

LANAI OFFSHORE ISLETS BOTANICAL SURVEY

Prepared for:
Department of Land and Natural Resources, Division of Forestry and Wildlife
and
Offshore Islet Restoration Committee

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We thank the following for contributing to this survey and report, and for their ongoing efforts to protect Hawaii's offshore islets. Lloyd Loope (United States Geological Survey), Chris Swenson (United States Fish and Wildlife Service, Offshore Islet Restoration Committee), Fern Duvall (Department of Land and Natural Resources / Division of Forestry and Wildlife), Robert Hobdy, Maya LeGrande (Offshore Islet Restoration Committee), Pacific Helicopters, Bishop Museum, and National Tropical Botanical Garden.

INTRODUCTION

The offshore islets of Lanai are comprised of several near shore sea stacks on the western and southern coasts. The Lanai islets, with the exception of Kapukalua Rock and Kiei islet, are seabird sanctuaries, managed by the State Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR / DOFAW). The Lanai islets, though fairly close to the main island of Lanai, have limited access due to rough seas and sheer cliffs. Being so inaccessible, these predator free islets are potential havens for native plants and numerous nesting seabirds.

On April 6, 2006, a botanical survey was done by Ken Wood, National Tropical Botanical Garden (NTBG), Forest Starr, United States Geological Survey (USGS), and Kim Starr (USGS). Chris Swenson, Offshore Islet Restoration Committee (OIRC), and Maya LeGrande (OIRC), assisted with logistical support. Permission to access the islets was given by Fern Duvall (DLNR / DOFAW). We visited the following islets: Kapukalua, Nanahoa, Kiei, Moku Naio, Kaneapua, Poopoo, and Puu Pehe. We were not able to land on Kapukalua, Nanahoa, or Moku Naio, but did hover near the islets, using binoculars to note the species and vegetation types that appeared to be present.

Previous surveys of several of the Lanai islets were done by Robert Hobdy during March and April, 1982. He was accompanied on some surveys by Paul Higashino and Don Fox. He approached the islets by kayak or viewed them from the main island of Lanai. He was able to land on Kiei, Poopoo, and Puu Pehe, though he was only able to survey lower areas of Puu Pehe. The Nanahoa Islets were also too steep to land on and were surveyed from the main island. His notes are included in this report.

The following report details our findings. For each islet a brief description is given with notes on vegetation, wildlife, threats, and restoration opportunities. A species checklist provides information on presence and abundance for plants observed. An annotated list of the vascular plant species for each islet details the current distribution observed during this survey, historical collections and observations, and recommendations for restoration. Also included for each islet are location maps, and photos showing general landscape and vegetation types. Additional photos of the plants of the Lanai offshore islets can be viewed at "www.hear.org/starr".

METHODOLOGY

Prior to the field work, survey notes of the islets from 1982 by Robert Hobdy were reviewed. We also conducted literature searches and checked online herbariums at Bishop Museum (BISH) and Smithsonian Institute (USNM) for historical collections of plants known from the offshore islets of Maui. Plant specimens collected during this survey have been deposited at the National Tropical Botanical Garden (PTBG) and BISH. All islets (Kiei, Kaneapua, Poopoo, Puu Pehe) were accessed via helicopter. For the smaller islets (Kiei and Kaneapua) we spent a half hour on each. Two of us were dropped off on Kiei (Starr & Starr) and one of us was dropped off on Kaneapua (Wood). For the larger islets (Poopoo and Puu Pehe) we spent about two hours on each islet with two of us on Puu Pehe (Starr & Starr) and one of us on Poopoo (Wood). We did walk through surveys noting plant species present and their relative abundance. For some

islets (Kapukalooa, Nanahoa, Moku Naio) which we were not able to land on, we did helicopter fly-by surveys by hovering over the islets and scanning for plants using binoculars. In addition, we reviewed digital images taken from the helicopter to further identify plants on islets which we could not land on. These helicopter survey identifications are not as accurate as on the ground surveys and are only meant to give a general idea of the plants we thought we observed.

Our goal was to make a list of plants present on the islets, describe their relative abundance, and highlight threats and restoration opportunities. We also made notes of general islet features, birds, arthropods, other wildlife, and observations of importance. Location coordinates given for each islet are for the datum UTM NAD 83 zone 4. Digital photos were taken during surveys. Due to wet winters over the past several years, the islets were green and it was a good time to search for plants and insects and see the area at a maximum biomass state. This winter had a dry beginning followed by a wet late season. As a result, many species had small seedlings present. The lack of nesting birds at this time of year also helped by allowing a full survey without disturbing the birds too much. During the survey period, the weather was sunny and windy.

RESULTS

During trips in April 2006, we surveyed 7 islets (Kapukalooa, Nanahoa, Kiei, Moku Naio, Kaneapua, Poopoo, and Puu Pehe). Some of these islets (Kapukalooa, Nanahoa, Moku Naio) did not receive full on the ground surveys, they were surveyed from a helicopter. During our surveys, we recorded the presence and abundance of 34 plant species. There were 11 native plant species and 23 non-native plant species. We made 45 plant collections and took 658 digital images.

Table 1. Total # plants by islet.

	Kapukalooa	Nanahoa	Kiei	Moku Naio	Kaneapua	Poopoo	Puu Pehe
TOTALS							
Total (this survey)	8	8	22	0	3	11	8
Native #	5	4	6	0	1	5	3
Native %	63%	50%	27%	0%	33%	45%	38%
Alien #	3	4	16	0	2	6	5
Alien %	38%	50%	73%	0%	67%	55%	63%

Native Plants

A few native plants remain on the Lanai islets. Most commonly observed was ilima (*Sida fallax*) in shrub form. Many seedlings were observed. Kiei islet seems to have remained the least over-run with non-native grasses, such as buffel grass (*Cenchrus echinatus*) and sandbur (*Cenchrus ciliaris*). On Kiei islet there were two patches of Hunakai (*Ipomoea tuboides*), several patches of hoary abutilon (*Abutilon incanum*), alena (*Boerhavia* sp.), and ohelo kai (*Lycium sandwicense*). An occasional pili grass

(*Heteropogon contortus*) was also observed. On Poopoo islet, many of the more rare native components, such as ihi (*Portulaca sclerocarpa*), native grasses (*Panicum fauriei*, *Panicum torridum*, and *Panicum xerophilum*), and nehe (*Lipochaeta heterophylla*, *Lipochaeta lavarum*) were not observed. It is possible that some of these still remain as seed bank below the sea of non-native grasses. A few native relics remained on Poopoo, including an occasional nohu (*Tribulus cistoides*), hoary abutilon (*Abutilon incanum*) and alena (*Boerhavia repens*).

Non-native Plants

Non-native grasses (buffel grass and sandbur) dominated several of the islets, including Poopoo and Puu Pehe. These two species formed large stands and were the dominant species on both islets. Many native species are no longer found on these islets, likely succumbing to the more vigorous non-native grasses. For instance, on Poopoo islet during Hobdy's survey in 1982, he listed *Panicum xerophilum* as abundant and *Cenchrus ciliaris* and *Cenchrus echinatus* as rare and uncommon. During this survey, the *Cenchrus* species were both the abundant ones and the native *Panicum* was not found at all. Some non-native species were found in low numbers and pulled, including the following: Spanish needles (*Bidens pilosa*), pitted beard grass (*Bothriochloa pertusa*), hairy horseweed (*Conyza bonariensis*), and bitter melon (*Momordica charantia*) on Kiei; lantana (*Lantana camara*) on Poopoo; and butterfly weed (*Asclepias curassavica*) and sour bush (*Pluchea carolinensis*) on Kaneapua Rock.

Plant Restoration

Most of the Lanai islets have steep cliffs on all sides and require helicopters to safely access, though some can be accessed by boat such as Poopoo, Kiei, parts of Nanahoa, and perhaps Kapukaloo. Restoration efforts would depend on the amount of resources available. If desired, the non-native grasses could be removed, as native plants seem to decline dramatically once they have taken hold on an islet. Areas near native species could be starting points for removal of non-native grasses, allowing native species to spread. It is possible that seeds of some of the now gone native species are still in the soil and may return once the pressure of the thicket of non-native grasses is removed. Native species no longer present could also be re-introduced. Other rare native coastal plants could also be introduced through out-planting or seed sowing. The recent planting of *Scaevola coriacea* did not seem to take, though Hobdy notes that it was a particularly dry period when they were out-planted. Further out-plantings could occur possibly timing them with wet winters. Seeds of native species could also be scattered as weeds are removed.

Native Wildlife

Wedge-tailed shearwaters (*Puffinus pacificus*) were observed pairing up on the islets. A few were heard moaning as we got near. Several pairs were observed in burrows. Many burrows were unoccupied. Most burrows were under rock ledges or jumbles of rock. Some burrows were observed in the heiau at Puu Pehe. Many other open burrows and guano were observed. A few white-tailed tropic birds (*Phaeton lepturus*) were observed flying near Puu Pehe and above the cliffs of the main island of Lanai. An Ulili (*Heteroscelus incanus*) was heard on the rocks below while on Puu Pehe.

Non-native Wildlife

On Kiei, we observed koa haole psyllids (*Heteropsylla cubana*) on haole koa (*Leucaena leucocephala*). On Puu Pehe, there were honey bees (*Apis mellifera*) visiting large ilima (*Sida fallax*) flowers, and a couple different species of paper wasps (*Polistes* spp.) flying around. The Hawaiian beet webworm (*Spoladea recurvalis*) and uhaloa moth (*Eublemma accedens*) were also on Puu Pehe, as were garden spiders (*Argiope* sp.). There were ants on Kiei and Puu Pehe. No skinks were seen on any of the Lanai islets.

ITINERARY

April 6, 2006	Kapukaloa Rock (fly-by only)
April 6, 2006	Nanahoa (fly-by only)
April 6, 2006	Kiei
April 6, 2006	Moku Naio (fly-by only)
April 6, 2006	Kaneapua Rock
April 6, 2006	Poopoo
April 6, 2006	Puu Pehe

The islets are presented here in order from north to south.

