A Stewardship Handbook For ‘Ihi‘ihilauākea Preserve

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I. INTRODUCTION AND OVERVIEW

‘Ihi‘ihilauākea Preserve is a 30-acre preserve located on the southeast end of O‘ahu and is a part of Koko Head Regional Park. Founded in March 1987 through a management agreement between the City and County of Honolulu and The Nature Conservancy of Hawaii (TNCH 1990), the preserve encompasses ‘Ihi‘ihilauākea Crater (Figure 1) and is home to the largest of five populations of *Marsilea villosa* Kaulfuss (USFWS 1996), an endemic Hawaiian water fern.

‘Ihi‘ihilauākea Crater is one of two sites on O‘ahu where an intact lowland dry herbland plant community still exists (Wagner et al. 1999). A distinguishing characteristic of such a community is the presence of an ephemeral pool, a relatively dry area subject to occasional flooding. The location of ‘Ihi‘ihilauākea Crater is perennially dry, with irregular floods caused by seasonal kona storms. The drastic extremes of summer desiccation and winter drenching are intolerable to many organisms but are necessary for the survival of certain drought-adapted plants.

Marsilea villosa, or ‘ihi‘ihi, is an endemic water fern adapted to such conditions. Resembling a four-leafed clover, ‘ihi‘ihi has an unusual lifestyle in which it can live in flooded areas as a water fern or survive dry, arid conditions as a dormant sporocarp. Despite these adaptations, *Marsilea villosa* is still in danger of extirpation from its present range due to a number of threats to which it has not adapted.

The goal of this stewardship plan is to address the current situation regarding these threats and to implement a feasible management strategy for ‘Ihi‘ihilauākea Preserve.

A U.S. Fish and Wildlife Service species recovery plan, a TNCH management plan, and a few studies have been developed in the past regarding ‘Ihi‘ihilauākea Preserve and *Marsilea villosa*. It is from these valuable resources that this stewardship plan has been assembled.

