	6	olapa	2	kolomona
a'e a'e	13	noni	13	alaha'e	1	kolomona	7	nehe	6	olena	2	ma'o
ihi	13	a'e a'e	12	awikiwiki	1	ma'o	6	noni	6	pukiawa	2	taro
hinahina	12	hinahina	12	ena'ena	1	nehe	5	pukiawa	6	taro	2	ekaha
koki'o ke'oke'o	12	koki'o ke'oke'o	11	hala	1	naio	5	wauke	6	a'ali'i	1	naio
koki'o ke'oke'o	12	akia	10	halapepe	1	pa'uohi'iaka	5	ahinahina	5	ala'ala wai nui	1	nehe
ma'o	12	ihi	10	hao	1	ekaha	4	ihi	5	alaha'e	1	pa'uohi'iaka
nehe	12	nehe	10	ho'awa	1	koki'o ke'oke'o	4	iliahii	5	amau	1	akiohala
pa'uohi'iaka	12	ohelo	10	iliahii	1	maile	4	ilie'e	5	hapu'u	1	alaha'e
nehe	11	pa'uohi'iaka	10	ilie'e	1	nehe	4	kolea	5	ilie'e	1	ho'awa
akia	10	naupaka kuahiwi	9	ilima	1	akiohala	3	naupaka kuahiwi	5	koki'o ke'oke'o	1	iliau
ala'ala wai nui	10	nehe	9	koa	1	alaha'e	3	ohelo	5	kolea	1	a'e
awa	10	ulei	9	koki'o ke'oke'o	1	hao	3	uki'uki	5	ko'oko'olau	1	ahinahina
ihi	10	ala'ala wai nui	8	kolea	1	hinahina	3	alaha'e	4	mamane	1	akoko
kolomona	10	iliahii	8	kolokolo kahakai	1	ihi	3	amau	4	milo	1	ala'ala wai nui
naupaka kuahiwi	10	kolokolo kahakai	8	kului	1	koki'o	3	ho'awa	4	naio	1	amau
ohelo	10	mamane	8	lama	1	kului	3	koa	4	nehe	1	hao
ulei	10	ma'o	8	maiapilo	1	palai	3	kului	4	nehe	1	hinahina
iliahii	9	pukiawa	8	mamaki	1	ahinahina	2	lama	4	ohi	1	ihi
kolokolo kahakai	9	alaha'e	7	ma'u	1	ala'ala wai nui	2	lama	4	ohi'a ha	1	ihi
naio	9	ahinahina	7	naio	1	amau	2	mamaki	4	ohi'a lehua	1	koki'o ke'oke'o
pukiawa	9	amau	7	nanea	1	awa	2	palai	4	olopua	1	kopiko
alaha'e	8	awa	7	naupaka kahakai	1	halapepe	2	pohuehue	4	pohuehue	1	kului
halapepe	8	halapepe	7	naupaka kuahiwi	1	ho'awa	2	a'ali'i	3	pukamole	1	maiapilo
ho'awa	8	ho'awa	7	ohi	1	ihi	2	a'e	3	ulei	1	manono
ko'oko'olau	8	mokihana	7	ohi'a lehua	1	iliau	2	akia	3	wauke	1	naupaka kuahiwi
mamane	8	ilie'e	6	painui	1	iliahii	2	awikiwiki	3			nehe
ahinahina	7	kului	6	palai	1	koki'o ke'oke'o	2	kolomona	3			ohi
Plant Familiarity		Aesthetic Appeal						Plant Availability (ability to obtain)				
plant	# familiar	plant	# high	plant	# low	plant	easy	plant	difficult	plant	not available	plant
ama'u	7	lama	6	pukamole	1	naupaka kuahiwi	2	naio	3			ohelo
ilie'e	7	palai	6	pukiawa	1	olena	2	ohi	3			palai
kului	7	kolea	5	uhalao	1	ulei	2	olena	3			ulei
olena	7	ko'oko'olau	5	ulei	1	a'e	1	pa'iniu	3			
palai	7	lama	5			akoko	1	a'e a'e	2			
wauke	7	maiapilo	5			akoko	1	akia	2			
ekaha	6	mamaki	5			ala'ala wai nui	1	ekaha	2			
kolea	6	uki'uki	5			amaranth	1	iliau	2			
lama	6	a'e	4			ena'ena	1	ilima	2			
lama	6	akiohala	4			holei	1	kolokolo kahakai	2			
maiapilo	6	ekaha	4			ilie'e	1	manono	2			
mamaki	6	iliau	4			ko'oko'olau	1	nanea	2			
ohi	5	kolea	4			kopiko	1	ohi'a ha	2			
uki'uki	5	kopiko	4			mamame	1	palai	2			
a'e	4	ohi'a ha	4			manono	1	taro	2			
akiohala	4	olapu	4			ma'u	1	aheahea	1			
amaranth	4	wauke	4			mokihana	1	akiohala	1			
hao	4	hao	3			nanea	1	akoko	1			
iliau	4	manono	3			ohi	1	akoko	1			
kopiko	4	olena	3			ohelo	1	ala'ala wai nui	1			
ohi'a lehua	4	akoko	2			ohi'a ha	1	amaranth	1			
olapa	4	ala'ala wai nui	2			olapa	1	hala	1			
ala'ala wai nui	3	awikiwiki	2			olopua	1	hame	1			

