OAHU OFFSHORE ISLETS BOTANICAL SURVEY

Prepared for:
Hawaii State Department of Land and Natural Resources
and Offshore Islet Restoration Committee

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INTRODUCTION

The offshore islets on Oahu's eastern side are comprised of several small calcareous islands, tuff cones, and lava cones. These predator free isles, part of the Hawaii State Seabird Sanctuary, provide refuge for numerous seabirds and native coastal plants. The islets offer a unique opportunity for restoration due to their isolation, small size, and harsh oceanic conditions. Conservation techniques applied by wildlife managers include removing non-native vegetation, trapping predators, and reintroducing native plants. To help guide these activities and gain knowledge of the current state of the flora, botanical surveys were done from Feb. 22, 2005 through Feb. 25, 2005, from April 18, 2005 through April 20, 2005, and on Feb. 28, 2006 by Forest Starr and Kim Starr (USGS). We were accompanied by Dave Smith (DLNR), Sheldon Plentovich (UH), and Ethan Shiinoki (DLNR). In 2006, we were also accompanied by Jaap Eijzenga (UH), Heather Eijzenga (UH), Roger Helm (FWS), David Preston (BISH), and Eric VanderWerf (FWS). Maya LeGrande (OIRC) assisted with logistics.

The following report includes a description of the flora. A species checklist provides information on presence and abundance for plants observed. For each islet is a brief description with notes on vegetation trends, threats, and restoration opportunities. An annotated checklist of the vascular plant species for each islet details the current distribution observed during this survey, historical collections and observations, and recommendations for control and restoration. Also included for each islet are maps and photos showing general vegetation types. Additional photos can be viewed at: http://www.hear.org/starr/naturalareas.

METHODOLOGY

Our goal was to make a list of plants present on the islets, describe their relative abundance, and highlight threats and restoration opportunities. Due to previous wet winters, the islets were green and it was a good time to search for plants and see the area at a maximum biomass state. The lack of birds at this time of year also helped by allowing a full survey without disturbing the birds. Prior to the field work, we conducted literature searches and checked Bishop Museum's and Smithsonian Institute's online herbariums for historical records of plants known from the offshore islets of Oahu. Plants specimens collected during this survey will be deposited at Bishop Museum. With the exception of Mokuauia which we waded to, and Moku Manu which we landed on with a helicopter, most islets were approached by boat. It took several hours to a full day to survey each islet. We did walk through surveys noting plant species present and their relative abundance. For several small islets (Kihewamoku, Pulemoku, Kukuihoolua, and Mokualai), we did helicopter fly by surveys where we hovered and searched for plants using binoculars.

RESULTS

During trips in February and April of 2005, we surveyed 10 islets (Mokuauia, Mokolii, Kapapa, Kekepa, Mokolea, Popoia, Mokulua North, Mokulua South, Manana, and Kaohikaipu). During surveys in February of 2006, we surveyed 5 islets (Kihewamoku, Pulemoku, Kukuihoolua, Mokualai, and Moku Manu). During our survey, we recorded the presence and abundance of 38 native and 93 non-native plant species. We made 246

plant collections (112 during the February 2005 surveys, 120 during the April 2005 surveys, and 14 during February 2006 surveys). 151 of these had not been previously collected and represent new islet records. While surveying the islets, we took 2,124 digital photos. The images and results can be viewed at www.hear.org/starr.

Table 1. Total number of plants by islet.

TOTALS	Kihewamoku	Mokuauia	Pulemoku	Kukuihoolua	Mokualai	Mokolii	Kapapa	Kekepa	Moku Manu North	Moku Manu South	Mokolea	Popoia	Mokulua North	Mokulua South	Manana	Kaohikaipu
Total (this survey)	0	52	0	1	1	72	41	13	3	14	4	29	37	42	42	32
Native #	0	16	0	1	1	20	15	9	2	5	2	15	17	18	11	15
Native %	0%	31%	0%	100%	100%	28%	37%	69%	67%	36%	50%	52%	46%	43%	26%	47%
Alien #	0	36	0	0	0	52	26	4	1	9	2	14	20	24	31	17
Alien %	0%	69%	0%	0%	0%	72%	63%	31%	33%	64%	50%	48%	54%	57%	74%	53%

Native Plants

Mokolii had the highest number of native plant species (20), followed by Mokulua south (18), Mokulua North (17), Mokuauia (16), Kapapa (15), Popoia (15), Kaohikaipu (15), Manana (11), Kekepa (9), Moku Manu (south) (5), Moku Manu (north) (2), Mokolea (2), Mokualai (1), and Kukuihoolua (1). The top eight islets with the highest percentage of native plant species include Kukuihoolua (100%), Mokualai (100%), Kekepa (69%), Moku Manu (north) (67%), Popoia (52%), Mokolea (50%), Kaohikaipu (47%), and Mokulua north (46%). However, this is merely a tally of number of species and does not necessarily show which islets had the most native cover. Islets which were predominantly comprised of native plants, or were in a more pristine state, include Kekepa, Moku Manu, Popoia, and Kaohikaipu. A few interesting new native plants found include akoko (*Chamaesyce degeneri*) on Kekepa, maia pilo (*Capparis sandwichiana*) on Mokolii, and the largest known stand of nohu in the main Hawaiian Islands on Moku Manu.

We found that most of the smaller islets that were more exposed to the harsh salt spray and conditions of the surrounding ocean were predominantly comprised of native plants. Native plant species were generally most abundant on windward sides of the islets where they have a competitive advantage due to harsh salt spray and windy conditions. These areas may be treated as special ecological areas and could be focus points for removing weeds and enhancing native plants. Restoration could start in these predominantly native areas and work towards weedier areas. Many of the management recommendations we suggest in this paper are drawn from the Laysan restoration plan created by Morin and Conant (1998). A more detailed restoration plan, further following the Laysan plan,

could be created for each islet. A non-technical pictorial guide of plants found on the Oahu offshore islets that is intended to assist future workers in identification and management of the plants can be found at www.hear.org/starr.

Non-native plants

Mokolii had the highest number of non-native plants (52), followed by Mokuauia (36), Manana (31), Kapapa (26), Mokulua south (24), Mokulua north (20), Kaohikaipu (17), Popoia (14), Moku Manu (south) (9), Kekepa (4), Mokolea (2), Moku Manu (north) (1), Mokualai (0), and Kukuihoolua (0). The top six islets with the highest percentage of non-native plant species include Manana (74%), Mokolii (72%), Mokuauia (69%), Moku Manu (south) (64%), Kapapa (63%), and Mokulua south (57%). However, this is merely a tally of number of species and does not necessarily show which islets had the most non-native cover. Islets which were comprised of non-native plants, or were more weedy, include Mokolii, Mokuauia, Manana, Mokulua north, Mokulua south, and Kapapa. However, even these more weedy islets still retained areas which were mostly native. A few weeds are restricted to certain areas and provide opportunities for removal before they become more widespread. For instance, both golden crown beard (*Verbesina encelioides*) and spiny achyranthes (*Achyranthes aspera*) are restricted to the southern end of the islet chain on the islets of Manana and Kaohikaipu. Some of the highlights for new non-native plants include: ivy gourd (*Coccinia grandis*) on Manana and Popoia; Golden crown beard and sandbur (*Cenchrus echinatus*) on Manana; button mangrove (*Conocarpus erectus*) on Popoia; sandbur on Moku Manu, and New Zealand spinach (*Tetragonia tetragonioides*) on several islets.

We found that leeward sides of islets, areas that faced the main island of Oahu, tended to be weedier than the windward sides of the islets that face out to sea. In addition, areas of high human use, such as landings and trails, tended to have higher concentrations of weeds and were often where weeds new to the islets were found. Several non-native plant species were found in limited numbers and were removed when possible. Several other weeds found in limited distribution could be removed in a similar fashion before they become widespread. Removing weeds early keeps control costs down and adds to the feasibility of successful control. Detecting new incipient weeds in the future could be enhanced with a "have you seen these plants" campaign which would enlist workers and visitors in weed detection.

ITINERARY

Feb. 22, 2005	Mokuauia
Feb. 23, 2005	Mokolea
Feb. 23, 2005	Popoia
Feb. 23, 2005	Mokulua South
Feb. 24, 2005	Kaohikaipu
Feb. 24, 2005	Mokulua North
Feb. 25, 2005	Manana
Apr. 18, 2005	Kekepa
Apr. 18, 2005	Kapapa
Apr. 19, 2005	Mokolii
Feb. 28, 2006	Moku Manu
Feb. 28, 2006	Mokualai
Feb. 28, 2006	Kukuihoolua
Feb. 28, 2006	Kihewamoku
Feb. 28, 2006	Pulemoku

The islets are presented here in order from North to South.

Figure 1. Oahu offshore islets map.

Table 2. Oahu offshore islets plant checklist.

Scientific name	Common name	Kihewamoku	Mokuauia	Pulemoku	Kukuihoolua	Mokualai	Mokolii	Kapapa	Kekepa	Moku Manu North	Moku Manu South	Mokolea	Popoia	Mokulua North	Mokulua South	Manana	Kaohikaipu
Acacia farnesiana	Klu	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Achyranthes aspera	Achyranthes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O/C	R
Ageratum conyzoides	Ageratum	-	-	-	-	-	R	-	-	-	-	-	-	X	-	O	-
Aloe vera	Aloe	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-
Alternanthera pungens	Khaki weed	-	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-
Alysicarpus vaginalis	Alyce clover	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	
Amaranthus spinosus	Spiny amaranth	-	R	-	-	-	-	-	-	-	-	-	-	-	-	C	-
Amaranthus viridis	Slender amaranth	-	-	-	-	-	-	-	-	-	C	-	-	-	-	O	-
Anagallis arvensis	Scarlet pimpernel	-	R	-	-	-	R	-	-	-	-	-	-	-	-	X	-
Argemone glauca	Pua kala	-	-	-	-	-	-	-	-	X	-	-	-	O	U	O	O
Asystasia gangetica	Chinese violet	-	C	-	-	-	-	-	O/C	-	-	-	C	-	-	-	-
Atriplex semibaccata	Australian saltbush	-	O	-	-	-	-	-	-	-	X	-	-	R/O	-	X	R
Atriplex suberecta	Saltbush	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bacopa monnieri	Aeae	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Batis maritima	Pickle weed	-	-	-	-	-	-	R	-	-	-	-	U	-	-	-	-
Bidens alba var. *radiata*	Spanish needles	-	O	-	-	-	C	R	R	-	-	-	-	C/D	O/C	-	-
Bidens pilosa	Spanish needles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Boerhavia coccinea	Boerhavia	-	R/O	-	-	-	R	-	-	-	-	-	-	R/O	U	O	-
Boerhavia glabrata	Alena	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	
Boerhavia repens	Alena	-	C/D	-	-	-	O	C/D	O	-	R	-	C	O/C	O/C	C/O	O
Bothriochloa pertusa	Pitted beard grass	-	-	-	-	-	-	-	-	-	-		-	-	O	-	-
Bougainvillea sp.	Bougainvillea	-	-	-	-	-	U	-	-	-	-	-	-	-	-	-	-
Canavalia sericea	Silky jackbean	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capparis sandwichiana	Maiapilo	-	-	-	-	-	R	-	O	-	-	-	O/C	-	-	-	-
Carica papaya	Papaya	-	X	-	-	-	-	-	-	-	-	-	R	-	-	-	-
Casuarina equisetifolia	Ironwood	-	C	-	-	-	-	D	-	-	-	-	R	-	R	-	-
Casuarina glauca	Longleaf ironwood	-	-	-	-	-	-	D	-	-	-	-	-	X	O	-	X
Cenchrus ciliaris	Buffel grass	-	-	-	-	-	-	-	-	-	R	-	-	-	U	D	R
Cenchrus echinatus	Sand bur	-	R	-	-	-	R	R	R	-	O	-	U	C/D	D	R	O
Centella asiatica	Asiatic pennywort	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Chamaecrista nictitans	Partridge pea	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Chamaesyce celastroides var. *amplectens*	Akoko	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Chamaesyce degeneri	Akoko	-	-	-	-	-	-	-	O	-	-	-	-	-	X	-	-
Chamaesyce hirta	Hairy spurge	-	-	-	-	-	X	-	-	-	-	-	-	X	U	R	-
Chamaesyce kuwaleana	Akoko	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Chamaesyce hypericifolia	Graceful spurge	-	R/O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chamaesyce prostrata	Prostrate spurge	-	X	-	-	-	-	X	-	-	-	-	-	-	-	X	-
Chamaesyce sp.	Spurge	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Chenopodium murale	Lambs quarters	-	R	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Chenopodium oahuense	Aweoweo	-	O	-	-	-	R	R	-	D	D	-	C	O	R	O	X
Chloris barbata	Swollen fingergrass	-	-	-	-	-	C	R	-	-	R	-	X	D	D	C	C

X = Previously observed U = Uncommon R = Rare O = Occasional C = Common D = Dominant
- = Not observed _ = No collection