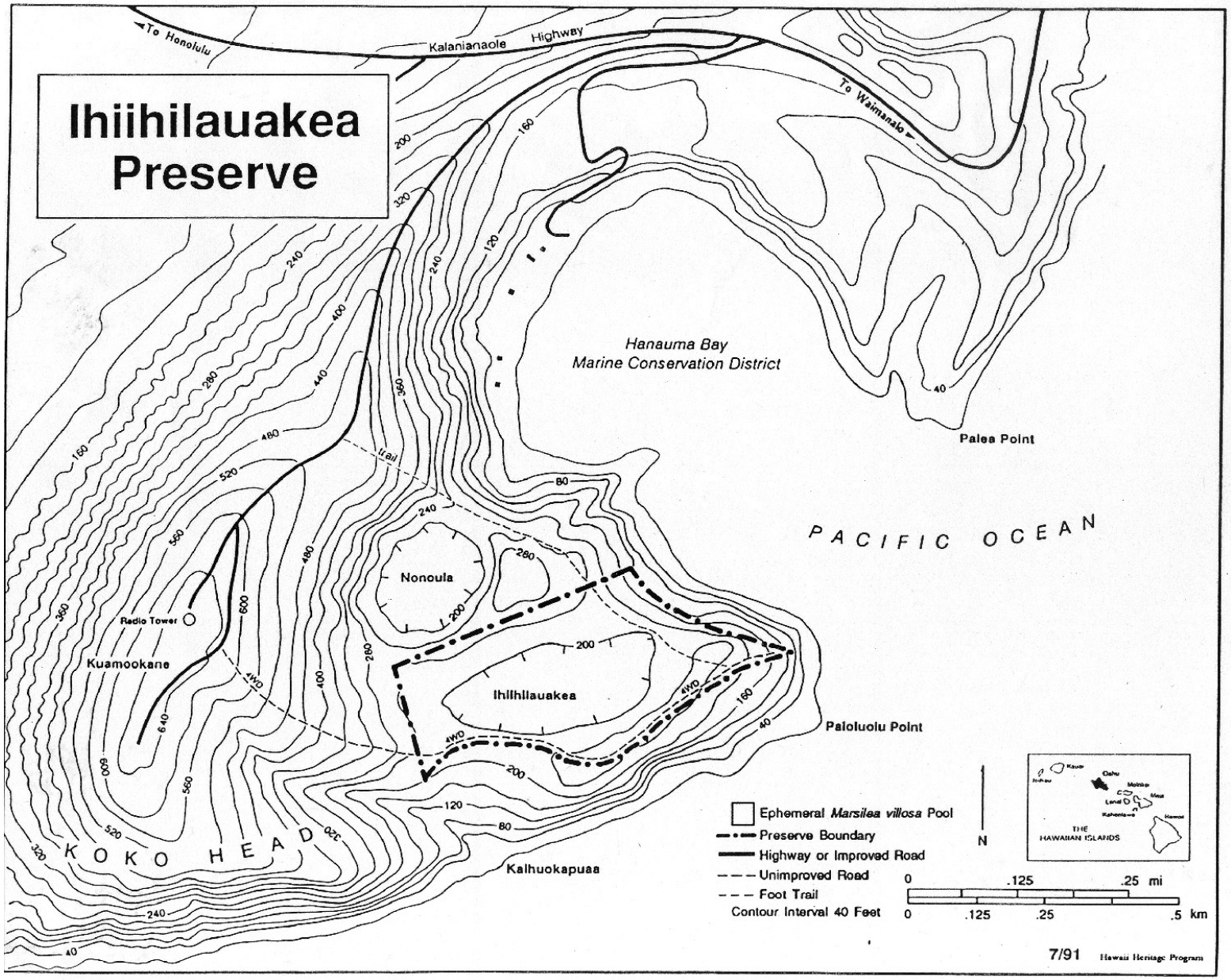

Figure 1. ‘Ihi‘ihilauākea Preserve

II. BACKGROUND INFORMATION OF ‘IHI‘IHILAUĀKEA CRATER

A. GEOLOGY

The Hawaiian Islands have the distinction of being the most isolated island group in the world (Carlquist 1980). Due to this isolated location, there are many unique geological features and biological processes that have occurred here. The geology of ‘Ihi‘ihilauākea Crater and the surrounding area offer a background to the status of ‘Ihi‘ihilauākea as a preserve and the rare flora and fauna within it.

O‘ahu was formed by two shield volcanoes three to one million years ago (Bruegmann 1986). Over time, these volcanoes eroded away into two mountain ranges: the Wai‘anae mountain range on the western end of O‘ahu and the Ko‘olau mountain range on the eastern end. The southeast end of O‘ahu, however, was formed by secondary volcanic activity as part of the Honolulu Volcanic Series of eruptions. Punchbowl Crater, Diamond Head Crater, and Tantalus are among the more notable geological features seen around Honolulu that were part of this series. The geological formations of southeast O‘ahu took place along what is known as the Koko Fissure, extending 5.3 miles from Manana (Rabbit Island) to the southwest of Koko Head. These formations include Kohe-lepelepe (Koko Crater), Kahauloa Crater (Koko Head Firing range), Hanauma Bay (Hanauma Bay Nature Preserve), Nono‘ula Crater, and ‘Ihi‘ihilauākea Crater.

Unlike the eruptions that formed the Wai‘anae and Ko‘olau Mountain ranges, the eruptions that formed Manana, Koko Crater, Kahauloa Crater, Hanauma Bay, and Koko Head were hydromagmatic, or influenced by water. In this case, sea water came in contact with magma (Carlquist 1980). These eruptions occurred when the sea level was 7.5 meters higher than it is today (Bruegmann 1986). Violent explosions involving steam and magma gases, or phreatomagmatic explosions, blasted through coral reefs that had formed on submerged basalt, throwing this material and ash into the air (Macdonald et al. 1983). Successive eruptions produced layer upon layer of ash and built up the eruption vents into cones and craters. These layers of basalt, coral, and ash were compacted by rain and settling, and produced a cement-like material called tuff (Macdonald et al. 1983).

Independent studies using carbon dating and K-Ar (potassium-argon) dating to determine the age of the Koko Fissure eruptions are not completely consistent (Macdonald et al. 1983). For example, the oldest and youngest radiocarbon dating on volcanic rock taken from Kahauloa and Hanauma Bay dates the eruptions to be between 7,000 and 32,000 years old (Hazlett and Hyndman 1996). Koko Head, which was supposed to have followed the Kahauloa and Hanauma eruptions, is estimated to be 300,000 years old (Macdonald et al. 1983).