APPENDIX F ~ SURVEY PLANT LIST DATA

Please indicate your familiarity with each plant species listed below. If familiar, please respond to the remaining questions.													
Habit	Scientific Name	Common Name	Familiar		Aesthetic Appeal		Availability of Plants			Frequency of Use			
			With		(personal view)		(ability to obtain)			(how often)			
			yes	no	high	low	easy	difficult	not avail.	often	seldom	never	
Fern	Asplenium nidus	Ekaha	6		4	2	4	2			3	3	
	Cibotium splendens	Hapu'u	20		20		14	5	1		10	9	1
	Microlepia strigosa	Palai	7		6	1	3	4			1	5	1
	Sadleria cyatheoides	Ama'u	7		7		2	4	1		1	5	1
	Sphenomeris chinensis	Pala'a	2		2			2					2
Med. Size	Pritchardia hillebrandii	Loulu Ielo	20		20		9	9	2		7	11	2
Palm													
Stem	Peperomia leptostachya	Ala'ala wai nui	10		8	2	2	8			1	7	2
Vine	Ipomoea pes-carprae	Pohuehue	17		15	2	12	4	1		7	10	
	Jaquemontia ovalifolia	Pa'uohi'iaka	12		10	2	5	7			3	7	2
Vine/Shrub	Alyxia oliviformis	Maile	22		16	6	4	14	4			13	9
Herb	Colocasia esculenta	Taro	22		17	5	18	2	2		4	13	5
	Curcuma longa	Olena	7		3	4	2	3	2			5	2
Annual/Perennial	Chenopodium Species	Aneahea											
Perennial	Astelia Species	Pa'iniu	3		2	1		3				1	2
	Bacopa monnieri	A'e a'e	13		12	1	11	2			2	6	1
	Bidens sandwicensis	Ko'oko'olau	8		5	3	1	6	1			5	3
	Canavalia napaliensis	Awikiwiki	3		2	1		3				2	1
	Carex wahuensis	Mau'u	2		1	1	1	1				2	
	Dianella sandwicensis	Uki'uki	5		5			5				4	1
	Gnaphalium sandwicense	Ena'ena	1			1	1						1
	Lipochaeta integrifolia	Nehe	12		10	2	5	6	1		3	6	3
	Lipochaeta succulenta	Nehe	11		9	2	4	6	1		1	8	2
	Peucedanum sandwicense	Makou	1		1			1				1	
	Plectranthus parviflorus	Ala'ala wai nui	3		2	1	1	1	1			3	
	Portulaca lutea	Ihi	13		13		3	7	3		1	8	4
	Portulaca molokiniensis	Ihi	10		10		2	5	3		1	6	3
	Vigna marina	Nanea	3		2	1	1	2				3	
Perennial													
Herb/	Hibiscus furcellatus	Akiohala	4		4		3	1			2	2	
Sub-shrub													
Sub-shrub	Artemisia kauaiensis	Ahinahina	7		7		2	5			1	6	
	Chamaesyce degeneri	Akoko	2		2		1	1				2	
	Heliotropium anomalum	Hinahina	12		12		3	9			1	10	1
	Waltheria indica	Uhalao	1			1		1				1	
Habit	Scientific Name	Common Name	Familiar		Aesthetic Appeal		Availability of Plants			Frequency of Use			
			With		(personal view)		(ability to obtain)			(how often)			
			yes	no	high	low	easy	difficult	not avail.	often	seldom	never	
Shrub	Achyranthes splendens	Amaranth	4		1	3	1	1	2			2	2
	Capparis sandwichiana	Maiapilo	6		5	1		6			1	2	3
	Chenopodium oahuense	Aheahea	1		1			1				1	
	Cordylone terminalis	Ti	21		21		21				21		
	Gossypium tomentosum	Ma'o	12		8	4	6	6			4	6	2
	Lepidium serra	Anaunau											
	Lythrum maritimum	Pukamole	2		1	1		1	1			2	

GLOSSARY

Definitions derived from *Conservation Biology in Hawaii* by Stone and Stone (1989), pp. 231-251 and the *Endangered Species Act of 1973* by the U.S. Fish and Wildlife Service (1994), pp. 2-4.

Adaptive radiation: The evolution of different forms from one species of animal or plant.

Alien, non-native, exotic or adventive: Brought to an area by humans, deliberately or by accident.

Biological control: Reduction or elimination of pest animals or weeds by introduction of natural enemies such as predators, parasites, and diseases.

Biological diversity: A variety of natural communities, species, or genotypes in a given area.

Community: A naturally occurring assemblage of plants and animals living and interacting in a defined area.

Conservation: All methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Critical habitat: The specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features essential to the conservation of the species and may require special management considerations or protection. Specific areas outside the geographical area occupied by the species at the time it is listed, upon determination by the Secretary that such areas are essential for the conservation of the species. Critical habitat may be established for those species now listed as threatened or endangered species for which no critical habitat has theretofore been established. Except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or threatened species.