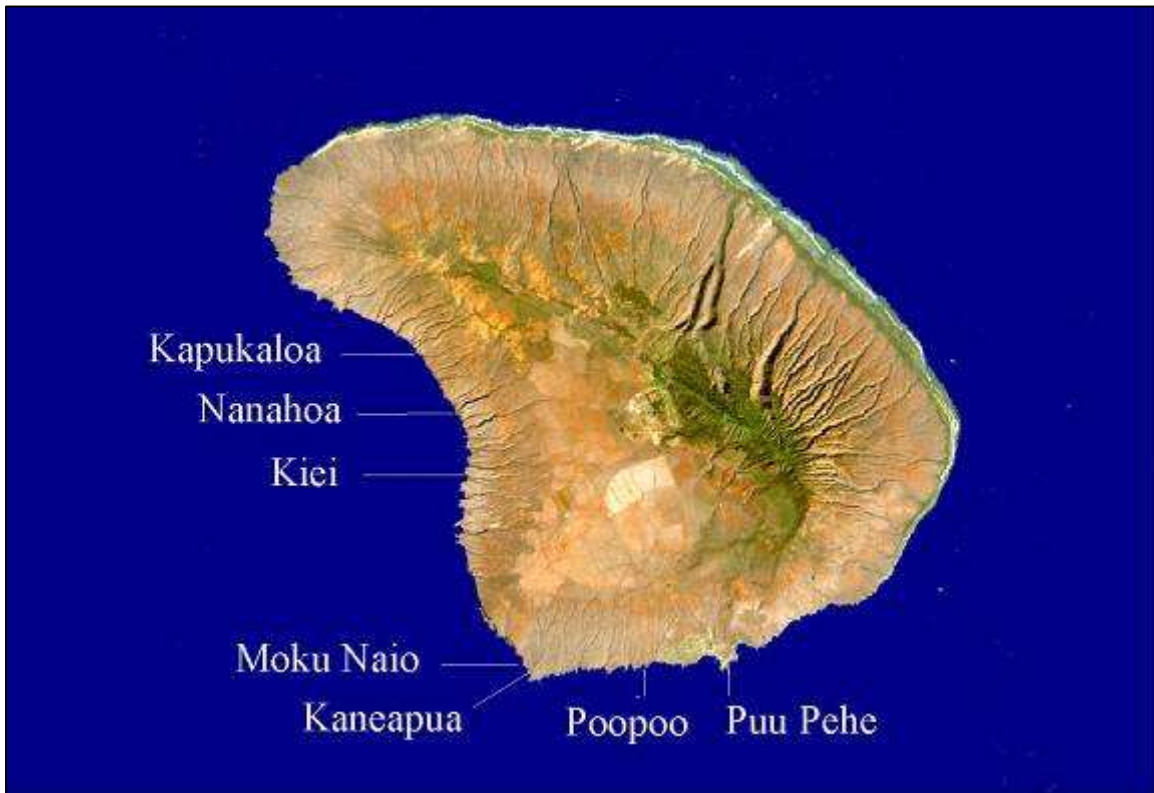


Figure 1. Map of Lanai islets.

Table 2. Checklist of plants

Scientific name	Common name	Kapukaloa	Nanahoa	Kiei	Moku Nao	Kaneapua	Poopoo	Puu Pehe
<i>Abutilon incanum</i>	Hoary abutilon	--	--	O	--	--	U	R
<i>Asclepias curassavica</i>	Butterfly weed	--	--	--	--	R	--	--
<i>Atriplex semibaccata</i>	Australian saltbush	<u>H</u>	--	--	--	--	--	--
<i>Bidens pilosa</i>	Spanish needles	--	--	R	--	--	--	--
<i>Boerhavia acutifolia</i>	Alena	--	--	X	--	--	X	--
<i>Boerhavia repens</i>	Alena	--	--	--	--	--	U	--
<i>Boerhavia</i> sp.	Alena	--	<u>X</u>	R	--	--	--	--
<i>Bothriochloa pertusa</i>	Pitted beard grass	<u>H</u>	<u>H</u>	R	--	--	--	--
<i>Cenchrus ciliaris</i>	Buffel grass	--	<u>H</u>	O	--	--	D	D
<i>Cenchrus echinatus</i>	Sand bur	--	--	R	--	--	O	D
<i>Chloris virgata</i>	Feather fingergrass	--	<u>X</u>	--	--	--	O	R
<i>Chloris</i> sp.	Fingergrass	--	--	--	--	--	--	--
<i>Conyza bonariensis</i>	Hairy horseweed	--	--	R	--	--	--	--
<i>Digitaria insularis</i>	Sourgrass	--	--	R	--	--	<u>X</u>	--
<i>Emilia fosbergii</i>	Pualele	--	--	O	--	--	--	--
<i>Gamochaeta pupurea</i>	Purple cudweed	--	--	<u>X</u>	--	--	--	--
<i>Gnaphalium</i> sp.	Gnaphalium	--	--	O	--	--	--	--
<i>Heteropogon contortus</i>	Pili grass	<u>H</u>	<u>H</u>	<u>X</u>	--	--	--	--
<i>Ipomoea tuboides</i>	Hunakai	<u>H</u>	<u>H</u>	R	--	--	X	<u>X</u>
<i>Jacquemontia ovalifolia</i> subsp. <i>sandwicensis</i>	Pau o Hiiaka	<u>H</u>	--	--	--	--	--	--
<i>Lantana camara</i>	Lantana	--	--	<u>X</u>	--	--	--	--
<i>Leucaena leucocephala</i>	Haole koa	<u>H</u>	<u>H</u>	C	--	--	R	--
<i>Lipochaeta heterophylla</i>	Nehe	--	--	--	--	--	X	--
<i>Lipochaeta lavarum</i>	Nehe	--	--	--	--	--	X	--
<i>Lycium sandwicense</i>	Ohelo kai	--	--	R	--	--	--	--
<i>Lycopersicon esculentum</i>	Cherry tomato	--	--	R	--	--	X	--
<i>Macroptilium lathyroides</i>	Cow pea	--	--	--	--	--	<u>X</u>	--
<i>Merremia aegyptia</i>	Hairy morning glory	--	--	--	--	--	O	O
<i>Momordica charantia</i>	Bitter melon	--	--	R	--	--	<u>X</u>	--
<i>Oxalis corniculata</i>	Yellow wood sorrel	--	--	R	--	--	--	--
<i>Panicum faurei</i>	Panicum	--	--	X	--	--	X	--
<i>Panicum maximum</i>	Guinea grass	--	--	R	--	--	--	--
<i>Panicum torridum</i>	Kakonakona	--	<u>X</u>	<u>X</u>	--	--	X	--
<i>Panicum xerophilum</i>	Kaioio	--	<u>H</u>	--	--	--	X	<u>X</u>
<i>Pluchea carolinensis</i>	Sour bush	--	--	--	--	R	--	--
<i>Portulaca oleracea</i>	Pigweed	--	<u>H</u>	C	--	--	C/D	C
<i>Portulaca sclerocarpa</i>	Ihi	--	--	--	--	--	X	--
<i>Setaria verticillata</i>	Bristly foxtail	--	--	<u>X</u>	--	--	<u>X</u>	--
<i>Sida fallax</i>	Ilima	<u>H</u>	<u>X</u>	C/D	--	--	C/D	C/D
<i>Solanum americanum</i>	Popolo	--	--	<u>X</u>	--	--	X	--
<i>Sonchus oleraceus</i>	Pualele	--	--	R	--	--	<u>X</u>	--
<i>Tribulus cistoides</i>	Nohu	--	--	--	--	--	U	--
<i>Vernonia cinerea</i>	Little ironweed	--	--	R	--	--	--	--
<i>Waltheria indica</i>	Uhaloa	<u>H</u>	<u>H</u>	O	--	O	O	O

X = Previously observed H = Observed from helicopter
R = Rare U = Uncommon O = Occasional C = Common D = Dominant
_ = No Voucher -- = Not observed

KAPUKALOOA ROCK



Figure 2. Kapukalooa Rock.

Overview

Kapukalooa Rock (white rock) was located just north of the Nanahoa islets and appeared to be attached by a wave worn bench to the main island of Lanai. The coordinates are: 707,416 E, 2,306,523 N. We hovered near the islet and scanned for plants using binoculars. The islet was fairly small in size, shaped a bit like a shark fin and contained sparse vegetation, mostly on the top somewhat flatter sloped portions of the islet. There was a distinctive white rock near the top. It's likely possible to land on the islet using a helicopter, boat, or kayak to better assess the vegetation that occurs there.

Vegetation

Because the survey was done while hovering in a helicopter and by reviewing digital images taken during while hovering, the identifications made here may be suspect. What appeared to be pili grass (*Heteropogon contortus*) or possibly pitted beard grass (*Bothriochloa pertusa*) was observed on the islet. There were a few scattered koa haole (*Leucaena leucocephala*) and ilima (*Sida fallax*) shrubs mixed in with the pili and buffel grass. There were occasional patches of uhaloa (*Waltheria indica*), Australian saltbush (*Atriplex semibaccata*), and possibly pau o Hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*), though the pau o Hiiaka may have been hunakai (*Ipomoea tuboides*). We observed possibly 8 species of plants, 5 (63%) were native and 3 (38%) were non-native.

Kapukalua Rock

Threats

The islet is connected to the main island of Lanai. Though the main island of Lanai nearby is very steep and precipitous, which may limit access to the attached rock. We saw what could have been guano patches toward the top of the islet, though we did not directly observe any seabird activity.

Restoration

If desired, a team could land on islet to get a better idea of what vegetation is truly present and what seabirds, if any, are nesting on the islet.

Annotated Plant List -- Kapukalua Rock

Atriplex semibaccata -- Australian saltbush -- (Chenopodiaceae) -- Alien

Observed from helicopter through binoculars.

Bothriochloa pertusa -- Pitted beard grass -- (Poaceae) -- Alien

Observed by reviewing digital images. Was either this, pili, or something similar we were observing on the cliff walls and islet margins.

Heteropogon contortus -- Pili -- (Poaceae) -- Questionably Indigenous

Observed from helicopter through binoculars. ID questionable, could have been another wispy grass.

Ipomoea tuboides -- Hunakai -- (Convolvulaceae) -- Endemic

Observed by reviewing digital images. Was either this and / or *Jacquemontia* we were observing. Twining in and amongst rocks and vegetation.

Jacquemontia ovalifolia subsp. *sandwicensis* -- Pau o Hiiaka -- (Convolvulaceae) -- Endemic

Observed from helicopter through binoculars. Was either this or hunakai we were observing.

Leucaena leucocephala -- Koa haole -- (Fabaceae) -- Alien

Observed from helicopter through binoculars. A few clumps.

Sida fallax -- Ilima -- (Malvaceae) -- Indigenous

Observed from helicopter through binoculars.

Waltheria indica -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous

Observed from helicopter through binoculars.

Kapukaloa Rock



Figure 3. Kapukaloa Rock map.