‘Ihi‘ihilauākea and Nono‘ula Craters are the most recent formations on Koko Head. ‘Ihi‘ihilauākea Crater is believed to have formed on top of the vent that produced Koko Head (Wentworth 1926). These successive eruptions may

have formed a dense underlying layer of basalt, which would prevent percolation of water, resulting in an ephemeral wetland.

B. FLORA AND FAUNA

The flora and fauna of Koko Head and ‘Ihi‘ihilauākea Crater presently include native as well as non-native species. Post-western contact has introduced many of these non-native species to the area, causing significant impact to the area’s original inhabitants.

Due to the lack of records available, oral traditions or written, the original vegetation of ‘Ihi‘ihilauākea Crater and the surrounding Koko Head area is unknown (Bruegmann 1986). However, one could speculate that the Koko Head area may have once been a native dry forest habitat much like Koko Crater, where several species of native plants could be found. Due to ranching, fires, and other human disturbances this native dry forest system has been lost.

There are approximately 48 plant species found in ‘Ihi‘ihilauākea Crater (See List 1). Of the plant species found within the crater, one is endemic (native, only found here), five are indigenous (native, found here as well as elsewhere), and 42 are alien (Wagner et al. 1999).

The only endemic native plant found in the crater, *Marsilea villosa,* is listed on the United States Fish and Wildlife’s endangered species list. The other native plants are *Boerhavia repens* (alena), *Jacquemontia ovalifolia* (pā‘ū o Hi‘iaka), *Sida fallax* (‘ilima), *Solanum americanum* (pōpolo, Glossy nightshade), and *Waltheria indica* (‘uhaloa) (Bruegmann 1986, Wester 1994).

There are many other native plants found in the surrounding Koko Head area. This would include four endemics, *Argemone glauca* (pua kala), *Eragrostis variabilis* (kāwelu), *Nama sandwicensis* and *Schiedea globosa* (mā‘oli‘oli), and three indigenous species, *Dodonaea viscosa* (‘a‘ali‘i), *Heteropogon contortus* (pili), *Lycium sandwicense* (‘ōhelo kai).

The original fauna of ‘Ihi‘ihilauākea Crater, much like the original vegetation, cannot be identified by oral traditions or written records. Recent studies, however, note the presence of several groups of invertebrates during flood conditions: ostracods (seed shrimp), copepods, cladocerans (water fleas), conchostracans (clam shrimp), notostracans (tadpole shrimp), and gastropods (land snails) (USFWS 1996).

Vertebrates found in the Koko Head area include many birds and mammals found elsewhere in the Hawaiian Islands. Birds found in the area include migratory shorebirds, seabirds, and introduced birds. The migratory shorebirds include *Arenaria interpres* (ruddy turnstone or ‘akekeke), *Calidris alba* (sanderling or hunakai) and *Pluvialis fulva* (Pacific golden plover or kōlea). Seabirds seen gliding overhead include *Fregata minor* (Great Frigatebird or ‘iwa), *Puffinis pacificus* (wedge-tailed shearwater or ‘ua‘u kani), and *Sula sula* (red-footed booby or ‘ā). Introduced birds like *Pycnonotus cafer* (red-vented bulbul), *Streptopelia chinensis* (spotted dove), and *Geopellia striata* (zebra dove).

One alien species that has become established in the crater is the Small Indian Mongoose (*Herpestes auropunctatus*). These brown, weasel-like predators were originally introduced to Hawai‘i from Jamaica in 1883 as a biological control for rats, agricultural pests of the sugar plantations (Stone and Pratt 1994). Unfortunately, there was a gross miscalculation: rats are nocturnal (active at night), mongooses are diurnal (active during the day). Timing allows

only dawn and dusk encounters between rats and mongooses, too narrow a window for effective rat control. This seemingly obvious mistake has had major repercussions affecting many ground-nesting birds, which are easy prey for the mongoose.