Scientific name	Common name	Kihewamoku	Mokuauia	Pulemoku	Kukuihoolua	Mokualai	Mokolii	Kapapa	Kekepa	Moku Manu North	Moku Manu South	Mokolea	Popoia	Mokulua North	Mokulua South	Manana	Kaohikaipu
Chloris gayana	Rhodes grass	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Christella sp.	Wood fern	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Chrysopogon aciculatus	Golden beardgrass	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-
Coccinia grandis	Ivy gourd	-	C	-	-	-	O	-	-	-	-	-	R/U	-	-	R	-
Coccoloba uvifera	Seagrape	-	C	-	-	-	-	R	-	-	-	-	-	-	-	-	-
Cocos nucifera	Coconut	-	R	-	-	-	R	R	-	-	-	-	-	-	-	R	-
Conocarpus erectus	Button mangrove	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-
Conyza bonariensis	Hairy horseweed	-	R	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Cordia subcordata	Kou	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Coronopus didymus	Swinecress	-	R	-	-	-	-	-	-	-	-	-	R/U	-	-	-	-
Crinum asiatica	Spider lily	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crotolaria incana	Fuzzy rattlepod	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Cucurbita pepo	Cucurbita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Cuscuta sandwichiana	Kaunaoa	-	X	-	-	-	-	R	-	-	-	-	X	-	-	-	X
Cyanthillium [*Vernonia*] *cinera*	Little ironweed	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Cynodon dactylon	Bermuda grass	-	O	-	-	-	X	O	X	-	-	-	X	C/D	-	O	X
Cyperus javanicus	Ahu awa	-	-	-	-	-	C	-	-	-	-	-	-	-	-	X	-
Cyperus sp.	Sedge	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Dactyloctenium aegyptium	Beach wiregrass	-	-	-	-	-	R	-	-	-	-	-	-	O/C	R/O	O	O
Desmodium incanum	Spanish clover	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Desmodium triflorum	Tick clover	-	-	-	-	-	O	-	-	-	-	-	-	X	X	-	-
Digitaria ciliaris	Henry's crabgrass	-	-	-	-	-	C	-	-	-	X	-	-	R/O	R	-	-
Digitaria insularis	Sourgrass	-	R	-	-	-	D	R	-	-	R	-	X	O	U	R	X
Digitaria setigera	Itchy crabgrass	-	-	-	-	-	O	-	-	-	-	-	-	R	-	-	-
Echinochloa colona	Jungle rice	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-
Eclipta prostrata	False daisy	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eleusine indica	Wiregrass	-	O	-	-	-	O	R/O	-	X	O/C	-	U	C	-	R/O	R
Emilia fosbergii	Pualele	-	X	-	-	-	O	O	-	-	-	-	-	R	R/O	O	R
Emilia sonchifolia var. *javanica*	Flora's paintbrush	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eragrostis amabilis	Lovegrass	-	-	-	-	-	-	R/O	-	-	-	-	-	-	-	X	-
Eragrostis ciliaris	Eragrostis	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Eragrostis variabilis	Emoloa, kawelu	-	R	-	-	-	-	X	-	-	-	-	-	C	R	R	-
Erigeron bellioides	Fleabane	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	
Fimbristylis cymosa	Button sedge	-	O	-	-	-	R	R	X	-	-	-	X	X	X	X	O
Gamochaeta pupurea	Purple cudweed	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Halophila hawaiiana	Halophila	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heliotropium anomalum var. *argenteum*	Hinahina	-	-	-	-	-	-	O	C	-	-	-	O	X	X	-	X
Heliotropium curassavicum	Nena	-	R/O	-	-	-	O	-	-	-	X	-	R	R	O	R	R
Heliotropium procumbens	Heliotrope	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Heteropogon contortus	Pili grass	-	-				C	-	-			-	-	R	R	X	-
Heterotheca grandiflora	Telegraph weed	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hibiscus tiliaceus	Hau	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	R
Indigofera suffruticosa	Indigo	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Ipomoea cairica	Koali ai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O/C
Ipomoea indica	Koali awa	-	X	-	-	-	R	O	-	-	-	-	O/C	-	-	-	R
Ipomoea littoralis	Morning glory	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Ipomoea pes-caprae subsp. *brasiliensis*	Pohuehue	-	O	-	-	-	O	X	-	-	-	-	-	X	R	O	X
Ipomoea sp.	Morning glory	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Jacquemontia ovalifolia subsp. *sandwicensis*	Pau o hiiaka	-	D	-	-	-	R/O	D	-	-	-	-	X	C	O	-	D
Lantana camara	Lantana	-	R/O	-	-	-	D	X	-	-	-	-	-	R	X	-	X
Lepidium bidentatum var. *o-waihiense*	Anaunau	-	-	-	-	-	-	X	-	-	-	-	-	X	X	-	-
Leucaena leucocephala	Haole koa	-	-	-	-	-	R	X	-	-	-	-	U	O	O/C	R	R
Lipochaeta integrifolia	Nehe	-	X	-	-	-	-	X	-	-	-	-	X	O	R	-	O/C
Lycium sandwicense	Ohelo kai	-	O	-	-	-	R	C	D	-	R	O/C	C	O	O	-	R
Macroptilium lathyroides	Cow pea	-	-	-	-	-	O	-	-	-	-	-	-	X	X	-	-
Malvastrum coromandelianum	Malvastrum	-	R	-	-	-	R	-	-	-	-	-	X	X	-	-	-
Melinis repens	Natal red top	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Merremia aegyptia	Hairy morning glory	-	-	-	-	-	-	-	-	-	-	-	-	R	R	O	-
Mimosa pudica	Sensitive plant	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Mucuna gigantea	Sea bean	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myoporum sandwicense	Naio	-	-	-	-	-	-	-	-	-	X	-	-	O	R	-	-
Nephrolepis sp.	Sword fern	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Nicotiana tabacum	Tobaco	-	R	-	-	-	R	-	-	-	-	-	-	-	-	O	-
Opuntia ficus-indica	Panini	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Oxalis corniculata	Yellow wood sorrel	-	X	-	-	-	R	-	-	-	-	-	-	R	X	-	-
Pandanus tectorius	Hala	-	X	-	-	-	-	-	-	-	-	-	-	-		-	-
Panicum faurei	Panicum	-	-	-	-	-	X	-	-	-	-	-	X	X	X	-	-
Panicum faurei subsp. *carteri*	Carter's panic grass	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Panicum maximum	Guinea grass	-	-	-	-	-	R	-	-	-	-	-	-	-	-		-
Panicum torridum	Kakonakona	-	-	-	-	-	-	-	-	-	X	-	-	X	-	X	-
Paspalum scorbiculatum	Ricegrass	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Paspalum vaginatum	Paspalum	-	R	-	-	-	-	O	-	-	-	R	U/O	R	U	-	-
Passiflora foetida	Love-in-a-mist	-	C/D	-	-	-	R	-	-	-	-	-	X	X	O/C	-	-
Passiflora suberosa	Huehue haole	-	R/O	-	-	-	O	X	-	-	-	-	-	-	R	O	O
Pennisetum clandestinum	Kikuyu grass	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Phyllanthus debilis	Phyllanthus	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Phymatosorus grossus	Lauae	-	X	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Physallis angulata	Smooth poha	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physallis peruviana	Cape gooseberry	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pithecellobium dulce	Manilla tamarind	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-

X = Previously observed U = Uncommon R = Rare O = Occasional C = Common D = Dominant
- = Not observed _ = No collection

Scientific name	Common name	Kihewamoku	Mokuauia	Pulemoku	Kukuihoolua	Mokualai	Mokolii	Kapapa	Kekepa	Moku Manu North	Moku Manu South	Mokolea	Popoia	Mokulua North	Mokulua South	Manana	Kaohikaipu
Plantago major	Common plantain	-	X				-	-	-			-	-	-	-	-	-
Plectranthus parviflorus	Alaalawainui wahine	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Pluchea carolinensis	Sourbush	-	O	-	-	-	O	O	-	-	-	-	X	-	-	R	-
Pluchea indica	Indian fleabane	-	R	-	-	-	C	O	-	-	-	-	X	X	-	R	-
Pluchea xfosbergii	Hybrid pluchea	-	R	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Portulaca lutea	Ihi	-	X	-	-	-	X	C	C	X	-	-	O/C	-	X	-	X
Portulaca oleracea	Pigweed	-	C	-	-	-	R	O	-	O/C	C	R/O	O	O/C	O	O	O
Portulaca pilosa	Portulaca	-	-	-	-	-	-	O	-	-	-	-	-	-	-	-	O
Portulaca villosa	Ihi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Prosopis pallida	Kiawe	-	-	-	-	-	-	-	-	-	-	-	-	R	-	R	-
Psidium guajava	Guava	-	X	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Psilotum nudum	Moa	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	
Reichardia picroides	Reichardia	-	-	-	-	-	-	X	-	-	-	-	-	-	-	O	X
Reichardia tingitana	Reichardia	-	-	-	-	-	-	-	-	-	-		-	-	X	-	-
Rhizophora mangle	Mangrove	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Rivina humilis	Coralberry	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scaevola taccada	Naupaka	-	D	-	-	-	O	O	O	-	-	-	O	C	O/C	O	O/C
Schefflera actinophylla	Octopus tree	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Schinus terebinthifolius	Christmasberry	-	-	-	-	-	D	-	-	-	-	-	-	-	-	-	-
Sesbania tomentosa	Ohai	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	X
Sesuvium portulacastrum	Akulikuli	-	D	-	D	D	O	C/D	C	-	O	O	D	O	O/C	O	O/C
Setaria verticillata	Bristly foxtail	-	-	-	-	-	-	-	-	-	O	-	X	X	-	O	R/O
Sida fallax	Ilima	-	C	-	-	-	C	D	D	X	X	-	U	C/D	O/C	X	D
Sidastrum micranthum	Sidastrum	-	-	-	-	-	-	R	-		-	-	-	-	-	-	-
Solanum americanum	Popolo	-	O	-	-	-	O	R	-	X	X	-	O	X	-	O	O
Solanum lycopersicon var. *crasiforme*	Tomato	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X	-
Sonchus oleraceus	Sow thistle	-	O	-	-	-	R	O	R	-	O	-	O	C	O	C	C
Sphagneticola trilobata	Wedelia	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Sporobolus indicus	Rat tail	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Sporobolus pyramidatus	Dropseed	-	-	-	-	-	R	R	-	-	-	-	-	-	-	-	R/O
Sporobolus virginicus	Akiaki	-	C	-	-	-	-	C	-	-	X	-	O	O	U	-	C
Stacytarpheta dichotoma	Vervain	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Stachytarpheta jamaicensis	Jamaica vervain	-	--	-	-	-	C	O	-	-	-	-	-	X	R	-	-
Stachytarpheta sp.	Vervain	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stachytarpheta urticifolia	Vervain	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-
Stapelia gigantea	Zulu giant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R/O	-
Tephrosia pupurea var. *purpurea*	Tephrosia	-	-	-	-	-	O	-	-	-	-	-	-	-	-	X	-
Terminalia catappa	False kamani	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-	-
Tetragonia tetragonioides	New Zealand spinach	-	R	-	-	-	-	O	-	-	-	-	-	-	R	R	-
Thespesia populnea	Milo	-	O	-	-	-	-	O	-	-	-	-	O	-	-	-	X
Tournefortia argentea	Beach heliotrope	-	C	-	-	-	O	C	-	-	-	-	U	-	-	-	R
Trianthema portulacastrum	Trianthema	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-

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Scientific name	Common name	Kihewamoku	Mokuauia	Pulemoku	Kukuihoolua	Mokualai	Mokolii	Kapapa	Kekepa	Moku Manu North	Moku Manu South	Mokolea	Popoia	Mokulua North	Mokulua South	Manana	Kaohikaipu
Tribulus cistoides	Nohu	-	-	-	-	-	-	-	-	D	D	-	R	R	R/O	R	-
Tridax procumbens	Coat buttons	-	-	-	-	-	-	-	-	-	-	-	-	R/O	U	O	-
Verbesina encelioides	Golden crown-beard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D	O
Vigna marina	Beach pea	-	R/O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vigna o-wahuensis	Vigna	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
Vitex rotundifolia	Pohinahina	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-
Waltheria indica	Uhaloa	-	-	-	-	-	R	-	-	-	-	-	-	R	R	R	-

X = Previously observed U = Uncommon R = Rare O = Occasional C = Common D = Dominant
- = Not observed _ = No collection

KIHEWAMOKU

Figure 2. Kihewamoku islet.

Overview
Kihewamoku islet is located in Malaekahana Bay, north of Mokuauia islet. It is a small calcareous islet, approximately <1 acre in size and reaches a height of about 10 ft. On Feb. 28, 2006, we did a helicopter fly by survey and searched for plants using binoculars. The small islet appears to be washed over occasionally by the ocean. No plants were observed during our survey.

Vegetation
We did not observe any vegetation on Kihewamoku during our survey. Waves were occasionally washing over the islet and deposits of salt were observed in small pockets of the rock. The environment is likely too harsh to support plant life.

Threats
Though open to the public, the landing is rough and the islet is fairly remote with rough seas surrounding it, limiting potential threats.

Restoration
With no vegetation present, no restoration recommendations for plants are given at this time. Perhaps future surveys could land on the islet to confirm the lack of vegetation.