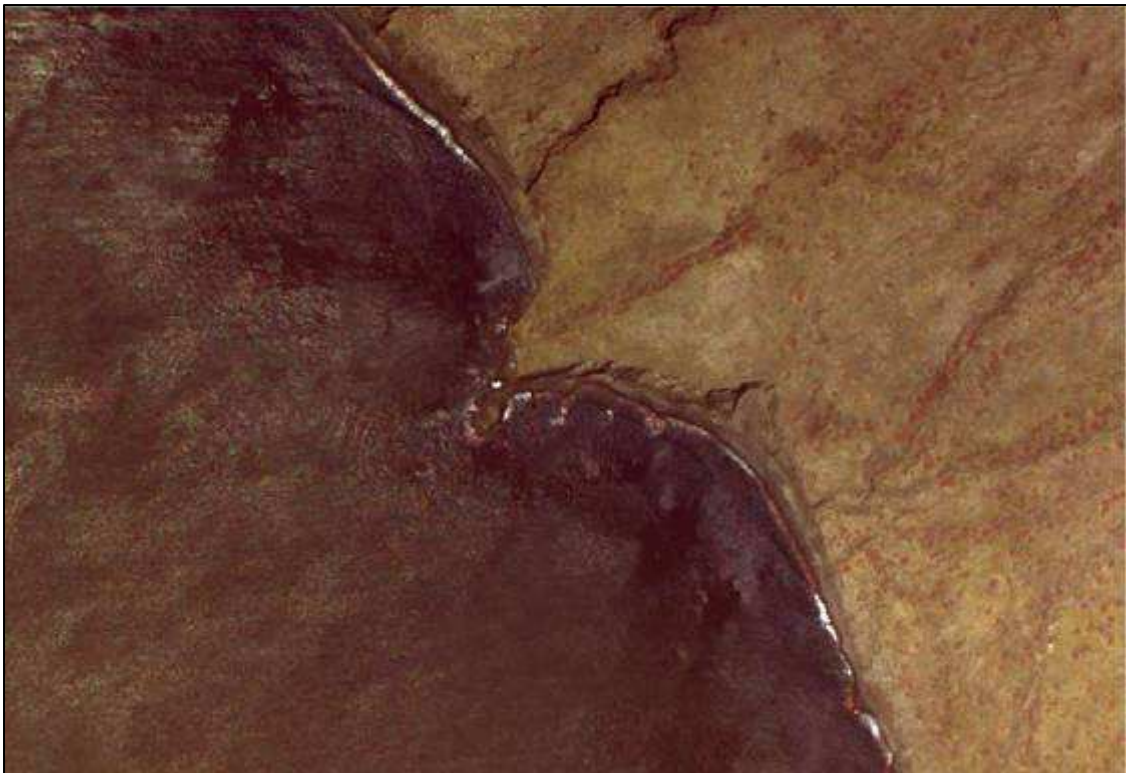


Figure 4. Kapukaloa Rock orthophoto.

Kapukaloa Rock

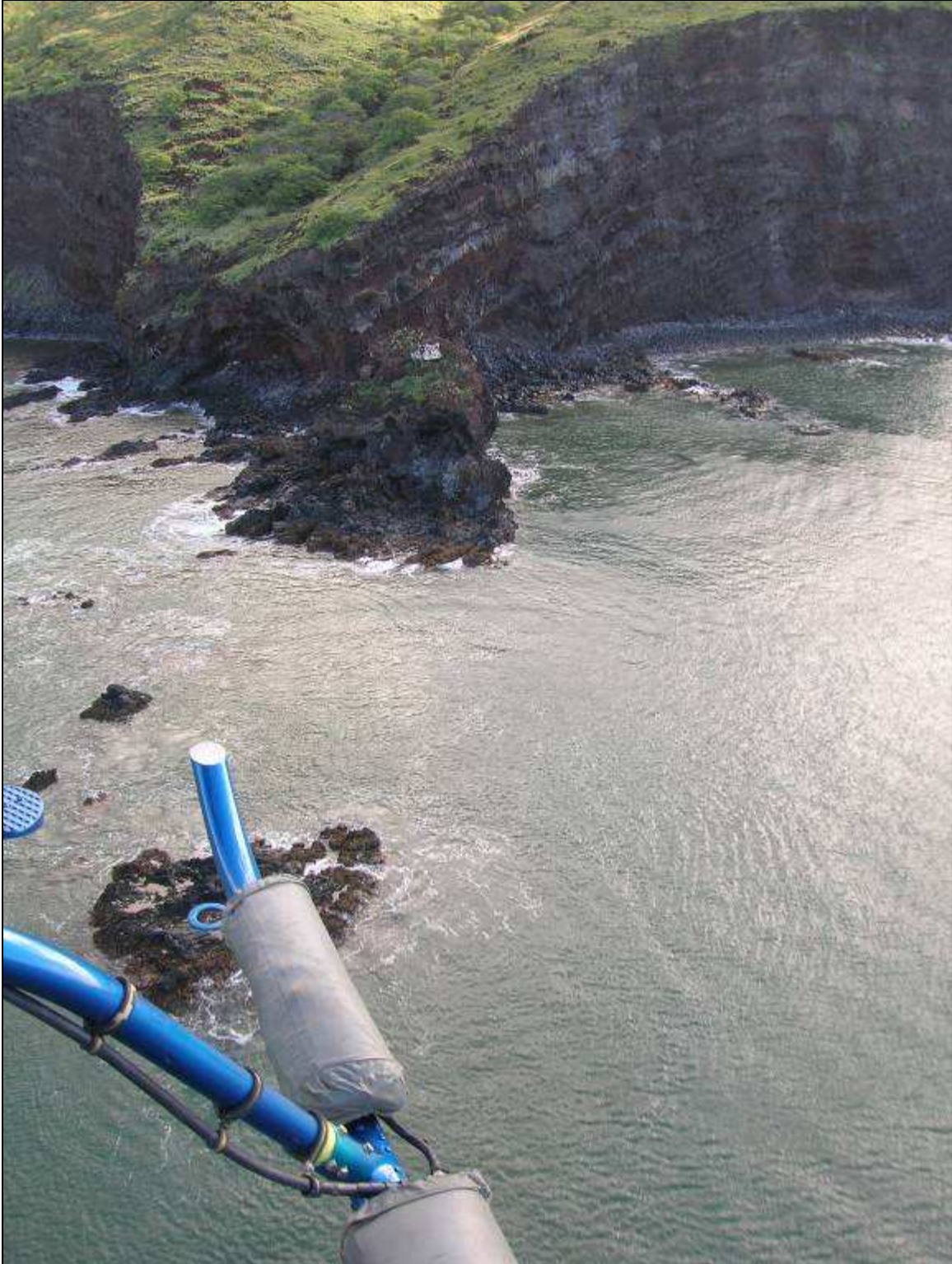


Figure 5. Kapukaloa Rock near main island of Lanai with sparse vegetation on top slope.

Kapukaloa Rock



Figure 6. Sparse vegetation of what appears to be hunakai (*Ipomoea tuboides*) and pili (*Heteropogon contortus*) on Kapukaloa Rock.



Figure 7. Sparse vegetation of what appears to be koa haole (*Leucaena leucocephala*) and uhaloa (*Waltheria indica*) on Kapukaloa Rock.

NANAHOA



Figure 8. Nanahoa Islets.

Overview

Nanahoa islets are a collection of 4 sea stacks off the western coast of Lanai, located just offshore near Honopu Bay. They are located at the following GPS coordinates: 708,926 E, 2,304,085 N. On April 6, 2006 we did a fly by survey of the 4 rocks collectively called Nanahoa and scanned for plants using binoculars. The one closest to the main island of Lanai is the tallest and has the most vegetation on it. Vegetation was only observed on the top surface. It is shaped like a round pillar of rock with a slanted top and stands about 128 ft. high. Just past this pillar are two medium sized rocks, one similar in shape to the large islet, but smaller in stature that also has some vegetation on the top surfaces, and one with a more pointed top with vegetation mostly near the top on the side. The furthest rock out is the shortest and is somewhat shark fin shaped with only one plant observed on it near the top, though we did not get a look at it closely. We attempted to land the helicopter on the tallest rock, but the winds were very strong at the time and we opted to just hover near it and scan for plants using binoculars. It may be possible that in lighter winds a helicopter could land on the tallest rock. In addition, if future trips were made, an attempt could be made to see what the plant was on the furthest out rock. A previous survey was done by Robert Hobdy in March, 1982. Due to steep terrain, Hobdy made the survey of the tallest rock from adjacent main island. His notes are including in the discussion below.

Nanahoa

Vegetation

Because the survey was done while hovering in a helicopter and by reviewing digital images taken during while hovering, the identifications made here may be suspect. Vegetation was mostly limited to the top surfaces of the pillar like rocks. The tallest rock had the most area for vegetation, followed by the two medium sized rocks. The shortest rock furthest away from the main island of Lanai had only one plant visible, though we did not get a good look at it. On the other rocks, we observed grasses (*Cenchrus ciliaris* and *Heteropogon contortus*) and other plants mixed in with the grasses, such as koa haole (*Leucaena leucocephala*), uhaloa (*Waltheria indica*), hunakai (*Ipomoea tuboides*), and pigweed (*Portulaca oleracea*). We observed possibly 8 species of plants, 4 (50%) were native and 4 (50%) were non-native. A previous survey of the islets from the main island of Lanai was made by Hobdy in 1982. During Hobdy's survey, he found 6 species of plants, 4 (67%) native and 2 (33%) non-native. He described the total vegetation - percentage of available substrate as 10-25%. Hobdy's notes are included for each species below. No collection information was found at BISH and USNM for Nanahoa islets.

Threats

Possibly non-native grasses.

Restoration

It is very hard to access these rocks making restoration more difficult.

Annotated Plant List -- Nanahoa Islets

***Boerhavia* sp. -- Alena -- (Nyctaginaceae) -- Indigenous**

Not observed during this survey. First observed in 1982 by Hobdy who did not list a species or description.

***Bothriochloa pertusa* -- Pitted beard grass -- (Poaceae) -- Alien**

Observed by reviewing digital images. Was either this, pili, or something similar we were observing on the cliff walls and islet margins.

***Cenchrus ciliaris* -- Buffel grass -- (Poaceae) -- Alien**

Observed from helicopter with binoculars on the tallest rock.

***Chloris virgata* -- Feather fingergrass -- (Poaceae) -- Alien**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as common.

***Heteropogon contortus* -- Pili -- (Poaceae) -- Questionably Indigenous**

Observed from helicopter with binoculars on the tallest rock.

***Ipomoea tuboides* -- Hunakai -- (Convolvulaceae) -- Endemic**

Observed from helicopter with binoculars on the tallest rock.

***Leucaena leucocephala* -- Koa haole -- (Fabaceae) -- Alien**

Nanahoa

Observed from helicopter with binoculars on the tallest rock closest to the main island of Lanai. First observed in 1982 by Hobdy who described the distribution as occasional.

***Panicum torridum* -- Konakona -- (Poaceae) -- Endemic**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as occasional.

***Panicum xerophilum* -- Konakona -- (Poaceae) -- Endemic**

Possibly observed from helicopter with binoculars on the medium sized rocks, though it was hard to distinguish which grass it really was. First observed in 1982 by Hobdy who described the distribution as occasional.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**

Observed from helicopter with binoculars on the tallest rock and on the medium sized rocks.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**

Not observed during this survey. First observed in 1982 by Hobdy who did not list a description.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**

Observed from helicopter with binoculars on the tallest Nanahoa rock and on the medium sized rocks.