List 1. Plants of ‘Ihi‘ihilauākea Crater (Bruegmann 1986, Wester and Ikagawa 1988, Wester 1994)

Scientific name	Common name	End/Ind/Alien
Marsilea villosa	‘ihi la‘au	Endemic
Boerhavia repens	alena	indigenous
Jacquemontia ovalifolia	pā‘ū o Hi‘iaka	indigenous
Sida fallax	‘ilima	indigenous
Solanum americanum	pōpolo, Glossy nightshade	indigenous
Waltheria indica	‘uhaloa	indigenous
Ageratum conyzoides	maile hohono	alien
Asystasia gangetica	Chinese violet	alien
Atriplex semibaccata	Australian saltbush	alien
Bidens pilosa	kī nehe	alien
Bothriochloa pertusa	Pitted beardgrass	alien
Cenchrus ciliaris	Buffelgrass	alien
Cenchrus echinatus	Common sandbur	alien
Chamaecrista nictitans	Partridge pea	alien
Chamaesyce hirta	garden spurge	alien
Chloris barbata	Swollen fingergrass	alien
Coccinia grandis	Ivy gourd	alien
Commelina diffusa	honohono	alien
Coronopus didymus	Swinecress	alien
Crotolaria incana	Fuzzy rattlepod	alien
Cynodon dactylon	mānienie haole, Bermuda grass	alien
Dactyloctenum aegypticum	Beach wiregrass	alien
Desmanthus virgatus	Slender mimosa	alien
Digitaria insularis	Sourgrass	alien
Echinochloa colonum	Jungle Rice grass	alien
Emilia sonchifolia	Flora's paintbrush	alien
Hyptis pectinata	Comb hyptis	alien
Lantana camara	Lantana	alien
Leucaena leucocephala	Koa haole	alien
Lycopersicon esculentum var. cerasiforme	cherry tomato	alien
Macroptilium lathroides	Wild bean, Cow pea	alien
Malvastrum coromandelianum	False mallow	alien
Merremia aegyptica	Hairy merremia	alien
Momordica charantia	Balsam pear	alien
Nicandra physalodes	Apple of Peru	alien
Ocimum gratissimum	Basil	alien
Panicum maximum	Guinea grass	alien
Passiflora foetida	Love-in-a-mist, Running pop	alien
Phyllanthus debilis	Niruri	alien
Portulaca oleracea	Pigweed	alien
Portulaca pilosa	‘Ākulikuli	alien
Prosopis pallida	kiawe	alien
Setaria verticillata	Bristly foxtail	alien
Sida rhombifolia	Sida	alien
Sonchus oleraceus	Pualele	alien
Stachtarpheta jamaicensis	Jamaican vervain	alien
Verbisina encelioides	Golden crown-beard	alien
Xanthium strumarium	Kīkānia	alien

C. CULTURAL HISTORY

Relatively little information is available on the cultural history of ‘Ihi‘ihilauākea Crater, but what is accessible can be found in legends and stories and in the modern histories of the area.

Various legends suggest possible origins of the name ‘Ihi‘ihilauākea and how it relates to the crater and *Marsilea villosa*. One legend states that ‘Ihi‘ihilauākea is the name of a wind that blows through Hanauma Bay (Nakuina 1992). In reference to the wind ‘Ihi‘ihilauākea, Hawaiian travelers sailing to Moloka‘i would stop off at Hanauma Bay if the winds weren’t right for sailing.

Another source says that ‘Ihi‘ihilauākea refers to a revered chiefess of the Maunalua district on O‘ahu. She was of ali‘i (royal) class and, therefore, directly descended from the gods. She was associated with the water fern and it became her kinolau (supernatural physical form) (Gon 2002).

A different legend mentions that ‘Ihi‘ihilauākea was a chiefess who was created by Pele. For some unknown reason she was turned into a cinder cone (Bruegmann 1986).

According to legend about Pā‘ao, who was a priest of the god Kūka‘ilimoku from ‘Upolu, Samoa, mentions the name ‘Ihi‘ihilauākea. Pā‘ao was banished from Samoa by his older brother, Lonopele. He fled to Hawai‘i, stopping by many islands and picking up followers on the way. Several kupua, or supernatural beings, joined his group, among them two sisters, ‘Ihi‘ihilauākea and Makapu‘u (Pukui 1933).

Historically, the dry, arid conditions of ‘Ihi‘ihilauākea Crater and the lack of available water made habitation impractical (Bruegmann 1986). Hanauma Bay, however was a favorite fishing ground of the ali‘i so the crater area may have seen occasional use by the ancient Hawaiians.