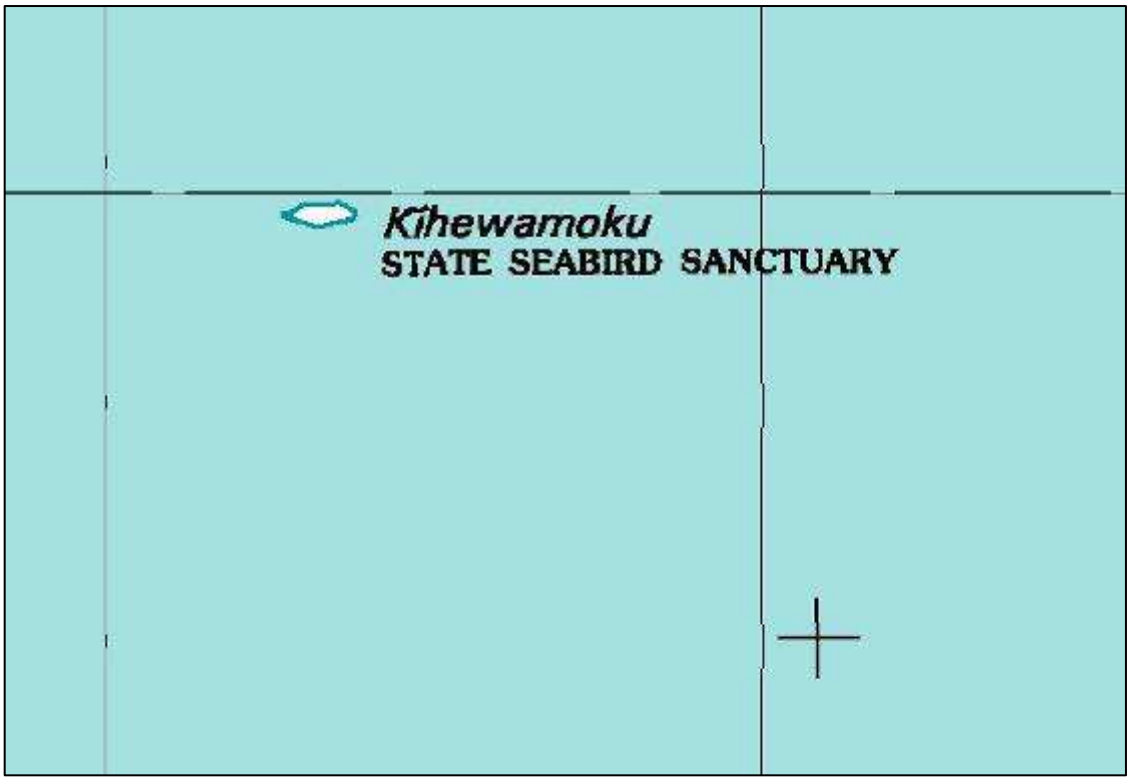

Figure 3. Kihewamoku map.

Figure 4. Kihewamoku orthophoto.

Figure 5. Kihewamoku islet with no plants present and wave washed surfaces.

MOKUAUIA

Figure 6. Mokuauia islet.

Overview

Mokuauia (Goat Island) is located in Laie Bay, Oahu, just offshore from Malaekahana Beach Park. Mokuauia is a calcareous islet, approximately 13 acres in size, reaching 10-15 ft. elevation (OIRC, 2005). A botanical survey of Mokuauia was done on Feb. 22, 2005. We waded over from Malaekahana Beach Park to the islet in the morning and did walk through surveys until the end of the day. Mokuauia is a long flat coralline islet with several arms that branch off a central area. There are several beaches along the coast which are interspersed with raised limestone. The islet is accessible to the public who are restricted to beaches and coastal trails. Most of the islet is composed of native coastal herb and shrublands with non-natives found mostly in the central and southwestern portions of the islet.

Vegetation

The islet's vegetation is made up of a mix of native herblands (*Boerhavia repens*, *Sesuvium portulacastrum*, *Jacquemontia ovalifolia* subsp. *sandwicensis*), naupaka (*Scaevola taccada*) shrublands on the northeastern side, and forested areas of sea grape (*Coccoloba uvifera*) and ironwood (*Casuarina equisetifolia*) in the central and western parts of the islet. Native vegetation dominates in saltier more windward areas with weedier sections near the central forested area. Many parts of the islet are bare, due to high surf. There are concentric zones of vegetation away from salt spray areas with akiaki (*Sporobolus virginicus*) along the coast, then *Sesuvium portulacastrum*, followed by *Boerhavia repens*, and ilima (*Sida fallax*) towards the inland. The ocean appears to

wash over the near shore areas and the effects of the harsh salt spray are observed as several of the ironwood and beach heliotrope (*Tournefortia argentea*) along the west and east side beaches appeared dead. During this survey, we found a total of 52 plant species. There were 16 (31%) native species and 36 (69%) non-native species. Though the non-native plants outnumber native species, the cover on the islet is predominantly native, especially on the windward side, with the non-natives mostly restricted to the southwestern and central portions. We collected 27 plant species for archival at Bishop Museum.

Threats

Threats to the native vegetation include competition from aggressive non-native weeds and trampling by humans. Trampling is currently minimized by designated paths and signage. Aggressive weeds include trees such as sea grape (*Coccoloba uvifera*) and ironwood (*Casuarina equisetifolia*); shrubs such as *Pluchea* spp. and *Lantana camara*; vines and groundcovers such as ivy gourd (*Coccinia grandis*), Chinese violet (*Asystasia gangetica*), non-native passion vines (*Passiflora suberosa* and *P. foetida*); and grasses such as sandbur (*Cenchrus echinatus*) and Bermuda grass (*Cynodon dactylon*). Most of the more widespread species could be removed with persistent efforts. There are a few incipient weeds such as spiny amaranth (*Amaranthus spinosus*), sandbur (*Cenchrus echinatus*), lantana (*Lantana camara*), *Pluchea* spp., and coral berry (*Rivina humilis*) that are limited in distribution and could be controlled now before they become widespread. Target incipient weeds could be included in a "have you seen these plants on Mokuauia Islet" poster which enlists workers, volunteers, and community members who frequently visit the islet in identification and detection efforts. Non-native birds including red-vented bulbuls (*Pycnonotus cafer*) and red crested cardinals (*Paroaria coronata*) were observed perching in ironwood and sea grape trees. These fruit eating birds are likely spreading invasive weeds such as ivy gourd. Removing the trees may decrease spread of these weeds by eliminating habitat for the birds. Areas and edges near the trees were extra weedy. Mosquitoes were observed only under the dense shade of the sea grape trees. There are a fair number of stumps exposed on the west beach, suggesting an eroding coastline. The coastline beach on the east side appears to be more stable with no roots exposed. Ants are known from the islet, including big headed ants (*Pheidole megacephala*), which were recently removed during an eradication trial (Sheldon Plentovich, *pers. comm.*), and fire ants (*Solenopsis geminata*), which were observed and felt near the landing during this survey.

Restoration

There are numerous native plants existing on the islet, especially in high salt spray areas such as the northeast side of the islet. Weeding could start in these areas and work inwards towards more weedier sections, such as the central area. Invasive plant species could be removed. Native plants once known from the islet that are no longer found, including nehe (*Lipochaeta integrifolia*) and ihi (*Portulaca lutea*), could be re-introduced. For propagation purposes, plants from nearby islets would be preferable, followed by plants from the main island of Oahu. If desired, rare native coastal plants suitable to the area that are not present, such as ohai (*Sesbania tomentosa*), hinahina (*Heliotropium anomalum* var. *argenteum*), and others could be out-planted. Seeds of

existing plants, such as emoloa (*Eragrostis variabilis*) and aweoweo (*Chenopodium oahuense*) could be spread. There is an anchialine pond that could possibly provide habitat for native damselfly (*Megalagrion xanthomeles*) restoration.

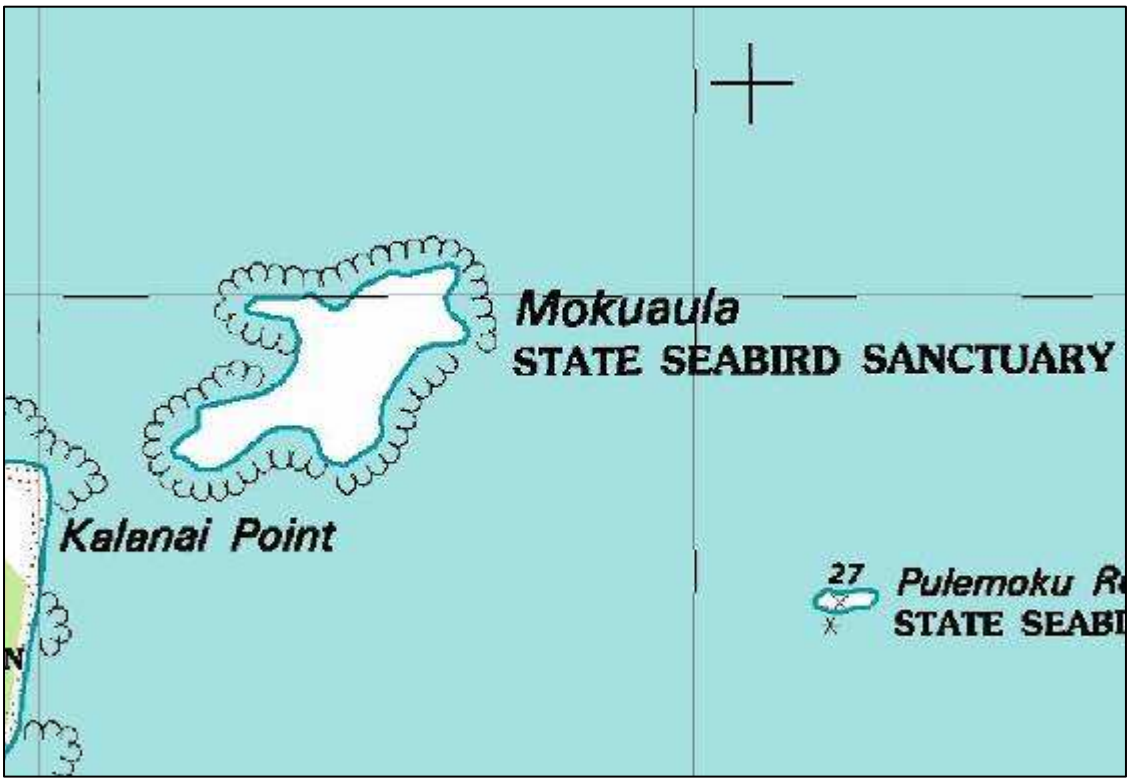

Figure 7. Mokuauia map.

Figure 8. Mokuauia orthophoto.

Figure 9. View of coastline with akiaki (*Sporobolus virginicus*) and pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*) strand vegetation.

Figure 10. Raised limestone with a mat of akulikuli (*Sesuvium portulacastrum*) and scattered ironwood (*Casuarina equisetifolia*) and beach heliotrope (*Tournefortia argentea*).

Figure 11. Akulikuli / alena (*Boerhavia repens*) herbland bordered by naupaka (*Scaevola taccada*) and milo (*Thespesia populnea*).

Figure 12. Raised limestone with scattered ironwood.

Annotated Plant List -- Mokuauia

***Amaranthus spinosus* -- Spiny amaranth -- (Amaranthaceae) -- Alien**

Rare. A single plant found near sea grape trees in central part of islet. First collected during this survey. This spiny plant could be hand pulled and bagged when found.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-12).

***Anagalis arvensis* -- Scarlet pimpernel -- (Primulaceae) -- Alien**

Rare. A couple small patches on southwest end. First collected by Neal in 1938. This diminutive herb is not the most aggressive invader, though it does get around, and could likely be hand-pulled.

19 Jun 1938, M.C. Neal (#s.n.), BISH 444360.

***Asystasia gangetica* -- Chinese violet -- (Acanthaceae) -- Alien**

Common in interior, especially the southwest end. Observed in 2002 by Le Grande. First collected during this survey. This colorful sprawling vine like plant has the ability to invade much of the interior of the islet. Small plants can be removed by hand pulling, making sure to get the main tap root. Larger infestations, and pesky tap roots, may require herbicide.

22 Feb. 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-24).

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

Occasional. Dozen or so patches scattered here and there. First collected by Neal in 1936. Can be distinguished from *A. suberecta* by fleshy fruit that turn red at maturity. Can be hand pulled.

26 Jul 1936, M.C. Neal (#s.n.), BISH 448830.

***Atriplex suberecta* -- Saltbush -- (Chenopodiaceae) -- Alien.**

Rare. A few patches in with *A. semibaccata*. First collected during this survey. Can be hand pulled.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-9).

***Bacopa monnieri* -- Aeae -- (Scrophulariaceae) -- Indigenous.**

Rare. One small patch on northeast part of islet. First collected by Fosberg in 1937 who noted, "very prostrate". Collected again in 1938 by Neal and Hartt. This species will likely come and go. It prefers moist areas. It can be propagated by cuttings. No actions recommended, other than routine monitoring.