Nanahoa



Figure 9. Nanahoa Islets map.



Figure 10. Nanahoa Islets orthophoto.

Nanahoa



Figure 11. Vegetated top portion of tallest Nanahoa Islet closest to the main island of Lanai.



Figure 12. Hovering near tallest Nanahoa Islet showing what appears to be mixed buffel grass (*Cenchrus ciliaris*), pili (*Heteropogon contortus*), koa haole (*Leucaena leucocephala*), and hunakai (*Ipomoea tuboides*).

Nanahoa



Figure 13. Two medium sized Nanahoa Islets showing vegetation and tide pools below.

Nanahoa



Figure 14. Shortest of the Nanahoa Islets located furthest out from main island of Lanai. Only one plant observed near top.

KIEI

Figure 15. Kiei Islet.

Overview

Kiei Islet is a small sea stack located just offshore from the main island of Lanai near Kiei Bay. The islet is approximately 1 acre in size and reaches a height of about 40 ft. The location coordinates are: 709,341 E, 2,301,790 N. On Apr. 6, 2006 two of us (Starr & Starr) were dropped off by helicopter on the lower shelf area and spent about a half hour conducting walk through surveys. The islet was fairly easy to walk around though there were some loose rocks and steep areas. The islet had several terrace like flat areas, lower, middle, and top. Several tide pools surrounded the small islet and landing by boat appeared risky. We observed a few pairs of wedge-tailed shearwaters (*Puffinus pacificus*) pairing up in burrows. There is probably room for about 100 or so birds on the islet. An active colony was observed on the northwest wall, under a thick lava flow. Burrows, some occupied, were also seen in cracks in rock piles.

Vegetation

The vegetation was relatively sparse and was found only on the elevated east end, generally on flat surfaces. Several native species were found about the islet, including two healthy patches of hunakai (*Ipomoea tuboides*), a few alena (*Boerhavia* sp.) patches, and one ohelo kai (*Lycium sandwicense*) patch. Other common native shrubs included ilima (*Sida fallax*) and hoary abutilon (*Abutilon incanum*) that were spread about the islet. Several non-native species occurred in low numbers and were pulled when possible, including: Spanish needles (*Bidens pilosa*), bitter melon (*Momordica charantia*), hairy horseweed (*Conyza bonariensis*), little ironweed (*Vernonia cinerea*), sandbur (*Cenchrus*

Kiei

echinatus), and sour grass (*Digitaria insularis*). We did not observe any of the native grasses (*Panicum fauriei* and *Panicum torridum*) which Hobdy described as rare in distribution in 1982. They could possibly remain as seeds in the soil. Due to recent rains, numerous seedlings were observed of both natives and non-natives. We observed 22 species of plants, 6 (27%) were native and 16 (73%) were non-native. A previous survey was done by Robert Hobdy on March 3, 1982. During his survey, he found 14 species of plants, 7 (50%) native and 7 (50%) non-native. An additional native species was found during specimen searches, so actual total number of species observed during his survey was 15, 8 (53%) native and 7 (47%) non-native. Hobdy's notes and collection information are included for each species below.

Threats

Though several non-native plants were present, many of which have previously not been recorded, none were very widespread yet and we were able to pull many of them during our short time there. In addition, the native plants seem to be doing fairly well and are not yet over-run with non-native grasses such as buffel grass (*Cenchrus ciliaris*) and sandbur (*Cenchrus echinatus*). These grasses now dominate other Lanai islets and native species have dwindled as a result. Periodic monitoring of this islet and a little weed pulling can be done in a short amount of time and go a long way.

Restoration

Periodic monitoring of vegetation and weed control of high threat species such as koa haole (*Leucaena leucocephala*), guinea grass (*Panicum maximum*), and non-native grasses (*Cenchrus ciliaris* and *Cenchrus echinatus*) could be done. There are still a couple patches of non-native grasses that were too large to hand pull. Native grasses (*Panicum fauriei* and *Panicum torridum*) could be re-introduced if desired, along with the questionably indigenous pili grass (*Heteropogon contortus*). Existing native plants, such as alena (*Boerhavia* sp.), hunakai (*Ipomoea tuboides*), and ilima (*Sida fallax*) could be allowed to spread. Additionally, rare plants such as ohai (*Sesbania tomentosa*), nohu (*Tribulus cistoides*), and ihi (*Portulaca molokini*) could be introduced.

Annotated Plant List -- Kiei Islet

***Abutilon incanum* -- Hoary abutilon -- (Malvaceae) -- Questionably Indigenous**

Occasional. A few plants and seedlings on middle terraces. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-08), BISH.

***Bidens pilosa* -- Spanish needles -- (Asteraceae) -- Alien**

Rare. One small seedling observed and pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-10), BISH.

***Boerhavia acutifolia* -- Alena -- (Nyctaginaceae) -- Indigenous**

See *Boerhavia* sp. discussion below. First collected in 1982 by Hobdy.

5 Apr 1982, Hobdy, R.W. (#1338), BISH 460492.

***Boerhavia* sp. -- Alena -- (Nyctaginaceae) -- Indigenous**

Rare. Couple healthy patches on west side of middle terrace. The *Boerhavia* sp. on this islet is native. However, there has been much taxonomic confusion of *Boerhavia* species in the past, so we hesitate to place a species name on these plants at this time. Collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-13), BISH.

***Bothriochloa pertusa* -- Pitted beard grass -- (Poaceae) -- Alien**

Rare. A couple plants. All hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-11), BISH.

***Cenchrus ciliaris* -- Buffel grass -- (Poaceae) -- Alien**

Occasional. A few clumps on steep slope on south side of islet. One small plant on upper terraced section. Reachable plants were pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-02), BISH.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**

Rare. One clump on summit which was hand pulled. First observed in 1982 by Hobdy who described the distribution as occasional. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-14), BISH.

***Conyza bonariensis* -- Hairy horseweed -- (Asteraceae) -- Alien**

Rare. A couple small plants. All hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-22), BISH.

***Digitaria insularis* -- Sour grass -- (Poaceae) -- Alien**

Rare. One small clump on north side. Hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-20), BISH.

***Emilia fosbergii* -- Pualele -- (Asteraceae) -- Alien**

Occasional. Scattered here and there on islet. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-01), BISH.

***Gamochaeta purpureum* -- Purple cudweed -- (Asteraceae) -- Alien**

[syn. *Gnaphalium purpureum*]

See *Gnaphalium* sp. discussion below. First observed in 1982 by Hobdy who described the distribution as rare.

***Gnaphalium* sp.-- *Gnaphalium* -- (Asteraceae) -- Alien**

Occasional. Scattered plants on north slope. There has been much taxonomic confusion and revision of *Gnaphalium* species recently, so we hesitate to place a species name on these plants at this time. Collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-15), BISH.

***Heteropogon contortus* -- Pili -- (Poaceae) -- Questionably Indigenous**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as common. May still exist as seeds in soil.

***Ipomoea tuboides* -- Hunakai -- (Convolvulaceae) -- Endemic**

Rare. Two healthy patches observed, one on lowest terrace on N side of islet and one on the upper terrace on the north side of the islet. First observed in 1982 by Hobdy who described the distribution as occasional. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-03), BISH.

***Lantana camara* -- Lantana -- Verbenaceae -- Alien**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as rare.

***Leucaena leucocephala* -- Koa haole -- (Fabaceae) -- Alien**

Common. About a dozen plus clumps. Barely sprouting from old stem bases. Plants were no more than 1 m tall. Some seedlings observed. First observed in 1982 by Hobdy who described the distribution as rare. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-09), BISH.

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**

Rare. One healthy patch on west slope of lowest terrace. First observed in 1982 by Hobdy who described the distribution as rare. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-04), BISH.

***Lycopersicon pimpinellifolium* -- Cherry tomato -- Solanaceae**

Rare. One small plant with fruit. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-06), BISH.

***Momordica charantia* -- Bitter melon -- Cucurbitaceae -- Alien**

Rare. A couple small plants and seedlings. All hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-19), BISH.

***Oxalis corniculata* -- Yellow wood sorrel -- Oxalidaceae -- Questionably Polynesian**

Rare. One small plant on north slope. Hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-07), BISH.

***Panicum fauriei* -- Panicum-- (Poaceae) -- Endemic**

[syn. *Panicum nubigenum*]

Not observed during this survey. First collected in 1982 by Hobdy who described the distribution as rare.

5 Apr 1982, Hobdy, R.W. (#1337), BISH 460493.

***Panicum maximum* -- Guinea grass-- (Poaceae) -- Alien**

Rare. One small clump on summit. Too large to pull. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-21), BISH.

***Panicum torridum* -- Konakona -- (Poaceae) -- Endemic**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as rare.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**

Kiei

Common. Found over much of the islet. Many seedlings observed. The soil contains abundant seeds that appear to be this species. First observed in 1982 by Hobby who described the distribution as occasional. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-16), BISH.

***Setaria verticillata* -- Bristly foxtail -- (Poaceae) -- Alien**

Not observed during this survey. First observed in 1982 by Hobby who described the distribution as uncommon.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**

Common to dominant in some spots. Many seedlings observed. First observed in 1982 by Hobby who described the distribution as common. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-17), BISH.

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**

Not observed during this survey. First observed in 1982 by Hobby who described the distribution as rare.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**

Rare. One small plant. Hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-18), BISH.

***Vernonia cinerea* -- Little ironweed -- (Asteraceae) -- Alien**

Rare. One plant observed on lowest terrace on north side of islet. Hand pulled. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-05), BISH.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**

Occasional. A few plants. Many seedlings observed. First observed in 1982 by Hobby who described the distribution as occasional. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-12), BISH.

Kiei



Figure 16. Kiei Islet map.