Cultural control: Making the environment less favorable for problem species or pests.

Ecological zone: Generally in terrestrial environments in Hawaii: elevational bands, areas with similar moisture, or some combination of these. Five broad ecological zones may be recognized on the basis of elevation. They are: coastal (sea level to the extent of salt spray); lowland (sea level to 3,000 ft); montane (3,000-6,000 ft); subalpine (6,000-9,000 ft); and alpine (over 9,000 ft). According to moisture alone, three zones can be recognized: dry (receiving less than 50 in. of annual rain or with soil dry most of the time); mesic (receiving between 50-100 in. or soil staying moist most of the time); and wet (receiving more than 100 in. per year or with prevailing wet soil conditions). The character or physiognomy (external aspect) of the natural vegetation can also be used to define broad ecological zones. In Hawaii we have desert (little or no vegetation), herbland, grassland, shrubland, forest, and mixed vegetation.

Ecosystem: The complex of interacting living (biotic) and non-living (abiotic) components of a particular environment.

Endangered: Any species which is in danger of extinction throughout all or a significant portion of its range.

Endemic: Peculiar to a particular area and nowhere else. Evolved in a particular area and found only there. Localized endemics are those with geographical ranges of less than 20,000 miles squared. Hawaii's lands area is only 65,000 miles squared, and many Hawaiian taxa are single-island endemics.

Ex situ: A conservation method involving removal of organisms or living parts (such as eggs, seeds, sperm) from their original environment, usually in an effort to ensure population survival.

Habitat: The specific place where plants and animals live. Includes biotic and abiotic factors needed to define an organism's requirement but is often designated by physical characteristics or a dominant plant type.

Hawaiian Heritage plant or Polynesian introduced plant: Plants which were brought to the Hawaiian Islands by ancient Polynesians.

Indigenous: A species occurring naturally in an area but also in other areas.

In situ: Conservation of plants and animals in their natural environment.

Native: Naturally occurring in an area. Not brought in by humans. Includes endemic (found naturally only in that area) and indigenous (found naturally in that area but also in other areas).

Native Hawaiian plant: A plant native to the Hawaiian Islands.

Natural area: An area set aside for preservation of a representative sample of natural communities for educational, scientific, and future needs. These may also be called reserves, preserves, or sanctuaries by different agencies, organizations, or persons and in different countries.

Naturalized: Referring to a non-native species established as if it were a native species in an area. A plant or animal that is reproducing and maintaining a population with our human help, even though it was introduced from elsewhere.

Plant: Any member of the plant kingdom, including seeds, roots, and other parts thereof.

Population: A group of individuals of the same species within a community or the total number of individuals of a given species or other taxon within a defined geographic area.

Recovery plan: A document developed by a recovery team, or on contract, to plan for removal of a species from the Federal Endangered or Threatened status by making the species a self-sustaining member of an ecosystem.

Refugium, refugia: An area that has remained unchanged while surrounding areas have changed markedly. A refugium serves as a refuge for species requiring specific habitats.

Relict: A remaining species of a group that was once widespread or diverse.

Species: Any subspecies of fish or wildlife or plants and distinct population segment of any species or vertebrate fish or wildlife which interbreeds when mature.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Threatened: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

VITA

Laila N. Tamimi

869 Hoalauna Way * Hilo, Hawaii 96720 * (808) 959 – 4444 *email address * hula24@gte.net

Professional Objective: A meaningful career involving the protection of native plants.

Education: *Master of Landscape Architecture*, Spring 1999, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
Thesis: “*Landscape Architects Use of Native Hawaiian Plants in Hawaii.*”

Bachelor of Science, General Agriculture, May 1991, University of Hawaii at Hilo, Hilo, Hawaii.

Employment: *Horticulturist/Natural Resource Specialist*, Pohakuloa Training Area, June 1997 to present. Duties are primarily focused around the Army’s Natural Resource Programs. Ecological restoration of degraded sites, propagation of common and rare plants to be used in restoration/outplanting efforts including designing a several hundred acre irrigation system to provide water to transplants and the design of an interpretive garden (to educate soldiers, hunters and general public on the natural and cultural significance of PTA) are among the many goals of this challenging position.

Landscape Designer, designed three residential projects, two in Hilo and one in Waipahu (including installation), all projects incorporated native Hawaiian plants. Currently working on two residential projects on the Big Island and a Japanese Garden on Oahu.

Professional Painter’s Assistant, Blacksburg, Virginia, July 1995 to Dec. 1995.

Full-Time Farmer, summers of 1993 and 1994.

Horticultural Research Technician, University of Hawaii Extension Service, Hilo, Hawaii, January 1992 to August 1992.

Affiliation/Activities: ASLA (Hawaii Chapter), Hawaii Dryland Forest Restoration Group, Hawaii Rare Plant Restoration Group, Society for Ecological Restoration and the National Wildflower Center for Research.

Volunteer, Hawaii Volcanoes National Park during the summer of 1994, monitored endangered hawksbill turtles.

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