4 Jul 1937, Fosberg, F.R. (#14148), Very prostrate, BISH 69570.

19 Jun 1938, Neal, M.C., Hartt, C. (#s.n.), BISH 445844, USNM 03031384.

***Bidens alba* var. *radiata* -- Spanish needle -- (Asteraceae) -- Alien**

Occasional patches across islet. Observed in 2002 by LeGrande. First collected during this survey. This species can be a challenge to control. Hand pulling or spraying the plants before they seed is crucial to getting ahead of this species.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-20).

***Boerhavia coccinea* -- Boerhavia -- (Nyctaginaceae) -- Alien**

Rare to occasional. A couple plants found on margins of sea grape trees. First collected during this survey. Can be hand pulled, though stubborn taproots may require herbicide.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-11).

***Boerhavia repens* -- Alena -- (Nyctaginaceae) -- Indigenous**
Common to dominant, mostly inland. Forming herblands with other species such as *Jacquemontia ovalifolia* subsp. *sandwicensis* on the northeast side and with *Sesuvium portulacastrum* elsewhere. Sometimes forming large pure mats. Occasionally found in coralline crevices near coast. Usually found just inland of akulikuli. First collected in 1937 by Fosberg. Collected again in 1938 by Neal, in 1967 by Brandow, and in 1977 by Corn. This species appears to be doing fine on Mokuauia. No actions recommended, other than routine monitoring.

4 Jul 1937, Fosberg, F.R., Egler, F.E. (# 14178), BISH 613437, USNM 03142046.
4 Jul 1937, Fosberg, F.R., Egler, F.E. (# 14179), USNM 03075609.
19 Jun 1938, Neal, M.C. (# s.n.), BISH 414351, 444355.
18 Apr 1967, Brandow, C.T. (#CB33), BISH 55930.
12 Nov.1977, Corn, C. (#s.n.), collected as *B. diffusa*, BISH 770397.

***Canavalia sericea* -- Silky jack bean -- (Convolvulaceae) -- Alien**
Not observed during this survey. First collected in 1938 by Neal.

19 Jun 1938, Neal, M.C. (# s.n.), BISH 414351, 414351.

***Carica papaya* -- Papaya -- (Caricaceae) -- Alien**
Not observed during this survey. Observed in 2002 by LeGrande. Food items such as papayas and tomatoes may pop up as people throw their lunches in the bushes. They can either be tolerated, as most will not persist long, or removed, so as not to encourage others to follow suit.

***Casuarina equisetifolia* -- Ironwood -- (Casuarinaceae) -- Alien**
Common. Trees on margins. A few seedlings. Some dead trees along beaches. First collected in 1937 by Fosberg. Collected again by Neal in 1938. Observed in 2002 by LeGrande. This aggressive tree has the ability to blanket most of Mokuauia. It is one of the main threats to native vegetation in sheer areas of coastal West Maui. However, in some bird refuges ironwood is an important tree for roosting and nesting, such as red-footed boobies (*Sula sula rubripes*) and frigates birds (*Fregata minor palmerstoni*). In this case though, these same native bird species are also shy of humans, and so will likely not colonize the heavily visited islet of Mokuauia. Some non-native fruit eating birds however are more tolerant of humans. Red-vented bulbuls (*Pycnonotus cafer*), red-crested cardinals (*Paroaria coronata*), and house sparrows (*Passer domesticus*) were observed roosting in ironwood trees on Mokuauia, and are likely spreading seeds of non-native plants such as ivy gourd (*Coccinia grandis*) from the nearby main island of Oahu. Perhaps if the ironwoods were removed, these non-native frugivores would not find Mokuauia as appealing. The only bird documented to breed on Mokuauia is the wedge-tailed shearwater (*Puffinus pacificus*), which nests on and in the ground, not in trees. The ironwood, and other non-native trees, such as sea grape (*Coccoloba uvifera*) and beach heliotrope (*Tournefortia argentea*), also appear to be tempering the harsh ocean and sun elements that would otherwise give the halophytic native plants in the center of the islet a competitive advantage. Removing the ironwood trees may allow the existing native plants to better compete, as they are doing on Popoia, requiring less maintenance to keep the islet flora tilted towards natives. Small ironwood trees can be hand-pulled. Large ironwood trees can be frilled in place, or cut down and stacked or removed, so as to

minimize seabird snags and perches for non-native frugivorous birds. More on removal of non-native trees from Mokuauia in *Coccoloba* and *Tournefortia* discussion.

4 Jul 1937, Fosberg, F.R., Egler, F.E. (#14160), , BISH 46727, USNM 02333243.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 445840.
16 May 1964, Long, C.R. (#1737), BISH 121957.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**
Rare. Two small patches were found on the southwestern side in a weedy area inland from the sign and beach. Plants were pulled and bagged. First collected by Neal in 1936. Collected again during this survey. This aggressive grass with spiny fruits could invade most of the inland portion of Mokuauia. It should be looked for during visits, and pulled and bagged when found.

26 Jul 1936, Neal, M. (# s.n.), BISH 448837.
22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-19).

***Centella asiatica* -- Marsh pennywort -- (Apiaceae) -- Alien**
Not observed during this survey. First and only collection by Fosberg in 1937. This creeping herb would likely not do well on Mokuauia.

4 Jul 1937, Fosberg, F.R. (# 14169), BISH 23397.

***Chamaesyce hypericifolia* -- Graceful spurge -- (Euphorbiaceae) -- Alien**
Rare to occasional. Scattered plants observed. First collected during this survey. This diminutive herb can be hand-pulled.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-18).

***Chamaesyce prostrata* -- Prostrate spurge -- (Euphorbiaceae) -- Alien**
Not observed during this survey. First collected by Neal in 1938. A common non-native herb. It could be hand pulled if found again, or could be tolerated as it can be tedious to control and doesn't really harm seabird nesting or push native plants aside.

19 Jun 1938, Neal, M.C. (#s.n.), BISH 444361.

***Chenopodium murale* -- Lamb's quarters -- (Chenopodiaceae) -- Alien**
Rare. One medium sized patch in center of islet. Observed in 2002 by LeGrande. First collected during this survey. This plant, though not the biggest bully, has an amazingly persistent seed bank. It can be hand-pulled, preferably before it sets seed.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-13).

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**
Occasional. A few patches here and there across the islet. First collected in 1936 by Neal. Observed in 2002 by LeGrande. Collected again during this survey. This species will likely spread on its own as non-native plants are removed. It will generally prefer the southern central part of the islet. Seeds could be spread in areas after non-natives are removed. This species seems to be doing fine on Mokuauia and no action seems necessary other than monitoring of status and distribution.

26 Jul 1936, Neal, M.C. (#s.n.), BISH 448836.
22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-21).

***Coccinia grandis* -- Ivy gourd -- (Cucurbitaceae) -- Alien**
Common. Crawling over vegetation, especially in center of islet, where it forms mats on the ground and climbs into dead ironwood trees. Observed in 2002 by LeGrande. First

collected during this survey. Both male and female flowers were observed. No fruit was observed. Plants are likely being transported from the main island of Oahu by bulbuls, cardinals, and other fruit eating birds that were observed perching in taller non-native trees such as sea grape (*Coccoloba*), beach heliotrope (*Tournefortia*), and ironwood (*Casuarina*). Removing the trees may help limit visitation by non-native birds and hence slow the introduction rate. Ivy gourd is best controlled with triclopyr using a basal bark herbicide method. Both introduced biological control agents, the beetle (*Asatopius coccinii*) and the moth (*Melittia oedipus*), were observed.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-26).

***Coccoloba uvifera* -- Sea grape -- (Polygonaceae) -- Alien**

Common. Large trees along center of islet, forming dense shady stands. A carpet of seedlings was found under and nearby some parent trees, in the same spot where akulikuli appeared to be dying back, presumably from shade. Mosquitoes were present in the dense shade under the sea grape groves. There appeared to be a line of weeds found around the margin of sea grape stands, perhaps utilizing the partial shade or bare ground. First collected by an unknown person in 1967. Collected again by Corn in 1977. Observed in 2002 by LeGrande. There are virtually no seabird species able to utilize the habitat created by sea grape. In addition, the dense shade precludes native plants and seems to promote mosquitoes, which can spread avian diseases. Given the present situation at Mokuauia, removal of these non-native trees seems to make sense. Small plants can be hand-pulled. Large plants can be frilled in place or chopped down and stacked or removed. More on removal of non-native trees from Mokuauia in *Casuarina* and *Tournefortia* discussion.

12 May 1967, Unknown collector (#s.n.), BISH 584751.
12 Nov.1977, Corn, C. (#s.n.), BISH 770471.

***Cocos nucifera* -- Coconut -- (Arecaceae) -- Polynesian**

Rare. One small tree which appeared to have been planted on eastern side of islet just inland of beach. Observed during this survey, was not collected. As with papaya, it could either be tolerated, or removed.

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

Rare. One plant found in central part of islet. First collected by Fosberg in 1937. Collected again in 1964 by Long. This species it not the most aggressive invader, but can become a pest in some situations. It can be hand pulled.

4 Jul 1937, Fosberg, F.R. (#14153), BISH 75139.
16 May 1964 , Long, C.R. (#1732), USNM 02658910.

***Coronopus didymus* -- Swinecress -- (Brassicaceae) -- Alien**

Rare. A few plants found in central western part of islet. First collected during this survey. This species can become widespread on islets such as Mokuauia. It could be hand pulled or sprayed when found. Follow up will likely be necessary due to a large seed set.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-3).

***Crinum asiaticum* -- Spider lily -- (Lilliaceae) -- Alien**

Occasional. A couple dozen plants in center of islet. Observed in 2002 by LeGrande. First collected during this survey. These plants don't provide much value to seabirds and displace native plants. Small plants can be hand pulled. Larger plants can be grubbed out.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-6).

***Cuscuta sandwichiana* -- Kaunaoa -- (Cuscutaceae) -- Endemic**

Not observed during this survey. First and only collection made in 1936 by Neal. This native parasitic vine could be re-introduced to Mokuauia. Its' preferred host is beach morning glory (*Ipomoea pes-caprae* subsp. *brasiliensis*), though it can grow on many other plant species.

26 Jul 1936, Neal, M.C. (#s.n.), BISH 448827.

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**

Occasional, especially in southwest center part of islet. First collected by Neal in 1936. Collected by Fosberg in 1937 who noted, "Dominant plant in certain areas, forming a dense m[sic]". Collected again by Neal in 1938. This grass could be controlled with foliar herbicide applications.

26 Jul 1936, Neal, M.C. (#s.n.), BISH 448838.
4 Jul 1937, Fosberg, F.R. (#14149), Dominant plant in certain areas, forming a dense m..., BISH 118448.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 444354.

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

Rare. A couple patches in the south central portion of the islet. First collected during this survey. This tall grass can become quite invasive. It can be hand pulled.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-16).

***Eclipta prostrata* [syn. *alba*] -- False daisy -- (Asteraceae) -- Alien**

Not observed during this survey. First collected by Fosberg in 1937. Collected again in 1938 by Neal. This creeping plant with small daisy like flowers prefers moist areas. It can become quite aggressive. Hand pulling sometimes is possible. Herbicide may be necessary in advanced infestations. We did not see *Eclipta* on any of the Oahu offshore islets.

4 Jul 1937, Fosberg, F.R. (#14150), BISH 75031.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 444359.

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**

Occasional patches. First collected during this survey. This ubiquitous grass can tolerate heavy traffic areas such as trails. It can usually be hand pulled.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-15).

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

Not observed during this survey. First collected by Fosberg in 1937. Collected again by Neal in 1938. This small herb with red flowers will occasionally pop up after rains. It generally only grows where other plants allow it to. It can be hand pulled.

4 Jul 1937, Fosberg, F.R. (#14152), BISH 75074.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 444364.

***Emilia sonchifolia* var. *javanica* -- Flora's paintbrush -- (Asteraceae) -- Alien**

Not observed during this survey. First collected in 1967. *E. sonchifolia*, with pale purple flowers, behaves just like *E. fosbergii*, showing up in open areas after rains.

12 May 1967, Unknown collector (#s.n.), BISH 584750.

***Eragrostis variabilis* -- Emoloa, Kawelu -- (Poaceae) -- Endemic**

Rare. One small patch in the south central part of islet, where it is growing in a mat of *Boerhavia repens*. First collected during this survey. This robust grass is a dominant on the low sand atolls of the Northwestern Hawaiian Islands, and provides good habitat for shearwater nesting. It would seemingly make sense to promote emoloa on Mokuauia. Seeds of this species could be sown in disturbance spots created during weed control efforts. It can also be propagated through divisions.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-7).

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**

Occasional. On exposed raised limestone on north part of islet. This tufted native sedge was first collected in 1937 by Fosberg. It was collected again in 1938 by Neal, in 1964 by Long who noted "northeast windward portion of island", and in 1977 by Corn. LeGrande observed this species in 2002. The subspecies level breakdown of *F. cymosa* has always seemed nebulous to us, with a range of plants showing characters of both subspecies. As Wagner et al. (1999) report, "At best, these are weak subspecies still in the process of differentiation". A genetic study of the different "subspecies" found on Oahu's offshore islets may help shed light on the taxonomy of this species. This species will pop up on its own in open areas, usually on hard exposed ground, or in cracks. Seeds could be scattered if more of this sedge was desired. However, this species seems to be doing fine on Mokuauia, and no actions are recommended other than regular monitoring.