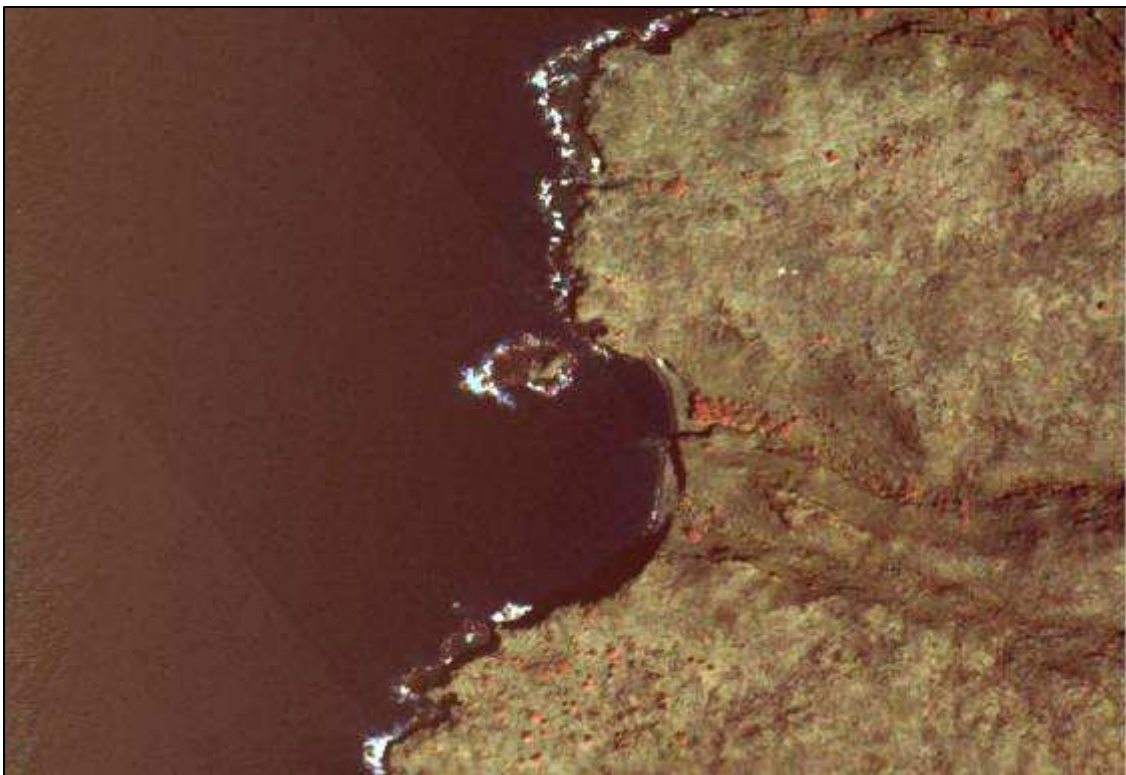


Figure 17. Kiei Islet orthophoto.



Figure 18. Healthy patch of alena (*Boerhavia* sp.) on west side of middle terrace with ilima (*Sida fallax*) and koa haole (*Leucaena leucocephala*) in background.



Figure 19. Ohelo kai (*Lycium sandwicense*) on west side of islet on lower terrace.



Figure 20. Hunakai (*Ipomoea tuboides*) on north side of islet on top terrace.



Figure 21. Spanish needles (*Bidens pilosa*) and pigweed (*Portulaca oleracea*) seedlings.



Figure 22. Hoary abutilon (*Abutilon incanum*) cluster of plants on middle terrace.

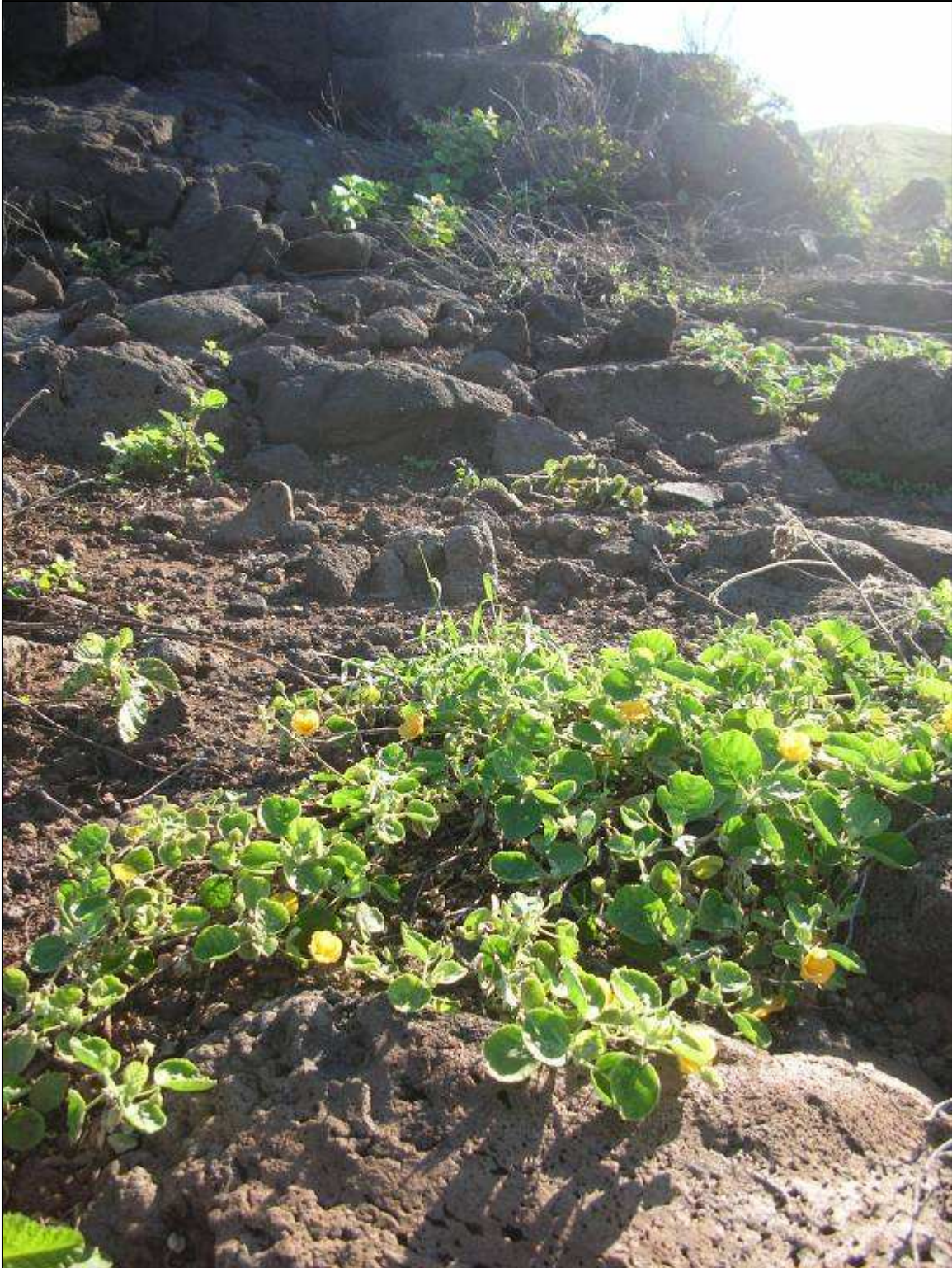


Figure 23. Ilima (*Sida fallax*) in flower with uhaloa (*Waltheria indica*) and hoary abutilon (*Abutilon incanum*) in background. Middle terrace of islet showing mostly open hard rock areas with sparse vegetation and wedge-tailed shearwater (*Puffinus pacificus*) burrows in cracks under rock piles at top of photo.

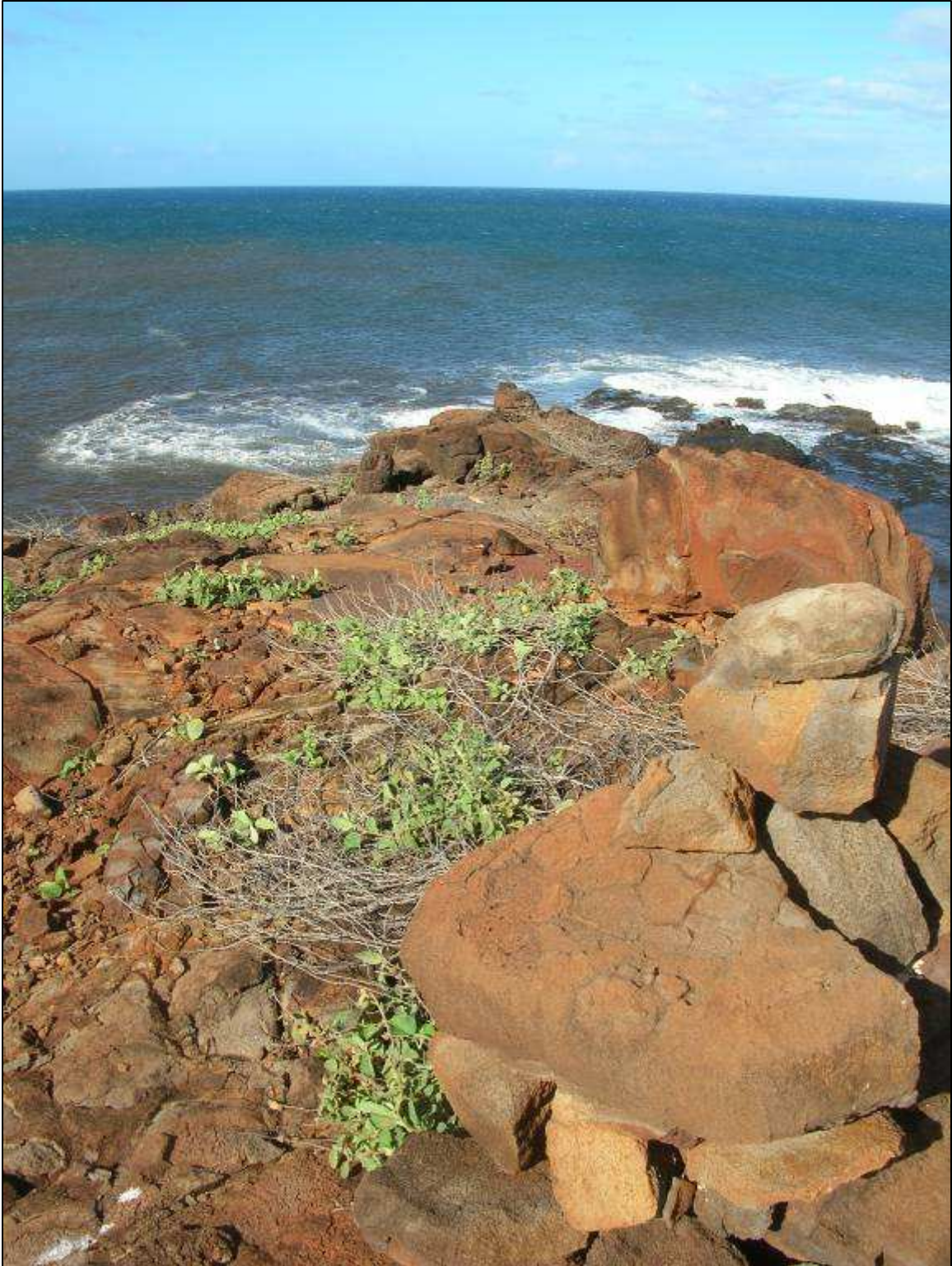


Figure 24. Upper terrace of islet showing sparse uhaloa (*Waltheria indica*) and ilima (*Sida fallax*).

MOKU NAIO



Figure 25. Moku Naio Islet.

Overview

Moku Naio Islet (Moku Noio Islet, Shark Fin Rock) is a small shark fin shaped rock located near the southern end of Pali Kaholo of the main island of Lanai and just offshore from Kahekili's Leap. The location coordinates are: 711,492 E, 2,294,402 N. The small islet is only .1 acre in size and reaches a height of about 30 ft. On Apr. 6, 2006 we flew near the islet and hovered while scanning for plants using binoculars. We did not see any plants growing on the small islet which is probably too harsh of an environment for plants to grow. Hobdy (1982) also did not observe vegetation on this islet. No collection information was found at BISH and USNM.