The royalty of Hawai‘i owned all of the lands in the Koko Head area. As part of the Bernice Pauahi Bishop Estate, it was leased for agriculture until 1927, after which it was sold to the City of Honolulu for one dollar. The area was used for cattle grazing well into the 1940’s. The Federal Aviation Administration then leased a section on top of Koko Head for radar facilities (Bruegmann 1986). Since then, several communications companies have built facilities on Koko Head.

D. ***MARSILEA VILLOSA*** KAULFUSS

Marsilea villosa, also known as ‘ihi‘ihi or ‘Ihi lā‘au, is an endemic water fern resembling a four-leafed clover (Figure 2). ‘Ihi‘ihi has an unusual lifestyle in which it can live in flooded areas as a water fern or survive dry, arid conditions as a dormant sporocarp. This unique adaptation allows it to survive seemingly adverse conditions and assists in its reproductive cycle. The life cycle of ‘ihi‘ihi (sporophyte to gametophyte, to sporophyte production) requires both conditions to be completed and is essential to its sexually reproductive success. Dry conditions facilitate the formation of the sporocarp (USFWS 1996), a reproductive structure containing megaspores (egg) and microspores (sperm) that forms at the base of the petiole. Wet conditions and scarification of the sporocarp wall allow imbibing of the sporocarp (Degener 1946), fertilization of the megaspore, and development of the sporophyte. Without an alternation of wet and dry conditions, reproduction would be strictly vegetative, through creeping rhizomes.

The lack of major flood events in the past few decades, along with other threats to the species facilitated an endangered species designation and protection by the Endangered Species Act of 1973. The United States Fish and Wildlife Service listed this plant as an endangered species on 22 June 1992 (USFWS 1996).

Historically, the distribution of *Marsilea villosa* was known from eleven populations on three islands (USFWS 1996). Currently, five populations are known to exist: three on O‘ahu and two on Moloka‘i. The largest of these populations is found on Koko Head, in ‘Ihi‘ihilauākea Crater.

Figure 2. *Marsilea villosa*

III. STEWARDSHIP PLAN FOR OF ‘IHI‘IHILAUĀKEA CRATER

A. REASONS FOR DECLINE AND CURRENT THREATS OF ***MARSILEA VILLOSA***

Marsilea villosa was listed as an endangered species by the United States Fish and Wildlife Service on 22 June 1992 (USFWS 1996). Reasons for the decline of *Marsilea* include destruction of natural hydrology, development, habitat degradation, competition with alien plant species, off-road vehicles, fire, trampling, impacts from humans and introduced animals, and prolonged drought.

Destruction of natural hydrology through land development affects an area’s ability to flood, a necessary component for sexual reproduction of *Marsilea.* Some areas where *M. villosa* was formerly found have been drained for agricultural or housing purposes (USFWS 1996). These areas are no longer able to sustain *Marsilea villosa* and populations are lost.

Competition with alien plant species proves to be especially harmful during the wet season, when most weeds become quickly established (USFWS 1996). The encroachment of weeds into areas where *Marsilea* is found limits the availability of resources and space.

Impacts by humans include damage from off-road vehicles, trampling, and fire (USFWS 1996). Such impacts open up areas where alien plant species can move in. Once these weeds become established, *Marsilea* have a much more difficult time competing for resources and space.

Impacts by animals are not as obvious as impacts by humans but are still threats nonetheless. The Small Indian Mongoose (*Herpestes auropunctatus*) is found all over O‘ahu and a community has become established in ‘Ihi‘ihilauākea Crater. The burrows that these animals dig are within and around the *Marsilea* populations. Much like other disturbances, burrowing opens up areas amongst the *Marsilea* where alien plants can and do invade (USFWS 1996).

The biggest threat to *Marsilea villosa* is a factor that man, unfortunately, cannot control or prevent: prolonged drought. The last major flood in which the ‘Ihi‘ihilauākea population of *Marsilea* was observed to be sexually reproducing occurred in the 1987-88 winter season (USFWS 1996). Besides being a facilitator for sexual reproduction, flood conditions also kill many of the alien plant species that cannot survive in standing water (USFWS 1996).

The aforementioned reasons for decline are also current threats to the ‘Ihi‘ihilauākea population of *Marsilea*. Of those reasons mentioned, competition with alien plants and impacts by humans are the priority issues that are addressed in this stewardship plan.