Fimbristylis cymosa
16 May 1964, Long, C.R. (#1746), USNM 02659935.
12 Nov 1977, Corn, C. (#s.n.), BISH 666999.
Fimbristylis cymosa subsp. *umbellato-capitata*
9 Jun 1938, Neal, M.C. (#s.n.), BISH 444362.
4 Jul 1937, Fosberg, F.R. (#14157), BISH 10724.
16 May 1964, Long, C.R. (#1746), Northeast windward portion of island, BISH 51567.

***Halophila hawaiiana* -- Halophila-- (Hydrocharitaceae) -- Endemic**

Not observed during this survey. First observed in 2002 by LeGrande who noted the following. "The population of *Halophila hawaiiana* on Mokuauia is located in patches restricted to the sandy bottom of the northern facing bay. The population can found from about 2 to 10 meters off shore in 1 to 2 meters of water depth."

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**

Rare to occasional. On northeast end scattered in between akulikuli (*Sesuvium portulacastrum*). First collected in 1936 by Neal. Collected again in 1937 by Fosberg, in 1938 by Neal, and in 1977 by Corn. Observed in 2002 by LeGrande. This native glabrous herb colonizes disturbance spots. It will likely pop up in areas where weeds are removed. This species seems to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.

26 Jul 1936, Neal, M.C. (#s.n.), BISH 448832.
4 Jul 1937, Fosberg, F.R., Egler, F.E. (#14163) USNM 03308098.

19 Jun 1938, Neal, M.C. (#s.n.), BISH 444368.
12 Nov 1977, Corn, C. (#s.n.), BISH 495243.

***Heliotropium procumbens* -- Heliotrope -- (Boraginaceae) -- Alien**
Rare. One patch in center of islet. First collected during this survey. This decumbent herb, resembling some native *Heliotropium* species, is a common non-native element of Hawaiian coastal vegetation. It can be hand pulled.
22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-10).

***Heterotheca grandiflora* -- Telegraph weed -- (Asteraceae) -- Alien**
Not observed during this survey. First collected by Neal in 1938. A pest in some areas, Mokuauia is likely suboptimal for this species. It could be looked for during regular monitoring and hand pulled if found.
1 Aug 1938, Neal, M.C. (#s.n.), BISH 423403.

***Ipomoea indica*-- Koali awa -- (Convolvulaceae) -- Indigenous**
Not observed during this survey. First collected by Neal in 1936. This species would likely do well on Mokuauia. Koali awa, which still exists on Popoia, could be re-introduced through seeds or cuttings.
26 Jul 1936, Neal, M.C. (#s.n.), BISH 448833.

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) -- Indigenous**
Occasional. Common near east shore. First collected in 1937 by Fosberg and Egler. Collected again by Neal in 1938, and in 1964 by Long. Observed in 2002 by LeGrande. This species seems to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.
4 Jul 1937, Fosberg, F.R., Egler, F.E. (#14168), BISH 47438, USNM 02431422.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 414369.
16 May 1964, Long, C.R. (#1717) USNM 02659854.
16 May 1964, Long, C.R. (#1738), USNM 02659856.

***Jacquemontia ovalifolia* subsp. *sandwicensis* -- Pau o hiiaka -- (Convolvulaceae) -- Endemic**
Dominant in places, especially the northeast end where extensive mats are found. First collected by Fosberg and Egler in 1937. Collected again in 1964 by Long and in 1977 by Corn. Observed in 2002 by LeGrande. This species seems to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.
4 Jul 1937, Fosberg, F.R. (#14162), BISH 122033.
4 Jul 1937, Fosberg, F.R., Egler, F.E. (#14162, 1 of 2) USNM 02155859.
4 Jul 1937, Fosberg, F.R. (#14162, 2 of 2) USNM 02155860.
16 May 1964, Long, C.R. (#1734), USNM 02659908.
12 Nov 1977, Corn, C. (#s.n.), BISH 667427.

***Lantana camara* -- Lantana -- Verbenaceae -- Alien**
Rare to occasional. On north side by dead hala. First collected in 1937 by Fosberg. This thorny bush has the capacity to become a pest, and can be usually hand pulled, making sure to be wary of the sharp spines. If the root can not be pulled out, it may require herbicide.
4 Jul 1937, Fosberg, F.R. (#14170), BISH 71958.

***Lipochaeta* [syn. *Melanthera*] *integrifolia* -- Nehe -- (Asteraceae) -- Endemic**
Not observed during this survey. First collected by Long in 1964 who noted, "Extreme N end of island". Collected again in 1977 by Corn. Not observed in 2002 by LeGrande. Nehe, which still exists on Kaohikaipu, could be propagated from seeds or cuttings and reintroduced to Mokuauia.

12 Nov 1977, Corn, C. (#s.n.), BISH 667370.
16 May 1964, Long, C.R. (#1745), Extreme N end of island, In crevice of rock. Found with *Boerhavia* & *Fimbristylis*, BISH 51427, USNM 02659395.

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**
Occasional. Most common on northeast part of islet where scattered patches can be found. One small patch in the center of islet. Observed in 2002 by LeGrande. First collected during this survey. This species seems to be doing fine on Mokuauia, and will likely spread as non-native plants are removed. No actions are recommended other than routine monitoring.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-2).

***Malvastrum coromandelianum* -- Malvastrum -- (Malvaceae) -- Alien**
Rare. Found on north end. First collected during this survey. This small shrub that superficially resembles ilima can be hand pulled.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-17).

***Mucuna gigantea* -- Sea bean -- (Fabaceae) -- Indigenous**
Not observed during this survey. First collected by Neal in 1938. This species has seeds that float and will occasionally be tossed up onto the beach, germinate, and then die, due to the harsh conditions on the islet. No other actions recommended other than routine monitoring for seedlings.

19 Jun 1938, Neal, M.C. (#s.n.), BISH 445843.

***Nicotiana tabacum* -- Tobacco -- (Solanaceae) -- Alien**
Rare. A few plants seen on north end by dead hala (*Pandanus tectorius*), on margin of sea grape trees (*Coccoloba uvifera*). Observed during this survey. Still needs to be collected. Occasionally found in lowland areas, also occurring on Manana, usually not a major pest, but will spread if not addressed. This sticky shrub can be hand pulled, but gloves should be worn, as toxins associated with the plant will rub off.

***Oxalis corniculata* -- Yellow wood sorrel -- (Oxalidaceae) -- Questionably Polynesian**
Not observed during this survey. First collected by Fosberg in 1937. Not observed in 2002 by LeGrande.

4 Jul 1937, Fosberg, F.R. (#14167), 2m, Between grass, BISH 61322.

***Pandanus tectorius* -- Hala -- (Pandanaceae) -- Indigenous**
Dead. Single dead skeleton about 3 m tall with many branches observed on northeast side of islet. Observed in 2002 by LeGrande who noted "appeared dead". No further actions are recommended other than regular monitoring for new plants.

***Paspalum vaginatum* -- Seashore paspalum -- (Poaceae) -- Alien**

Rare. What appeared to be this grass was found near the sea on the raised limestone on the base of the northwest spur. First collected during this survey.
22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-29).

***Passiflora foetida* -- Love-in-a-mist -- (Passifloraceae) -- Alien**
Common to dominant. Crawling over vegetation on western side of islet. First collected in 1964 by Long who noted, "leeward side of island". Observed in 2002 by LeGrande. This vine with red fruits has been on Mokuauia for 40 yrs. and is well established. It will be difficult, but not impossible to remove. Hand pulling roots should work for most vines.
16 May 1964, Long, C.R. (#1718), Leeward side of island, USNM 02659729.

***Passiflora suberosa* -- Huehue haole -- (Passifloraceae) -- Alien**
Rare to occasional. Scattered across islet. First collected in 1938 by Neal. Not as common as *P. foetida*, though on Mokuauia longer, this vine with blue fruits can be hand pulled when found.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 445841.

***Phymatosorus grossus* -- lauae -- (Polypodiaceae) -- Alien**
Not observed during this survey. First collected by Fosberg in 1937.
4 Jul 1937, Fosberg, F.R. (#14155), 3m, In crevice in coral rock, BISH 8391.

***Physalis angulata* -- Smooth poha -- (Solanaceae) -- Alien**
Occasional in center of islet. First collected during this survey. Closely related to *P. peruviana*, from which it can be distinguished by mostly glabrous plant parts, and corollas 15 mm in width, with a diffuse brownish basal spot. A collection was made to document it's presence on Mokuauia and to confirm the species identity. *P. angulata* is an obscure plant that is becoming more common in Hawaii. It doesn't appear to be the worst invader, but is taking up space native plants could occupy. This species could likely be hand pulled.
22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-22).

***Physalis peruviana* -- Poha -- (Solanaceae) -- Alien**
Not observed during this survey. Observed in 2002 by LeGrande. There is a chance this plant may have been misidentified in 2002, and that it was actually *P. angulata*.

***Plantago major* -- Plantago -- (Plantaginaceae) -- Alien**
Not observed during this survey. First and only collection made by Neal in 1938. This species is common in the lawn at the nearby Malaekahana Beach Park.
1 Aug 1938, Neal, M.C. (#s.n.), BISH 423402.

***Pluchea carolinensis* -- Sourbush -- (Asteraceae) -- Alien**
Occasional. Scattered about the middle of the islet. Observed in 2002 by LeGrande. First collected during this survey. This and other species of *Pluchea* can invade lowland areas such as Mokuauia. Plants can be dug up. If the root can not be dug up, herbicide may be needed.
22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-4).

***Pluchea indica* -- Indian fleabane -- (Asteraceae) -- Alien**
Rare. One plant found on raised limestone on northwest side of islet. Another found on northeast side near coast. This species could become invasive on Mokuauia. Plants can be dug up. If the root can not be dug up, herbicide may be needed. Observed in 2002 by LeGrande. First collected during this survey.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-1).

***Pluchea x fosbergii* -- Hybrid pluchea -- (Asteraceae) -- Alien**
Rare. One patch near dead hala. Along with other *Pluchea* spp., this species could smother much of Mokuauia. This hybrid pluchea does not set fertile seeds and can be dug up. If the root can not be dug up, herbicide may be needed. First collected during this survey.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-5).

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Not observed during this survey. Observed in 2002 by LeGrande. *P. lutea* can be distinguished by having larger flowers with numerous stamens, >12 up to 50. *P. lutea* could very well be on the islet, but was overlooked. If another search of Mokuauia doesn't find *P. lutea*, it could be propagated from seeds or cuttings from Popoia and reintroduced to Mokuauia.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Common. Scattered across islet. Some plants getting quite large. First collected (no date given, but likely 1915) by Stokes. Collected in 1936 by Neal, and in 1977 by Corn. Observed in 2002 by LeGrande. Non-native *P. oleracea* can be distinguished from the native *P. lutea* by having small flowers with less stamens, <12-15. The non-native *P. oleracea* hybridizes with *P. lutea* and in many places has replaced the native *P. lutea*, which is now rare in distribution. *P. oleracea* could be removed by hand pulling and bagging plants, once properly identified with flowers. It could be replaced with *P. lutea*.

No date, Stokes, J.F.G. (#s.n.), BISH 448834
26 Jul 1936, Neal, M.C. (#s.n.), BISH 448834.
12 Nov 1977, Corn, C. (#s.n.), BISH 770487.

***Psidium guajava* -- Guava -- (Myrtaceae) -- Alien**
Not observed during this survey. First and only collection by Long in 1964. Not observed in 2002 by LeGrande. This species likely did not persist long on Mokuauia.

16 May 1964, Long, C.R. (#1716), Leeward side, USNM 02659772.

***Rivina humilis* -- Coral berry -- (Phytolaccaceae) -- Alien**
Rare. A couple plants scattered under and near sea grape trees in center part of islet. They were hand pulled. First collected during this survey. This plant seems to prefer shade, and could be hand pulled when discovered. This small shrub will likely continue to show up on Mokuauia from time to time, as it is common in the understory in nearby Malaekahana Beach Park. Cutting the sea grapes will likely allow less spread of this species by birds perching and pooping seeds on Mokuauia, and will bring more sunlight to the ground, giving the native coastal plants a competitive advantage over this shade preferring species.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-8).

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous.**
Dominant. Seedlings and scattered small patches were found along the coast. A large dense patch covers much of the north end of the islet. First collected by Neal in 1938. Collected again in 1964 by Long and in 1977 by Corn. Observed in 2002 by LeGrande. This species appears to be doing fine on Mokuauia. No actions recommended, other than routine monitoring.

19 Jun 1938, Neal, M.C. (#s.n.), BISH 444366.
16 May 1964, Long, C.R. (#1742), BISH 51375.
12 Nov 1977, Corn, C. (#s.n.), BISH 667558.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Dominant on most of the islet, where it forms mats. A very dense patch is found near the small anchialine pond near the northern part of islet. Akulikuli is the only plant able to grow on the surf spray impacted northwest spur, and is often the closest plant to the ocean in other parts the islet. First collected by Neal in 1936. Collected again in 1937 by Fosberg and Egler, by Long in 1964 who noted, "Windward side of island", and by Corn in 1977. Observed in 2002 by LeGrande. Easily propagated through cuttings. This species is doing fine of Mokuauia. No actions recommended other than routine monitoring.