Vegetation

No vegetation was found during our survey.

Threats

None known.

Restoration

With no vegetation present, no restoration recommendations are made here.

Annotated Plant List -- Moku Naio

No plants present.

Moku Naio

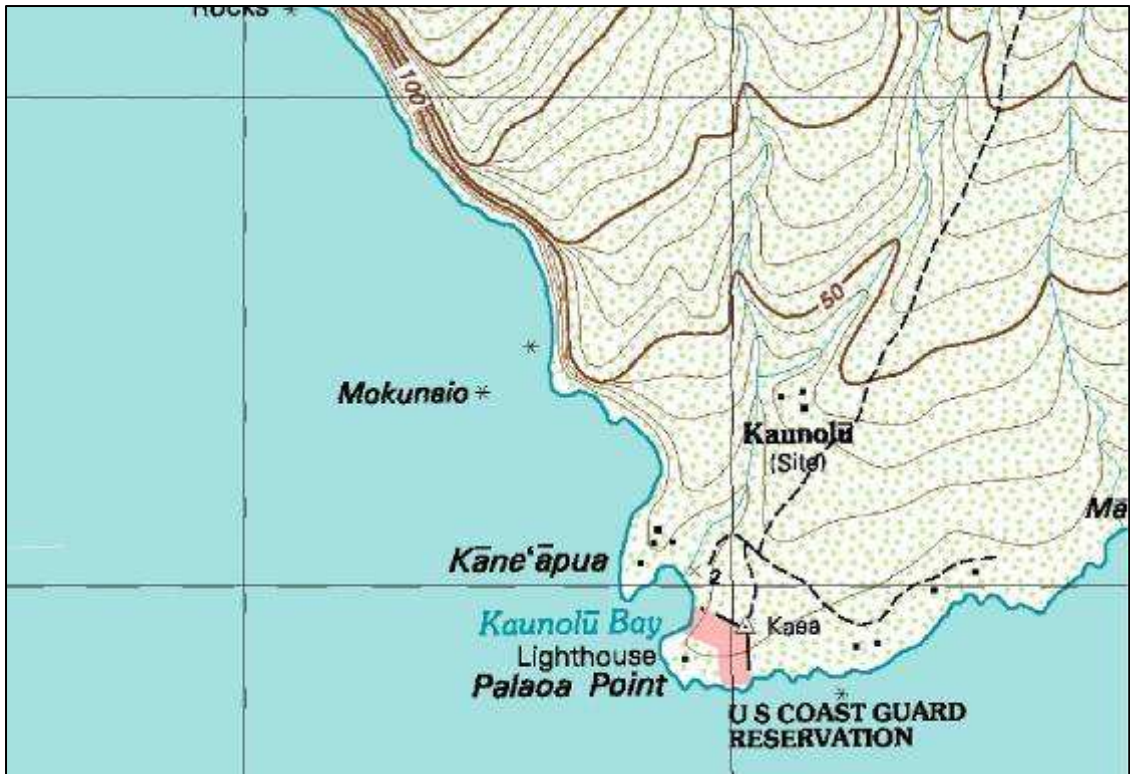


Figure 26. Moku Naio Islet map.



Figure 27. Moku Naio Islet orthophoto.

Moku Naio



Figure 28. Moku Naio Islet with no vegetation.



Figure 29. Moku Naio Islet with no vegetation.

KANEAPUA ROCK



Figure 30. Kaneapua Rock.

Overview

Kaneapua Rock is located just south of Moku Naio along the southwest coastline of the main island of Lanai. It is just to the northwest of Palaoa Point Light House, 10 m elev., 35 m long x 10 m wide. The GPS coordinates are: 771, 824 E, 2,294,044 N. On Apr. 6, 2005, one of us (Wood) was dropped off by helicopter and spent about 30 minutes doing walk through surveys. Kaneapua is a basalt rock surrounded by a marine bench with tide-pools and ocean, within 10 m of the mainland. There was no sign of seabirds. There was a rock heiau on the northern end 3 m long x 2 m wide x 1-2 m tall, and coral scattered around the heiau walls.

Vegetation

Kaneapua has a wind and salt-water exposed dry shrubland with sparse cover of uhaloa (*Waltheria indica*), with the only other vegetation being single plants of non-native sourbush (*Pluchea carolinensis*) and butterfly weed (*Asclepias curassavica*) which were removed during this survey. A total of 3 plants were observed, 1 (33%) was native and 2 (67%) were non-native. Collections were made of all 3 species of plants observed.

Threats

Being so close to the main island, visitation by humans is likely a threat. No seabirds were observed and predators may be present. This rock is not part of the state seabird sanctuary.

Kaneapua

Restoration

The few weeds that were present during this survey were removed. If desired, the rock could occasionally be visited and weeds removed. Additionally, rare plants such as ohai (*Sesbania tomentosa*), nohu (*Tribulus cistoides*), and ihi (*Portulaca molokini*) could be introduced.

Annotated Plant List -- Kaneapua Rock

***Asclepias curassavica* -- Butterfly weed -- (Asclepiadaceae) -- Alien**

Rare. Herb, 30 cm tall, vegetative. Single plant observed and pulled.

6 Apr 2006, Wood, K.R. (#00808), 33 ft (10 m), BISH, PTBG.

***Pluchea carolinensis* -- Sourbush -- (Asteraceae) -- Alien**

Rare. Shrub, 50 cm tall. Single plant observed and pulled.

6 Apr 2006, Wood, K.R. (#11807), 33 ft (10 m), BISH, PTBG.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**

Occasional. Sparsely distributed on islet, stems decumbent brown-red, corolla yellow.

6 Apr 2006, Wood, K.R. (#11806), 33 ft (10 m), BISH, PTBG.

Kaneapua



Figure 31. Kaneapua Rock map.



Figure 32. Kaneapua Rock orthophoto.

Kaneapua



Figure 33. Kaneapua Rock with tide-pools.



Figure 34. Kaneapua Rock with sparse vegetation of uhaloa, and sourbush (*Pluchea carolinensis*) and butterfly weed (*Asclepias curassavica*), which were both pulled.

POOPOO



Figure 35. Poopoo Islet.

Overview

Poopoo Islet is located on the south-central coast of Lanai. The coordinates are: 716,388 E, 2,294,186 N. On Apr. 6, 2006 one of the team (Wood) conducted a botanical survey of Poopoo Islet. He was dropped off by helicopter and spent about 2 hours doing walk through surveys. Poopoo is a teardrop shaped islet just offshore and west of Huawai Bay. It is narrow on the north end broadening on the south, made up of basaltic substrate of boulders and soil, approximately 20 m elev., 40 m x 40 m, with a marine-bench with tide-pools on the south. About seven pair of wedge-tailed shearwaters (*Puffinus pacificus*) observed pairing off in burrows on upper western slope. About 40 additional burrows observed, easy access to top from both the southwest and northwest corners of islet.

Vegetation

The top of the islet is a non-native buffel grass (*Cenchrus ciliaris*) grassland with relic native shrubs of ilima (*Sida fallax*), along with a few uncommon relics of nohu (*Tribulus cistoides*), uhaloa (*Waltheria indica*), hoary abutilon (*Abutilon incanum*), and alena (*Boerhavia repens*). Other non-native associates include pigweed (*Portulaca oleracea*), hairy morning glory (*Merremia aegyptia*), sandbur (*Cenchrus echinatus*), fingergrass (*Chloris virgata*), hairy horseweed (*Conyza bonariensis*), and lantana (*Lantana camara*). There was also a mushroom, which was uncommon, growing out of rooting grass stems. During this survey, a total of 11 species were observed, 5 (45%) were native and 6 (55%) were non-native. A previous botanical survey of Poopoo Islet was done by Robert

Poopoo

Hobdy, Paul Higashino, and Don Fox on April 5, 1982. During their survey, they found 25 species of plants, 12 (48%) native and 13 (52%) non-native. In a summary report (Hobdy 1982), Hobdy notes that the native species dominated the vegetation, with *Panicum xerophilum* forming a thick cover over most of the area, interspersed with many *Sida fallax* plants. His notes and what appears to be Higashino's notes are included for each species below. Collection information is also included for each species.

Threats

Non-native grasses (*Cenchrus ciliaris* and *Cenchrus echinatus*) are probably the greatest threat to the vegetation right now. Other weedy non-native species include pigweed, hairy morning glory, fingergrass, hairy horseweed, and lantana. The ease of access on to this islet by boat may make it more susceptible to introductions of non-natives by folks accessing the islet.

Restoration

This islet is accessible by boat, making restoration a little easier than some of the other Lanai islets which require helicopter support for safe access. Non-native grasses, seemingly the current greatest threat to the native vegetation, could be removed. Restoration could focus on removing weeds near native species to allow them to spread. Many of the more rare native components, such as ihi (*Portulaca sclerocarpa*), native grasses (*Panicum fauriei*, *Panicum torridum*, and *Panicum xerophilum*), and nehe (*Lipochaeta heterophylla*, *Lipochaeta lavarum*) were not observed. It is possible that some of these still remain as seed bank below the sea of non-native grasses. Native species previously known from the islet could be also be re-introduced through either seed throwing or out-planting. Additionally, rare plants such as ohai (*Sesbania tomentosa*), nohu (*Tribulus cistoides*), and ihi (*Portulaca molokini*) could be introduced.

Annotated Plant List -- Poopoo Islet

***Abutilon incanum* -- Hoary abutilon -- (Malvaceae) -- Questionably Indigenous**

Uncommon. Sub-shrub, 50 cm tall, leaves light green, tinged blue, corolla yellow-white, uncommon in grassland. First collected during this survey.

6 Apr 2006, Wood, K.R. (#11811), 50 ft (15 m), BISH, PTBG.

***Boerhavia acutifolia* -- Alena -- (Nyctaginaceae) -- Indigenous**

[Taxonomic name change: *Boerhavia glabrata*]. See below. First collected in 1982 by Hobdy who described the distribution as common. Also collected by Higashino in 1982.

5 Apr 1982, Hobdy, R.W. (#1359), BISH 460494.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9742).

***Boerhavia repens* -- Alena -- (Nyctaginaceae) -- Indigenous**

Uncommon. Herb decumbent stems green or green-pink, anthocarps glabrous, corolla pink-white. Collected during this survey.