B. CONSERVATION EFFORTS

Conservation of *Marsilea villosa* thus far has involved the efforts of a number of different agencies and organizations to protect the species on several different levels. Federal, State, and County agencies along with private organizations and individuals have all contributed to the protection and conservation of *M. villosa*.

The United States Fish and Wildlife Service listed *Marsilea villosa* as an endangered species. This designation provides protection of *M. villosa* under the Endangered Species Act of 1973, which prohibits collection of endangered plants from wild populations on Federal property without a permit and malicious damage or destruction of listed species.

The Endangered Species Act of 1973 also made a provision that applies to any government agency that has an endangered species present on the property that they occupy. The US Navy has a population of *Marsilea* around the antennae towers of their Lualualei Naval Magazine. Past conservation efforts there included the removal of cattle and monitoring of the area (USFWS 1996).

A species recovery plan for *Marsilea villosa* was developed and completed by Marie Bruegmann of the USFWS in April of 1996 (USFWS 1996). This recovery plan outlines the steps needed to improve the status of *M. villosa* for delisting from the endangered species list.

The State of Hawaii has also implemented a similar Endangered Species Act that applies to endangered plant populations on state property. *Marsilea villosa* is listed on the State of Hawaii's endangered species list and makes it illegal to collect without a permit or destroy any endangered species. There are no known populations of *M. villosa* on state lands (USFWS 1996).

The City and County of Honolulu owns Koko Head Regional Park, of which ʻIhiʻihilauākea Crater, home of the largest population of *M. villosa*, is a part of. In March of 1987, the City and County entered into a cooperative management agreement with The Nature Conservancy of Hawaii, establishing ʻIhiʻihilauākea Crater as a preserve (TNCH 1990). In this agreement, the City and County supplies all necessary materials for the preserve and TNCH takes care of management (USFWS 1996).

Studies by Marie Bruegmann of the USFWS, Lyndon Wester of UH-Mānoa's Geography Department, and staff of TNCH were conducted to determine effective management strategies and techniques. Volunteer groups from the Hawaiian Botanical Society and The Nature Conservancy of Hawaii have manually weeded in and around the main population of *Marsilea* (TNCH 1990).

The findings of these studies resulted in metal posts being installed as barriers to discourage entrance by off-road vehicles. Signs have also been erected to mark the northern entrances of the preserve.

C. MANAGEMENT CONSIDERATIONS

Because of the unique environmental conditions of the preserve, the preserve's location, and the endangered status of *Marsilea villosa*, several considerations need to be made regarding management of 'Ihi'ihilauākea Preserve. Weed control, minimizing disturbance, and monitoring the *Marsilea* population are priority issues that need to be focused on to best assist the recovery of *Marsilea villosa*.

Alien plants compete with *M. villosa* for space. Encroachment by these weeds is accelerated during periods of mild moisture (enough moisture for weeds to grow but not enough for flooding to occur). Manual hand weeding and weed whacking activities would be most effective during the seasonally wet season, when weed growth is most vigorous (TNCH 1990). This strategy suppresses the growth of weeds, allowing *M. villosa* to compete for space (Wester 1994).

Minimizing disturbance to the population reduces the chance for alien plant species to become established in and around the *Marsilea*. Maintenance of the metal barriers is essential to keeping out off-road vehicles. Human trampling can also cause considerable damage, so minimizing "aimless walking" in the crater should be a priority. The use of worn and established trails and careful, calculated stepping when navigating within the preserve would minimize this disturbance. Campfires and litter should also be kept out of the preserves at all times (TNCH 1990).

Monitoring of the *Marsilea* population is important in the overall management of the preserve. Conditions in nature are rarely static and a change in status may require immediate attention or a change in strategy. For example, a 1988 study showed *Echinochloa colonum* as the most dominant invasive weed (Wester and Ikagawa 1988). Subsequent studies in 1990 and 1991 showed a dramatic decrease in *Echinochloa colonum* and an increase in another invasive, *Panicum maximum*, the new dominant weed (Wester 1989, Wester 1994). Such monitoring should be done at regular intervals and after significant events (floods, fires, etc.).

D. MANAGEMENT STRATEGIES

The main strategies utilized by this stewardship plan involve control of threats to the *Marsilea* population and monitoring of the population for management strategy evaluation.