26 Jul 1936, Neal, M.C. (#s.n.), BISH 448828, USNM 03217907.
4 Jul 1937, Fosberg, F.R., Egler, F.E. (#14174), USNM 03308190.
4 Jul 1937, Fosberg, F.R., Egler, F.E. (#14176), BISH 643388, USNM 03308191.
16 May 1964, Long, C.R. (#1734a), Windward side of island, BISH 452640, USNM 02659836.
12 Nov 1977, Corn, C. (#s.n.), BISH 668182.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Common. Large patches cover the center of islet. An aberrant large leafed form was found in the center of the islet. First collected by Neal in 1936. Collected again in 1937 by Fosberg, by Neal in 1937, by Long in 1964, and by Corn in 1977. Observed in 2002 by LeGrande. This species seems to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.

24 Jul 1936, Neal, M.C. (#s.n.), BISH 448831.
4 Jul 1937, Fosberg, F.R. (#14171), BISH 57917.
4 Jul 1937, Fosberg, F.R. (#14175), BISH 57927.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 414348.
16 May 1964, Long, C.R. (#1719), BISH 638008, USNM 02659316, 03274353.
12 Nov 1977, Corn, C. (#s.n.), BISH 770295.

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**
Occasional in center of islet. First collected in 1937 by Fosberg. Collected again in 1938. Observed in 2002 by LeGrande. There is some taxonomic uncertainty with this species, specifically whether it is native or not. At this point, we are leaning towards treating it as native. Given that, this species seems to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.

4 Jul 1937, Fosberg, F.R. (#14164), BISH 70111.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 444349.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Occasional. Scattered across islet, especially in the protected inland of the southern part of the islet. First collected in 1938 by Neal. Collected again in 1964 by Long who noted,

"on leeward portions". Observed in 2002 by LeGrande. This annual will show up after rains, generally only growing where other plants allow it to. It can be hand pulled.

19 Jun 1938, Neal, M.C. (#s.n.), BISH 444356.
16 May 1964, Long, C.R. (#1744), On leeward portions, BISH 460800, USNM 02659227.

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**

Common on margins of islet and along beaches. Occasional inland. Closest plant to ocean in sandy portions of islet. First collected in 1936 by Neal and again in 1938 by Neal. This species seems to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.

26 Jul 1936, Neal, M.C. (#s.n.), BISH 448835.
19 Jun 1938, Neal, M.C. (#s.n.), BISH 444352, 444365, 630112.

***Stachytarpheta* sp. -- Vervain -- (Verbenaceae) -- Alien**

Not observed during this survey. First collected by Fosberg in 1937. Not observed in 2002 by LeGrande.

4 Jul 1937, Fosberg, F.R. (#14154), BISH 571564.

***Tetragonia tetragonioides* -- New Zealand spinach -- (Aizoaceae) -- Alien**

Rare. Two patches in center of islet. First collected during this survey. One of the worst weeds in the Farallon Islands, California (Peter Pyle, *pers. comm.*). This plant is easy to hand pull, but can be difficult to completely get rid of because of a persistent seed bank. Bagging seeds will help reduce necessary follow up. This succulent plant may occasionally re-invade through wave action washing floating seeds up onto the islet, and should be looked for during regular surveys.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-14).

***Thespesia populnea* -- Milo -- (Malvaceae) -- Questionably Indigenous**

Occasional, a few patches, especially on the southwest point, where a 25 m x 10 m patch creates a thicket about 3 m tall. Observed in 2002 by LeGrande. First collected during this survey. This questionably indigenous tree can become quite aggressive, doesn't really provide good breeding habitat for shearwaters, and displaces native plant habitat. It could either be allowed to spread, or could be removed along with the non-native trees. See discussion of milo on Popoia for additional information.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-23).

***Tournefortia argentea* -- Beach heliotrope -- (Boraginaceae) -- Alien**

Common on margins of islet, especially along the southern and eastern shores. Many of the trees looked dead. Observed in 2002 by LeGrande. First collected during this survey. This species plays a crucial role in some situations, and can be a pest in others. Given the current situation at Mokuauia, removal of this species from the islet seems to make sense. Small plants can be hand pulled. Larger plants can be frilled in place or cut down and stacked or removed. More on removal of non-native trees from Mokuauia in *Casuarina* and *Coccoloba* discussion.

22 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050222-25).

***Vigna marina* -- Nanea, beach pea -- (Fabaceae) -- Indigenous**

Rare to occasional. A couple patches. First collected in 1937 by Fosberg. Collected again in 1967. This non-twining vine with yellow flowers prefers moist areas and will

likely spread as non-native plants are removed. This species appears to be doing fine on Mokuauia, and no actions are recommended other than routine monitoring.

4 Jul 1937, Fosberg, F.R. (#14165), BISH 56256, 687094, 687090.
12 May 1967, Unknown collector (#s.n.), BISH.

PULEMOKU

Figure 13. Pulemoku islet.

Overview
Pulemoku islet is located in Malaekahana Bay, just south of Mokuauia islet. It is a small calcareous islet, approximately 1 acre in size and reaches a height of about 10-15 ft. On Feb. 28, 2006, we did a helicopter fly by survey and searched for plants using binoculars. This small islet appears to be washed over occasionally by the ocean. No plants were observed during our survey.

Vegetation
We did not observe any vegetation on Pulemoku during our survey. Waves were occasionally washing over the islet. The environment is likely too harsh to support plant life.

Threats
Though open to the public during daylight hours, the landing is rough and the islet is fairly remote with rough seas surrounding it, limiting potential threats.

Restoration
With no vegetation present, no restoration recommendations for plants are given at this time. Perhaps future surveys could land on the islet to confirm the lack of vegetation.

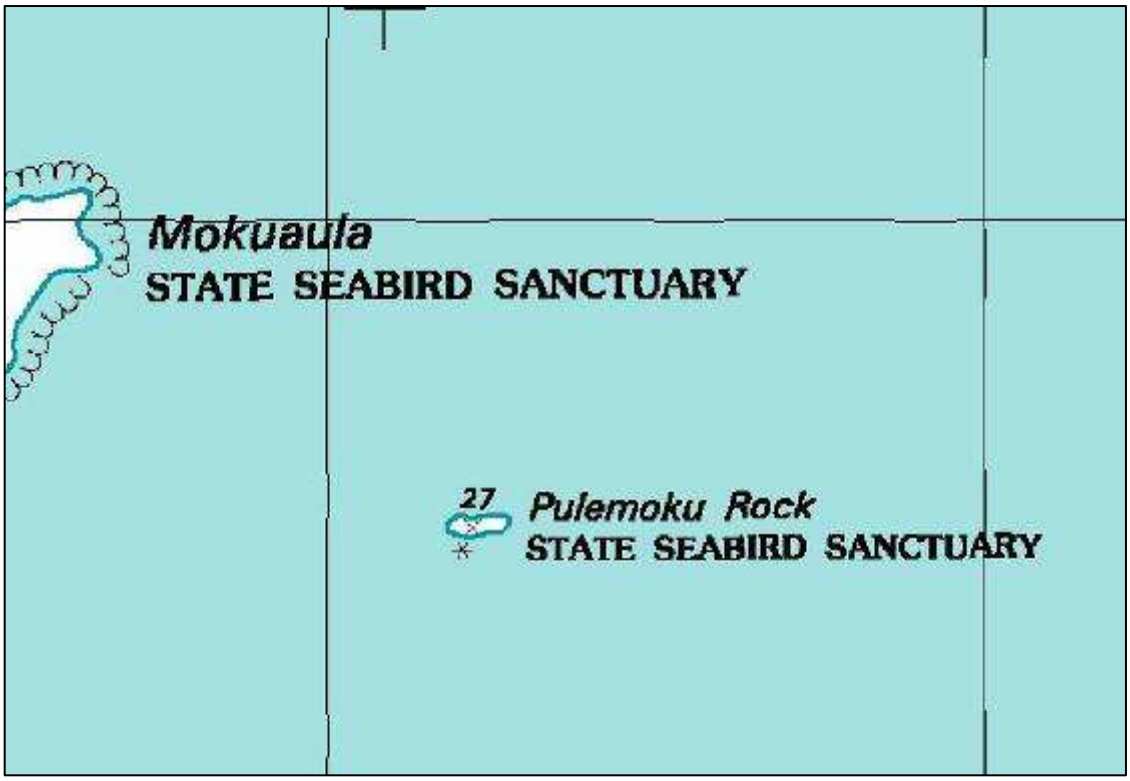

Figure 14. Pulemoku map.

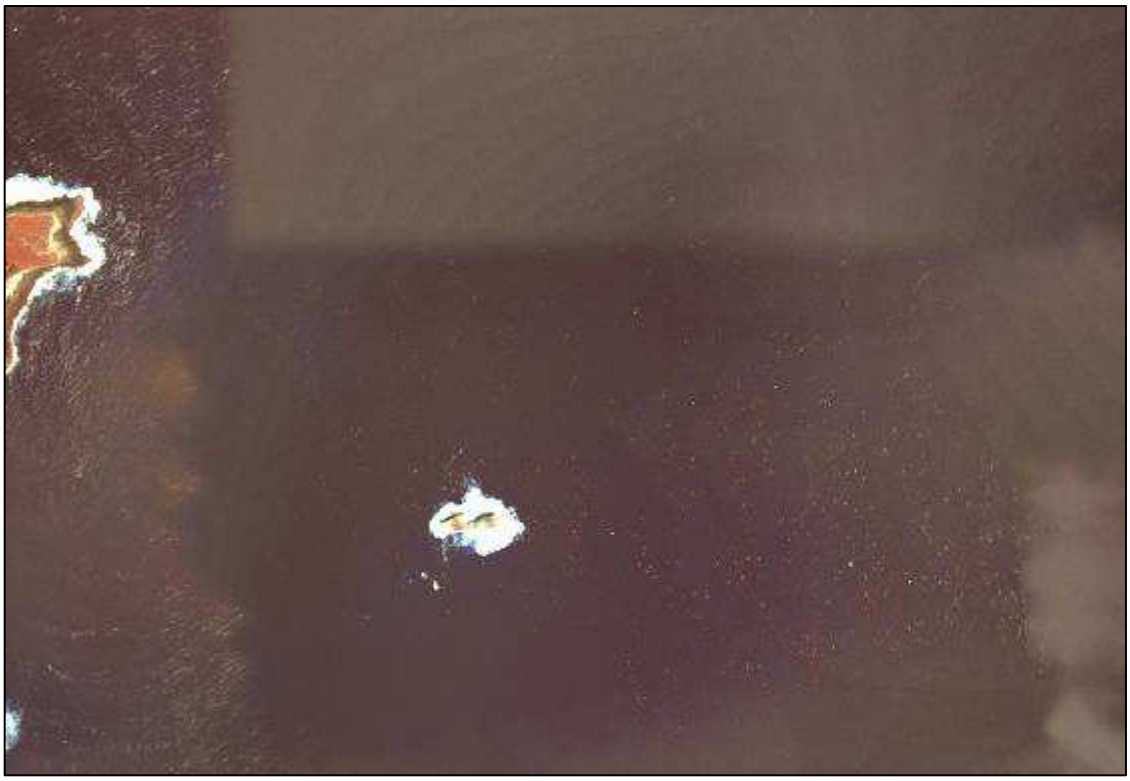

Figure 15. Pulemoku orthophoto.

Figure 16. Pulemoku islet with no vegetation and wave washed surfaces.

Figure 17. Pulemoku islet devoid of vegetation.

KUKUIHOOLUA

Figure 18. Kukuihoolua islet.

Overview
Kukuihoolua islet is located in Laie Bay, just offshore from Laie Pt. The calcareous islet is about 2 acres in size and reaches a height of about 20 ft. There is a prominent arch in the center of the islet. We did not land on the island. We did a visual scan with binoculars from Laie Point State Wayside, and did a follow up helicopter survey hovering near the islet, also using binoculars. Both times we observed just 1 native plant, akulikuli (*Sesuvium portulacastrum*), mostly in areas where the ocean does not wash over too severely.

Vegetation
Akulikuli was the only plant species observed during our survey. It was common on slopes where the ocean did not wash over too severely. In the past, two other species were observed, ohelo kai (*Lycium sandwicense*), and button mangrove (*Conocarpus erectus*). Plants likely come and go on this high energy islet. Further survey on foot, or from Laie Pt. with a high powered scope would help confirm if there are any other plants present.

Threats
The islet is close to Laie Pt. and can apparently be swam to or kayaked to from the point. However, the crossing is rough sometimes, which may help limit potential threats. Being so close to human habitation, non-native plant species, such as button mangrove, which has been collected from the islet in the past, and others could pose a potential threat.

Restoration
The islet is made up of a single native species, akulikuli, which seems to be doing well on its own. It would be good to land on the islet and do a ground survey, or to survey the islet with a high powered scope from Laie Pt.