6 Apr 2006, Wood, K.R. (#11818), 40 ft (12 m), BISH, PTBG.

***Cenchrus ciliaris* -- Buffel grass -- (Poaceae) -- Alien**

Poopoo

Dominant. Dominant grass, about 35 cm tall, thickly covering summit of islet, in flower. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as rare. Collected again during this survey.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9736), small island 100 yards off Lanai's southern coast, c. 30.48 m, BISH 477014.
6 Apr 2006, Wood, K.R. (#11809), 66 ft (20 m), BISH, PTBG.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**

[syn. *Cenchrus echinatus* var. *hillebrandianus*]. Occasional. Grass, along east rim, lower sheaths with purple tinge, occasional with fingergrass (*Chloris virgata*). First observed in 1982 by Hobdy who described the distribution of *C. echinatus* var. *hillebrandianus* as occasional and *C. echinatus* as uncommon. First collected during this survey.

6 Apr 2006, Wood, K.R. (#11819), 40 ft (12 m), BISH, PTBG.

***Chloris virgata* -- Feather fingergrass -- (Poaceae) -- Alien**

Occasional. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as abundant.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9738), small island 100 yards off Lanai's southern coast, c. 30 m, BISH 484499.

***Digitaria insularis* -- Sourgrass -- (Poaceae) -- Alien**

[syn. *Triachne insularis*]. Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as rare.

***Ipomoea tuboides* -- Hunakai -- (Convolvulaceae) -- Endemic**

Not observed during this survey. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as uncommon.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9741), small island 100 yards off Lanai's southern coast, c. 100 ft, BISH 477034.

***Lantana camara* -- Lantana -- (Verbenaceae) -- Alien**

Rare. Sing plant observed and pulled. Shrub, 70 cm tall. First collected during this survey.

6 Apr 2006, Wood, K.R. (#11816), 40 ft (12 m), BISH, PTBG.

***Leucaena leucocephala* -- Koa haole -- (Fabaceae) -- Alien**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as rare. Higashino's notes report, "only 1 seen".

***Lipochaeta heterophylla* -- Nehe -- (Asteraceae) -- Endemic**

Not observed during this survey. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as occasional.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9733), 100 yards off Lanai's southern coast, c. 100 ft, BISH 477033.

***Lipochaeta lavarum* -- Nehe -- (Asteraceae) -- Endemic**

Not observed during this survey. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as rare.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9732), small island 100 yards off Lanai's southern coast, c. 100 ft, BISH 477022.

Poopoo

***Lycopersicon esculentum* -- Cherry tomato -- (Solanaceae) -- Alien**

Not observed during this survey. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as common.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9743), small island 100 yards off Lanai's southern coast, c. 100 ft, BISH 477702.

***Macroptilium lathyroides* -- Cow pea-- (Fabaceae) -- Alien**

[syn. *Phaseolus lathyroides*]. Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as rare.

***Merremia aegyptia* -- Hairy merremia -- (Convolvulaceae) -- Questionably Alien**

Occasional. Vines, immature, 35-70 cm long, pubescent with reddish-brown hairs, old capsules and seeds observed. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as occasional. Collected again during this survey.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9734), small island 100 yards off Lanai's southern coast, c. 100 ft, BISH 477019.

6 Apr 2006, Wood, K.R. (#11815), 55 ft (17 m), BISH, PTBG.

***Momordica charantia* -- Bitter melon -- (Cucurbitaceae) -- Alien**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as uncommon.

***Panicum fauriei* -- Panicum-- (Poaceae) -- Endemic**

[syn. *Panicum nubigenum*]. Not observed during this survey. First collected by Hobdy and Higashino in 1982. Hobdy reported the distribution as occasional.

5 Apr 1982, Hobdy, R.W. (#1360), BISH 460476.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9744), small island 100 yards off Lanai's southern coast, c. 30 m, BISH 473423.

***Panicum torridum* -- Konakona -- (Poaceae) -- Endemic**

Not observed during this survey. First collected by Hobdy and Higashino in 1982. Hobdy reported the distribution as occasional.

5 Apr 1982, Hobdy, R.W. (#1362), BISH 460474.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9740), small island 100 yards off Lanai's southern coast, c. 30 m, BISH 477029.

***Panicum xerophilum* -- Konakona -- (Poaceae) -- Endemic**

Not observed during this survey. First collected in 1982 by Hobdy who described the distribution as abundant.

5 Apr 1982, Hobdy, R.W. (#1361), BISH 460475.

5 Apr 1982, Hobdy, R.W. (#1358), BISH 460495.

5 Apr 1982, Hobdy, R.W. (#1357), BISH 460496.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**

Common to dominant. Herb with smooth sprawling pin-red stems, corolla yellow, second dominant after buffel grass (*Cenchrus ciliaris*). First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as common. Collected again during this survey.

Poopoo

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9746), small island 100 yards off Lanai's southern coast, c. 100 ft, vegetation consisting of native shrubs, native herbs, native grasses, and exotic grasses, BISH 477018.

6 Apr 2006, Wood, K.R. (#11810), 66 ft (20 m), BISH, PTBG.

***Portulaca sclerocarpa* -- Ihi makole -- (Portulacaceae) -- Endemic**

Not observed during this survey. Listed as an endangered species (Wagner *et al.*, 1999). First collected in 1982 by Hobdy who described the distribution as uncommon. Also collected by Higashino in 1982, but no record of it was found at BISH.

5 Apr 1982, Hobdy, R.W. (#1356), BISH 460483.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9747).

***Setaria verticillata* -- Bristly foxtail -- (Poaceae) -- Alien**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as rare.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**

Common to dominant. Third dominant species on islet. Shrubs of 35-70 cm, stems gray brown erect or spreading horizontally. First observed in 1982 by Hobdy who described the distribution as abundant. First collected during this survey.

6 Apr 2006, Wood, K.R. (#11814), 50 ft (15 m), BISH, PTBG.

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**

Not observed during this survey. First collected in 1982 by Higashino *et al.* Hobdy reported the distribution as rare.

5 Apr 1982, Higashino, P.K., R.W. Hobdy, and D. Fox, (#9745), small island 100 yards off Lanai's southern coast, c. 100 ft, BISH 477025.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**

Not observed during this survey. First observed in 1982 by Hobdy who described the distribution as uncommon.

***Tribulus cistoides* -- Nohu -- (Zygophyllaceae) -- Indigenous**

Uncommon. Sub-shrub, decumbent stems, corolla yellow, ca. 20 scattered individuals on west above vertical sides of islet. First observed in 1982 by Hobdy who described the distribution as uncommon. First collected during this survey.

6 Apr 2006, Wood, K.R. (#11812), 50 ft (15 m), BISH, PTBG.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**

Occasional. Sub-shrub, stems spreading, decumbent light green, leaves dark green above, paler below. First observed in 1982 by Hobdy who described the distribution as uncommon. First collected during this survey.

6 Apr 2006, Wood, K.R. (#11813), 50 ft (15 m), BISH, PTBG.

Poopoo

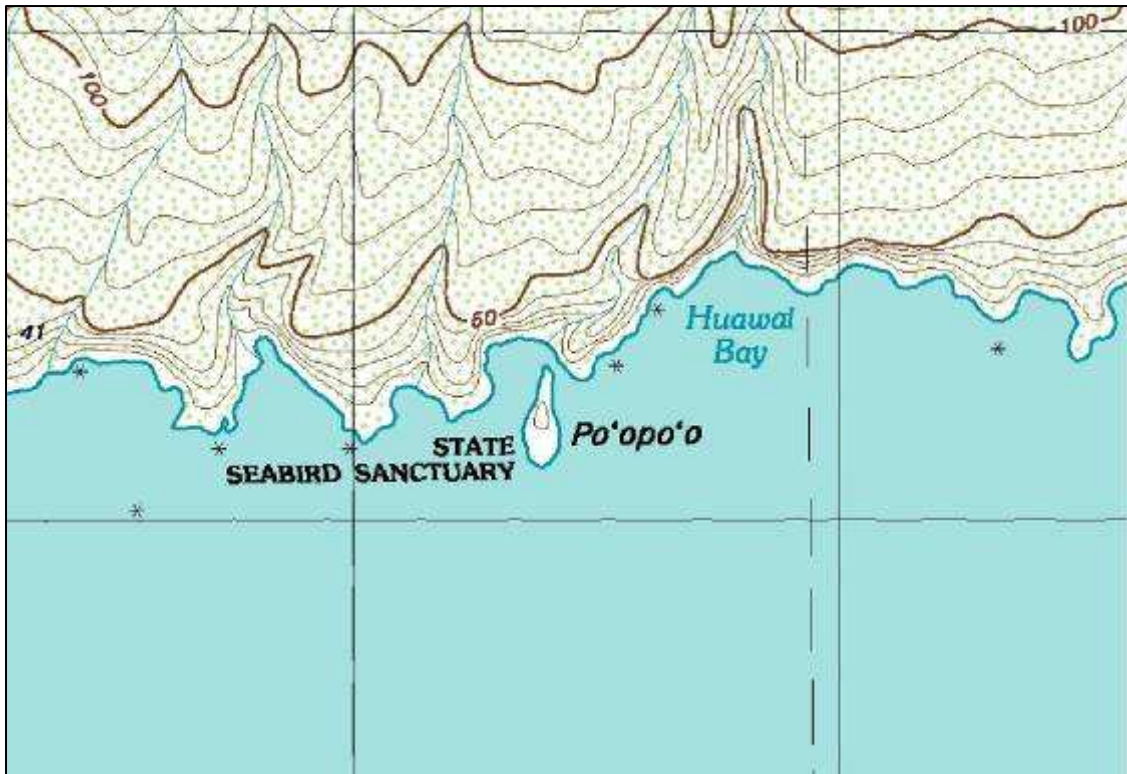


Figure 36. Poopoo Islet map.



Figure 37. Poopoo Islet orthophoto.

Poopoo



Figure 38. Poopoo Islet with cover of buffel grass (*Cenchrus ciliaris*).



Figure 39. Dominant buffel grass.

Poopoo



Figure 40. Poopoo Islet with cover of buffel grass and ilima (*Sida fallax*), tide-pools on wave worn bench below.

PUU PEHE



Figure 41. Puu Pehe Islet.

Overview

Puu Pehe Islet (Sweetheart Rock) is a tall basalt sea stack located near Manele / Hulupoe Bay just offshore from the main island of Lanai in Puu Pehe cove, which includes a sand beach on the west side of the cove and precipitous sheer walls on the east side. The location coordinates are: 719,677 E, 2,294,176 N. On Apr. 6, 2006, two of us (Starr & Starr) were dropped by helicopter on the islet and conducted walk through botanical surveys. We spent about 2 hours total on the islet. Puu Pehe is a small islet about 1.6 acres in size reaching a height of about 100 ft. The islet has a flat top area and a sloping area towards the east. There are loose blocks of basalt with pockets of soil. The north and west sides have sheer cliffs. A wave worn bench with tide-pools lie below. There is a heiau on the top of the islet. Several non-vegetated rocks lie nearby the islet. Puu Pehe Islet is mostly a dry grass and shrubland, dominated by buffel grass (*Cenchrus ciliaris*) and sandbur (*Cenchrus echinatus*), with lima (*Sida fallax*) shrubs interspersed among the grasses. We saw a dozen or so pairs of wedge-tailed shearwaters in burrows and under rocks piles. We saw many more unoccupied burrows. The islet could probably support a couple to a few hundred birds. A few white-tailed tropic birds (*Phaeton lepturus*) were seen flying near the islet. An ulili (*Heteroscelus incanus*) was heard on the rocks below. We also saw a mynah (*Acridotheres tristis*) flying from the main island of Lanai about the cove and heard a gray francolin (*Francolinus pondicerianus*) call from the kiawe trees (*Prosopis pallida*) on the main island. Some insects on Puu Pehe include ants, garden spiders (*Argiope* sp.), honey bees (*Apis mellifera*) visiting ilima flowers, paper

Puu Pehe

wasps (*Polistes* spp.), uhaloa moths (*Eublemma accedens*), Hawaiian beat webworms (*Spoladea recurvalis*), and small cricket-like orthopterans.