1. Threat Control

The two primary threats to the *Marsilea* population are weeds and human disturbance. Weed control involves a somewhat labor-intensive effort while human disturbance requires a maintenance-based approach.

Weed control can be done by two different methods: manually removing weeds by hand or weed whacking with string trimmers. Hand weeding is done by identifying and removing every alien plant and seedling from the area in and around the *Marsilea* population. The pulled weeds are then discarded in piles at the south end of the preserve, downwind from the *Marsilea* population, to minimize weed seed dispersal into the population. Pulling every weed on the crater floor is rarely feasible so areas must be prioritized by: (1) the amount of *Marsilea villosa* present and (2) the type of weed present. Special consideration should be made for areas dominated by living *Marsilea*, where weeds haven't significantly impacted the population yet, and where the more aggressive weeds are becoming established.

Weed whacking with string trimmers or brush cutters is another option when there are few work participants or when participants are experienced with such equipment. The objective is to trim the seed heads off of the invasive grasses before they shade out the *Marsilea* and set seed. Weed whacking would be done at a height several inches above the ground to ensure that no *Marsilea* is accidentally cut. The results of weed whacking experiments showed that the weed whacked plot had half as many seed heads as the control plot (Bruegmann 1989, memo to BF Morgan and L Wester, unreferenced).

Rules prohibiting activities that disturb the *Marsilea* population are difficult to enforce. Therefore, deterrents such as metal barriers and posted signs are used to inhibit and discourage such activities. Since the installation of the metal barriers, disturbance by off-road vehicles has been kept to a minimum. Periodically checking the sturdiness of the barriers and reinforcing it when necessary will help maintain this protection. The signs should also be maintained to be sure they are still legible and serving their purpose.

Occasionally, hikers will visit the preserve. Walking in and amongst the *Marsilea* should be discouraged so as to minimize any disturbance, especially during the wet growing season (TNCH 1990). If walking through the preserve is necessary, staying on the worn trails is recommended since no *Marsilea* are actively growing there. Trash, regardless of who brought it into the preserve, should always be packed out.

The Small Indian Mongoose (*Herpestes auropunctatus*) has impacted the *Marsilea* population by burrowing and opening up areas to weed invasion. Although there isn't a large population of these animals in the crater, they are present. The scarcity of resources (food and water) seems to be the limiting factor in the crater, but should this situation improve for the mongooses, the

relatively minor threat may escalate into a major problem. Live trapping to control mongoose populations may be done by management staff if the burrowing threat increases.

2. Monitoring

Monitoring and evaluating observations of the current state of the *Marsilea* population is the most important part of this stewardship plan. It is a good indication of the effectiveness of the current management strategies. As the habitat and environmental conditions change, so will the challenges of protecting the *Marsilea* population. Careful record keeping of observations would aid in assessing the effectiveness of management strategies and help in developing new strategies. Some things to observe are the presence of new weed species, the extent of the encroachment of the more aggressive weeds, the current status of the *Marsilea* population, and any other information related to this conservation effort.

E. PROJECT PLANNING

Good planning can help in organizing successful work trips. Several factors contribute to good planning. The following is taken from the Volunteer Stewardship Network's Volunteer Leadership Training (See Appendix A).

Project Planning

1. Scope of work for the day

Set a scope of work for the day, and outline it for the participants. Let them know what you want to accomplish and why the work is important. Try to set a scope of work that is achievable in the amount of time available: If it is part of a larger project, define it in terms of a set of smaller projects that can be accomplished. Describe the tools that will be used and how to use them.

2. Divide work into several tasks

Decide what tasks need to be accomplished to complete the project. See if some tasks can be done at the same time in different areas, or if they will need to be done sequentially (e.g. weeding around plantings can be done at the same time as watering other plantings; felling and brushing is followed by bucking and piling slash). Try to have tasks for people with varying physical abilities. See what other things can be accomplished at the project site if there is extra time.

3. Have initial priority tasks, then additional tasks to get to

If the group finishes the initial objectives and there is time and they are willing to keep on going, plan for additional tasks that can be accomplished in the area. A good idea is to plan to work until lunch, then take a break and assess whether to continue with the main tasks, start new ones, or end for the day.

4. Roster, number of participants

Prior to the work trip, set a roster of participants. Decide on an appropriate number of participants for the project based on the scope of the work to be done, available transportation, tools, level of supervision necessary.

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