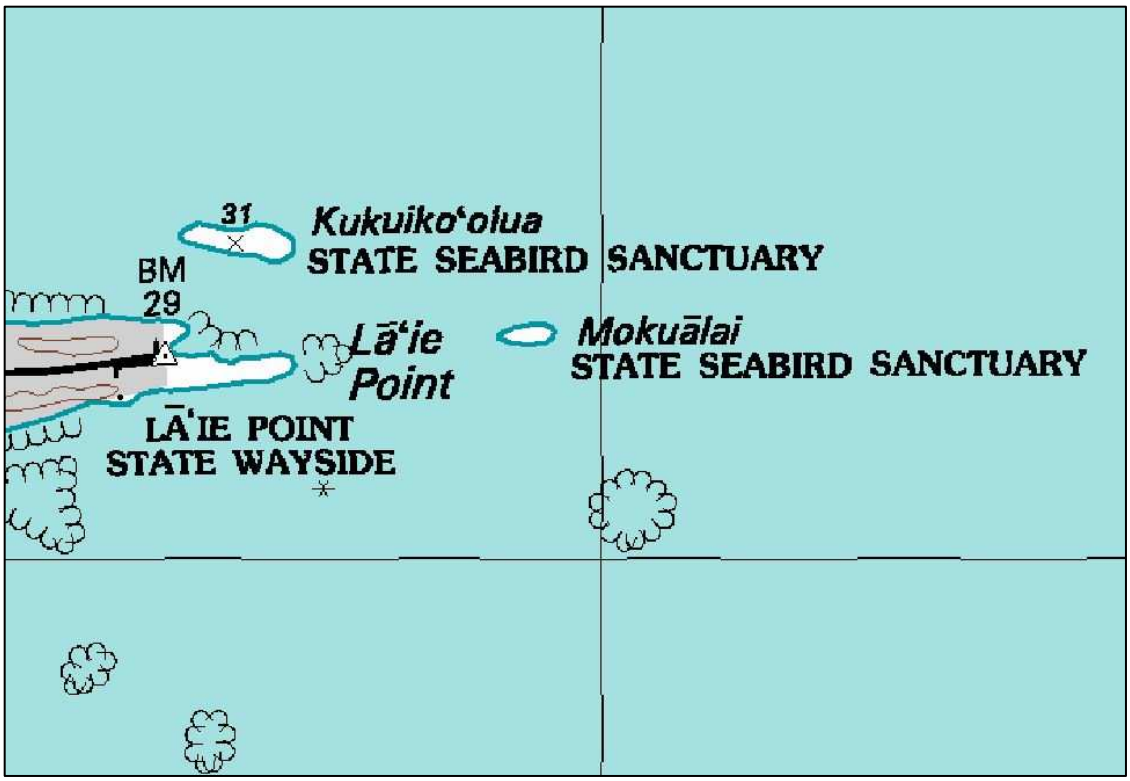

Figure 19. Kukuihoolua map.

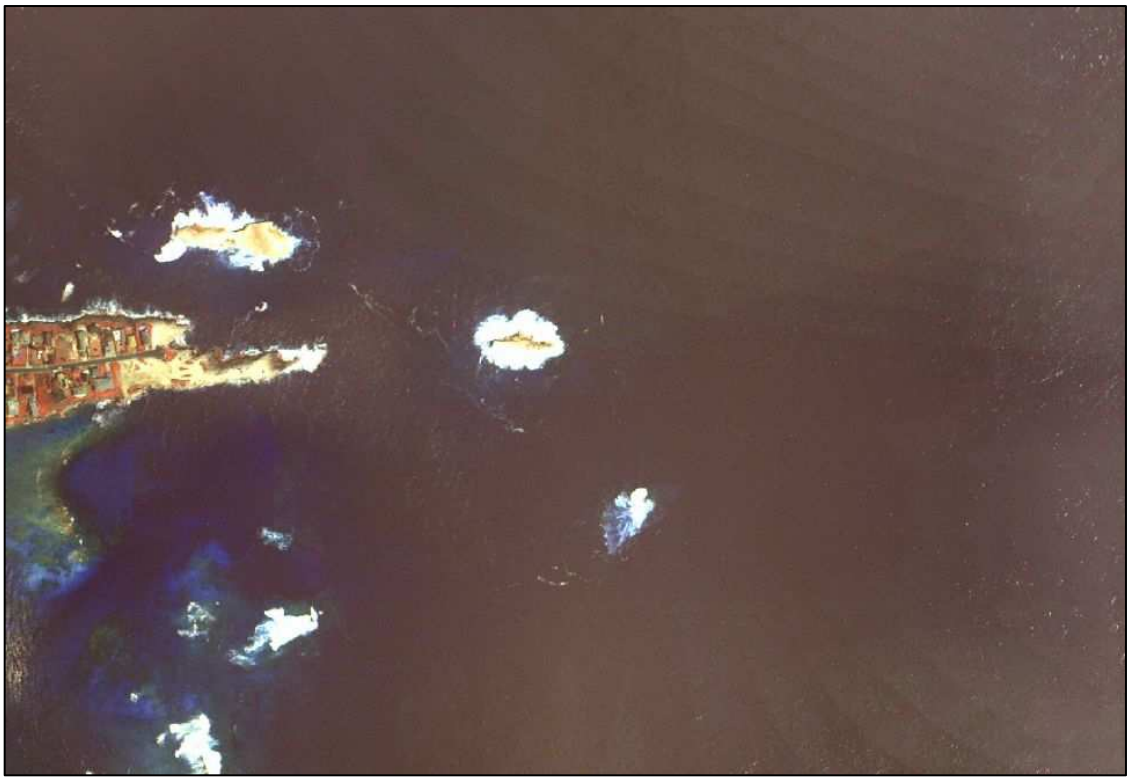

Figure 20. Kukuihoolua orthophoto.

Figure 21. Kukuihoolua islet with akulikuli (*Sesuvium portulacastrum*) in areas where the ocean does not wash over too severely.

Annotated Plant List -- Kukuihoolua

***Conocarpus erectus* -- Button mangrove -- (Combretaceae) -- Alien**

Not observed during this survey. It could be on the island but went undetected, due to the survey methods employed. Checking on foot or by high-powered scope from Laie Pt. would help determine whether it still persists, or not. First collected by Neal in 1938.

Aug 1938, Neal, M.C. (#s.n.), BISH 617898, 617899, 617900.

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

Not observed during this survey. It could be on the island but went undetected, due to the survey methods employed. Checking on foot or by high-powered scope from Laie Pt. would help determine whether it still persists, or not. First collected by Neal in 1938.

2 Aug 1938, Neal, M.C. (#s.n.), BISH 423394.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**

Common where the ocean does not wash over too severely. Akulikuli is one of the most salt tolerant of the native plants, and is often the closest plant to the ocean. First collected by Neal in 1938.

2 Aug 1938, Neal, M.C. (#s.n.), BISH 423396.

MOKUALAI

Figure 22. Mokualai islet.

Overview
Mokualai is located in Laie Bay, south of Kukuihoolua islet, just off of Laie Pt. It is a small coralline islet, approximately 1 acre in size reaching a height of about 20 ft. We did not land on the island. We did a visual scan with binoculars from Laie Point State Wayside, and did a follow up helicopter survey hovering near the islet, also using binoculars. Both times we observed just 1 native plant, akulikuli (*Sesuvium portulacastrum*), mostly in areas where the ocean does not wash over too severely.

Vegetation
Akulikuli was the only plant species observed during our survey. It was common on the slopes of the islet where the ocean did not wash over too severely. Further surveys on foot, or with high powered scopes would help confirm if there are any other plants.

Threats
The islet is close to Laie Pt. and can apparently be swam to or kayaked to from the point. However, the crossing is rough sometimes and the landing is tough, which may limit potential threats. Being so close to human habitation, invasion by non-native plant species could be a potential threat, though the environment is fairly harsh.

Restoration
The islet is made up of a single native species, akulikuli, which seems to be doing well on its own. It would be good to land on the islet or scan with a high powered scope.

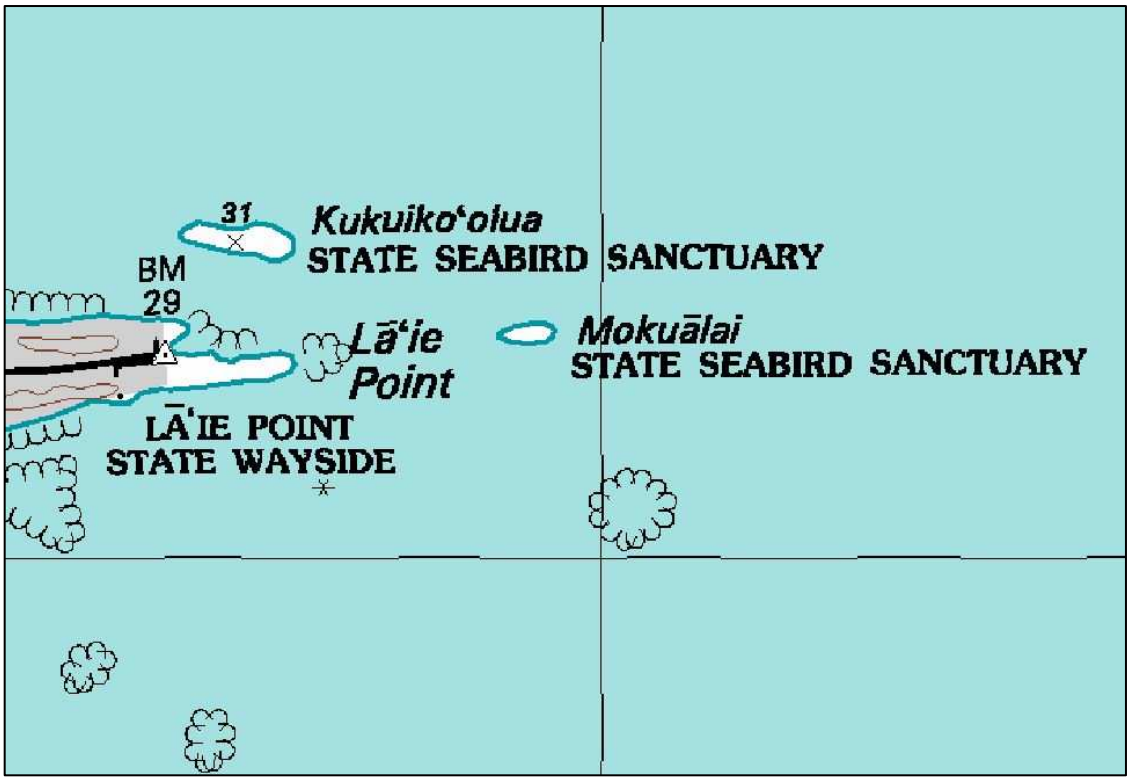

Figure 23. Mokualai map.

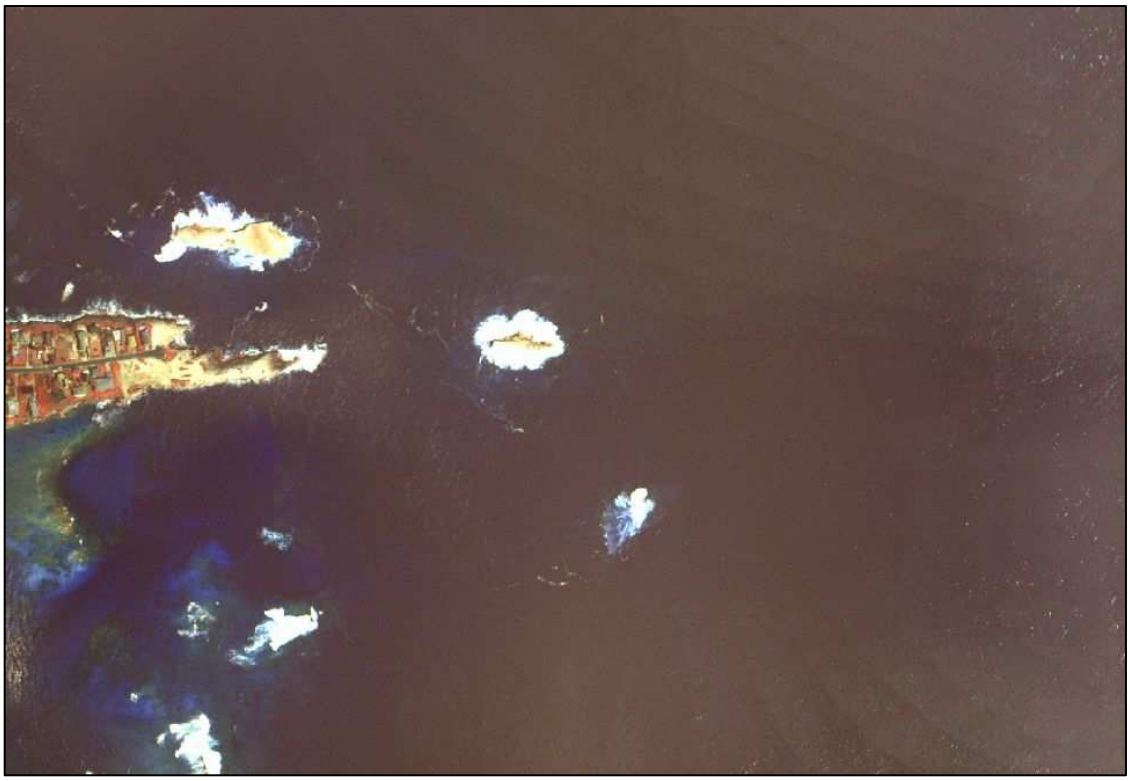

Figure 24. Mokualai orthophoto.