Vegetation

The islet is densely vegetated and is mostly dominated by non-native grasses. The most common one being buffel grass which dominates the islet. Sandbur was the second most commonly observed plant, followed by ilima shrubs, which were especially common in rocky areas on the east side. A fair sized patch of lamb's quarters (*Chenopodium murale*) exists on the east side just below the heiau. There was an occasional uhaloa (*Waltheria indica*), a few small hairy merremia (*Merremia aegyptia*), and a lone hoary abutilon (*Abutilon incanum*) on the flat plateau area on top. Non-native pigweed (*Portulaca oleracea*) was common in open areas and there were many seedlings present. A total of 8 species were observed, 3 (38%) were native and 5 (63%) were non-native. A previous survey was done by Robert Hobdy in March, 1982. Due to steep terrain, a full survey was not done. Hobdy made the survey from a kayak and from 3/4 of the way up the cliff. During his survey, he found 3 species of plants, all native. He described the total vegetation - percentage of available substrate as 20%. His notes are included for each species below.

Threats

Non-native grasses seem to be all dominating and seemingly contribute to a lack of native vegetation.

Restoration

The non-native grasses on Puu Pehe could be removed and native plants could be allowed to spread. Native plants no longer present, such as hunakai (*Ipomoea tuboides*) and panicum (*Panicum xerophilum*) may still exist as seeds in the soil. They could also be re-introduced if desired. Additionally, rare plants such as ohai (*Sesbania tomentosa*), nohu (*Tribulus cistoides*), and ihi (*Portulaca molokini*) could be introduced. Puu Pehe requires a helicopter landing for safe access, so restoration of this islet will likely require higher levels of resources than nearby Poopoo, which can also be accessed by boat. That said, those same access constraints may also help Puu Pehe be more resilient to introductions.

Annotated Plant List -- Puu Pehe Islet

***Abutilon incanum* -- Hoary abutilon -- (Malvaceae) -- Questionably Indigenous**

Rare. One plant found on upper flat area. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-30), BISH.

***Cenchrus ciliaris* -- Buffel grass -- (Poaceae) -- Alien**

Dominant. Dominates islet. Found on all parts except sheer faces. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-28), BISH.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**

Dominant. Second in dominance to *Cenchrus ciliaris*, but not by much. Also found virtually everywhere on islet. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-29), BISH.

Puu Pehe

***Chenopodium murale* -- Lamb's quarters -- (Chenopodiaceae) -- Alien**

Common. Especially near rock jumble on east slope. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-31), BISH.

***Chloris virgata* -- Feather fingergrass -- (Poaceae) -- Alien**

Rare. Small clump found on flat top area near heiau. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-23), BISH.

***Ipomoea tuboides* -- Hunakai -- (Convolvulaceae) -- Endemic**

Not observed during this survey. First observed in 1982 by Hobdy.

***Merremia aegyptia* -- Hairy merremia -- (Convolvulaceae) -- Questionably Alien**

Occasional. A few plants on northwest tip. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-25), BISH.

***Panicum xerophilum* -- Konakona -- (Poaceae) -- Endemic**

Not observed during this survey. First observed in 1982 by Hobdy.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**

Common. Lots of seedlings and small plants in open areas and under buffel grass. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-27), BISH.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**

Common to dominant. The third most common plant on the islet. Clumps found over much of the islet, especially common in rocky areas on east slope. Many seedlings observed. First observed in 1982 by Hobdy. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-24), BISH.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**

Occasional. Scattered plants. Seedlings observed. First collected during this survey.

6 Apr 2006, Starr, F. & K. Starr (#060406-26), BISH.

Puu Pehe

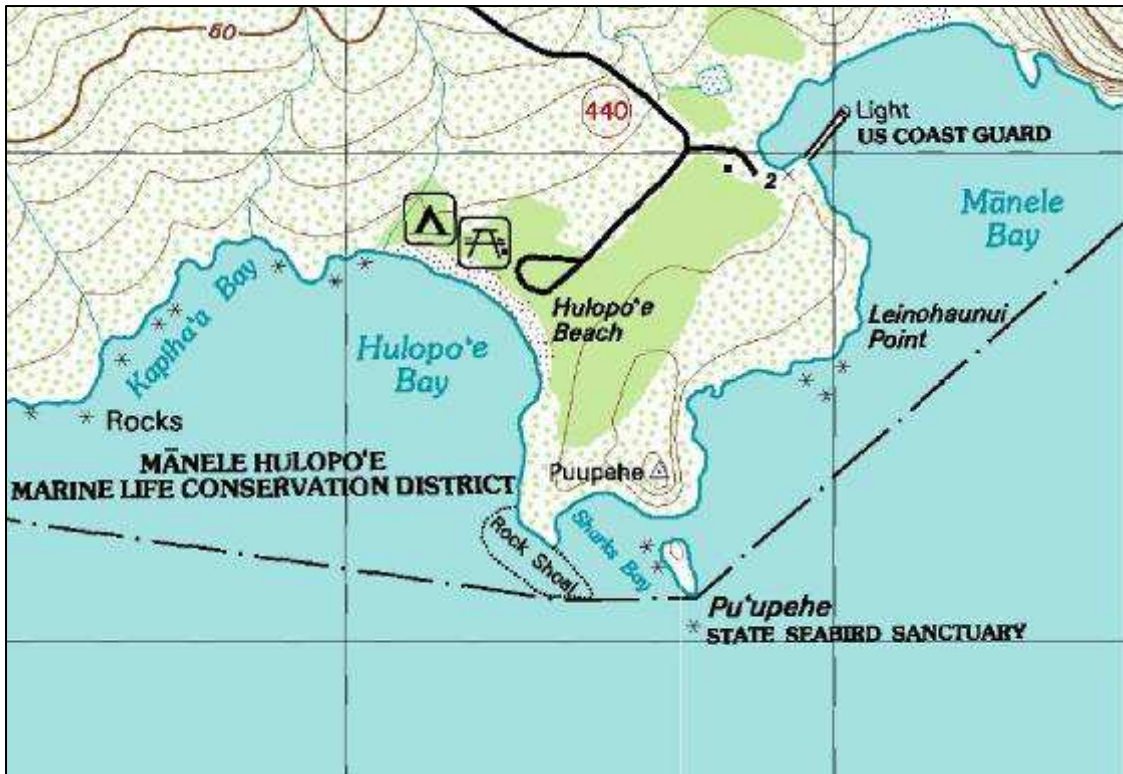


Figure 42. Puu Pehe Islet map.

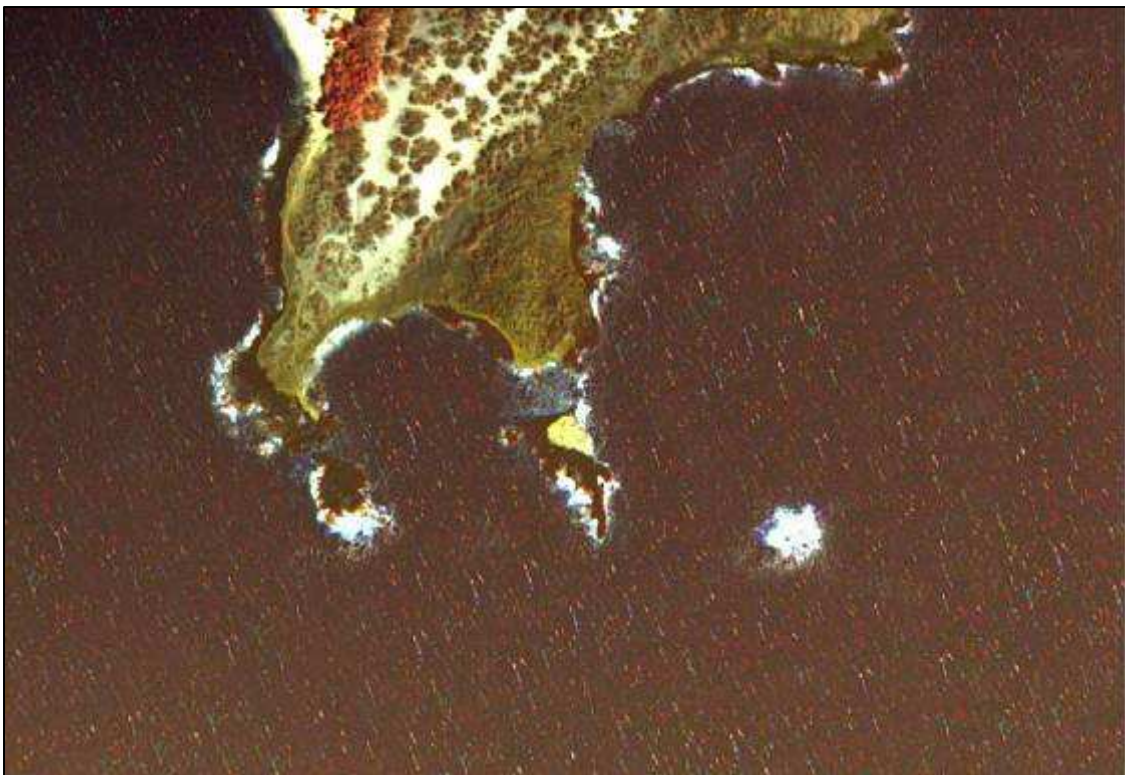


Figure 43. Puu Pehe Islet orthophoto.



Figure 44. Heiau, ilima (*Sida fallax*) shrubs, and buffel grass (*Cenchrus ciliaris*).



Figure 45. East slope with mixed non-native grasses (*Cenchrus ciliaris* and *Cenchrus echinatus*) and ilima (*Sida fallax*) shrubs.



Figure 46. Ilima and non-native grasses on east slope. Ilima seedlings in foreground.

Puu Pehe



Figure 47. Rock piles on top flat section of Puu Pehe Islet with ilima and non-native grasses.



Figure 48. Lamb's quarters (*Chenopodium murale*) and ilima with wedge-tailed shearwater burrows in cracks under large basalt rock layers.

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