Figure 25. Mokualai islet washed by waves in the lower central portion, with akulikuli in non-wave washed areas.

Annotated Plant List -- Mokualai

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**

Common where the ocean does not wash over too severely. What appeared to be this species was observed through binoculars from Laie Pt., and from a helicopter hovering closer to the islet. We did not make a collection during this survey. It would be good to get on to the island and make a collection to confirm the identification and document the presence. Additionally, perhaps there are other plant species on this islet, landing on the islet either by swimming, boating, or helicopter and doing a ground survey would be best. Another useful step may be to scan the islet with a high powered spotting scope from Laie Pt.

MOKOLII

Figure 26. Mokolii islet.

Overview

Mokolii (Chinaman's Hat) is located on the north side of Kaneohe Bay about 600 yards offshore from Kualoa Park. The islet is a sea stack about 12.5 acres in size and is roundish in shape with a steeper rocky section that makes up the top portion which rises to a summit of 206 ft. (OIRC, 2005). A botanical survey of Mokolii islet was done on April 19, 2005. We were accompanied by David Smith. We boated to the islet in the morning, waded to shore, and did walk through surveys until afternoon. The islet is open to the public during daylight hours and is owned by the City and County of Honolulu. In March 2002, DOFAW, with the assistance of local volunteers, removed rats from the islet. As a result, the wedge tailed shearwater (*Puffinus pacificus*) population has increased dramatically, along with near shore marine life. Though the islet is dominated by weedy plant species, native plants still remain mostly in coastal areas, especially on the northeastern side.

Vegetation

Native species, including the endangered *Panicum fauriei* var. *carteri* grass, are found near the coastal margins and are doing especially well on the windward side, including ahu awa (*Cyperus javanicus*), naupaka (*Scaevola taccada*), and ilima (*Sida fallax*). Above the shoreline, the lower slopes are dominated mostly by non-native vegetation such as Christmas berry (*Schinus terebinthifolius*), lantana (*Lantana camara*), and Spanish needles (*Bidens alba* var. *radiata*), and ornamental trees and shrubs, including false kamani (*Terminalia catappa*) and *Bougainvillea* sp. Many other weedy legumes

exist, such as *Crotalaria incana*, *Desmodium* spp., and *Indigofera* spp. occur along lower portions of the slope, especially in leeward areas. A few coconuts (*Cocos nucifera*) occur on the west side. The steeper rocky walls still have some native vegetation left including maia pilo (*Capparis sandwichiana*) and ala ala wai nui wahine (*Plectranthus parviflorus*). The summit section is mostly dominated by shrubs and grasses such as Christmas berry, natal red top (*Melinis repens*), and pili grass (*Heteropogon contortus*). Several invasive plants occur in limited numbers, such as ivy gourd (*Coccinia grandis*), opiuma (*Pithecellobium dulce*), guinea grass (*Panicum maximum*), haole koa (*Leucaena leucocephala*), octopus tree (*Schefflera actinophylla*), and sandbur (*Cenchrus echinatus*). These could be removed before they become more widespread. During this survey, we observed a total of 72 plant species. There were 20 (28%) native species and 52 (72%) non-native species. We made 68 plant collections.

Threats

With less restrictions and high visitor count, the islet is extra vulnerable to introduction of non-native plants and animals and other human related threats, such as the trampling of native plants. A few non-native fruit eating birds were observed on the islet, including one grey francolin (*Francolinus pondicerianus*), and about a half dozen red vented bulbuls (*Pycnonotus cafer*), which were also heard calling from the Christmas berry canopies. These birds have the potential to bring invasive plants from the main island, such as ivy gourd and octopus tree. Decreasing the taller trees such as Christmas berry may help limit visitation by these birds. Mosquitoes were also observed under the dense Christmas berry thickets. Opening the area up by removing the Christmas berry will help limit mosquito habitat as well. Widespread weeds such as lantana and Christmas berry have been removed in the past. Continued removal is advised, especially near native plants and along trails. There are many incipient invasive weeds that are limited in distribution. These could be removed now before they become more widespread and costly to control. Ants were observed over most of the islet.

Restoration

Easy access is not always a threat and can lead to increased opportunities for enlisting the public in restoration efforts, as shown with the rat eradication, which was made possible with the help of the local community. Volunteers could continue to assist in restoration efforts. The endangered grass, *Panicum fauriei* var. *carteri,* could be allowed to spread in the area by keeping weeds at bay. The grass could be brought into cultivation and seeds could be gathered from the cultivated plants to spread on the islet. The area east of the *Panicum* would be suitable habitat for spreading seeds. Seeds of other native plants such as aweoweo (*Chenopodium oahuense*), emoloa (*Eragrostis variabilis*), and pili (*Heteropogon contortus*) could be spread. A few maia pilo (*Capparis sandwichiana*) were found on the sheer north wall where the Christmas berry tops out. Christmas berry nearby could be cleared to give the maia pilo room to grow. Seeds of this species could be spread or plants could be grown for out-planting on the islet. The native mint, ala ala wai nui wahine, which is also found growing on the sheer rock wall on the upper slopes, is spread easily by taking cuttings and placing them in cracks in the rock. This could be done along the steep rock walls. Many natives exist on the northeast side of the islet near the coast and the area could serve as a starting point for restoration by slowly removing

weeds from nearby native plants, allowing the natives to expand. Other native plants suitable to the area could be out-planted, such as naio (*Myoporum sandwicense*), ohai (*Sesbania tomentosa*), alahee (*Psydrax odorata*), and others. The *Portulaca oleracea* could be removed and replaced with *Portulaca lutea*. The removal of Christmas berry and others widespread weeds could continue, allowing more room for native plants and nesting seabirds. There were wedge-tailed shearwaters in pairs in burrows and no signs of rats were noted. In the splash zone, many pipipi (*Nerites* spp.) and crabs were observed. Several tide pools occur on the northeast side.

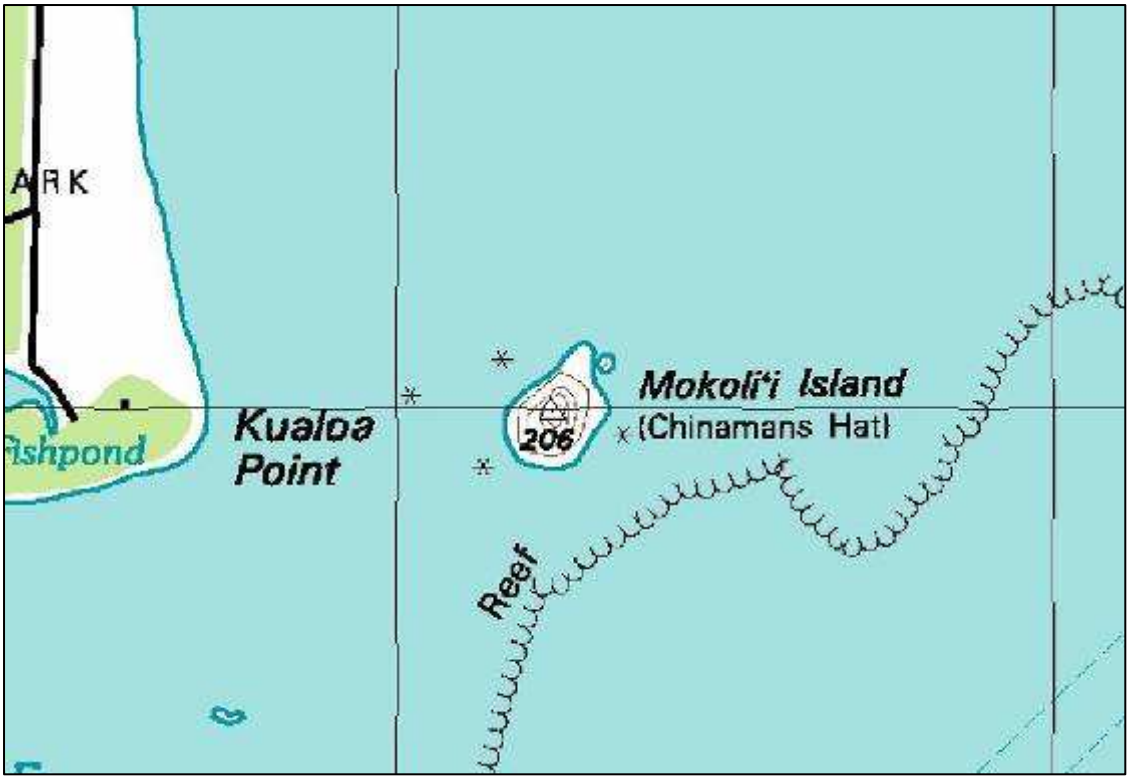

Figure 27. Mokolii map.

Figure 28. Mokolii orthophoto.

Figure 29. Near shore vegetation on the northwest side of the islet, with large false kamani (*Terminalia catappa*) and mixed lantana (*Lantana camara*) and Jamaican vervain (*Stachytarpheta jamaicense*).

Figure 30. Coastal windward margin with large patches of naupaka (*Scaevola taccada*) and ilima (*Sida fallax*). Upslope mostly non-native grasses and shrubs.

Figure 31. Middle slopes with thickets of Christmas berry (*Schinus terebinthifolius*), lantana, and sourgrass (*Digitaria insularis*), topped with a sheer rocky upper slope where a few natives persist, including maia pilo (*Capparis sandwichiana*) and ala ala wai nui wahine (*Plectranthus parviflorus*).

Figure 32. Summit top with natal red top (*Melinis repens*), pili grass (*Heteropogon contortus*), Christmas berry, and lantana.

Annotated Plant List -- Mokolii

***Ageratum conyzoides* -- Maile honohono -- (Asteraceae) -- Alien**
Rare. On sheer rocks. First collected during this survey. Could be hand pulled, but would be difficult to remove from the islet completely due to sheer rock walls.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-8).

***Alysicarpus vaginalis* -- Alyce clover -- (Fabaceae) -- Alien**
Rare. One plant on west end. First collected during this survey. Could be hand pulled, but would be difficult to remove from the islet completely due to sheer rock walls.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-49).

***Anagalis arvensis* -- Scarlet pimpernel -- (Primulaceae) -- Alien**
Rare. A few patches on east end. First collected in 1947 by Rogers. Observed in 2002 by LeGrande. Collected again during this survey. Not the worst invader. Could be removed if it gets into the *Panicum fauriei* or other high value sites.
17 May 1947, Rogers, D.P. (#s.n.), BISH 17716.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-29).

***Bidens alba* var. *radiata* -- Spanish needle -- (Asteraceae) -- Alien**
Common. Spread over entire islet. First observed in 2002 by LeGrande. First collected during this survey. Too widespread to remove from entire islet easily. Could be removed from high value sites.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-63).
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-5).

***Boerhavia coccinea* -- Boerhavia -- (Nyctaginaceae) -- Alien**
Rare. A couple small plants. First collected during this survey. Could be removed before they become more common.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-36).

***Boerhavia repens* -- Alena -- (Nyctaginaceae) -- Indigenous**
Occasional. A few large patches. First observed in 2002 by LeGrande. First collected during this survey. This plant appears to be doing well and will likely colonize areas that have non-natives removed. Could be removed before they spread.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-30).

***Bougainvillea* sp. -- Bougainvillea -- (Nyctaginaceae) -- Alien**
Uncommon. Scattered plants on west side. First observed in 2002 by LeGrande. First collected during this survey.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-31).

***Capparis sandwichiana* -- Maia pilo -- (Capparaceae) -- Endemic**
Rare. A few small plants on sheer north wall. First collected during this survey. The population is hanging on there and could be out-planted in areas where non-natives are removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-4).

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

Rare. A few plants near coast on south side. First observed in 2002 by LeGrande. First collected during this survey. One of the more potentially invasive species on Mokolii. This spiny grass could be removed before it becomes widespread.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-28).

***Centella asiatica* -- Asiatic pennywort -- (Apiaceae) -- Alien**
Not observed during this survey. First collected by Neal in 1938.
24 Sep 1938, Neal, M.C. (#s.n.), BISH 448849.

***Chamaecrista nictitans* -- Partridge pea -- (Fabaceae) -- Alien**
Rare. One patch near coast on south side. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before it becomes more widespread.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-18).

***Chamaesyce hirta* -- Hairy spurge -- (Euphorbiaceae) -- Alien**
Not observed during this survey. First collected in 1937 by Fosberg. Observed in 2002 by LeGrande. May have been overlooked. This ephemeral herb will likely come and go on Mokolii.
31 Jan 1937, Fosberg, F.R. (#13582), 4 m, BISH 49945.

***Chamaesyce* sp. -- Spurge -- (Euphorbiaceae) -- Alien**
Rare. A few plants. First collected during this survey. ID uncertain.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-55).

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**
Rare. Less than 12 small plants near coast, especially on north side. First collected during this survey. May have come from seed throwing. Could continue to scatter seeds, especially in areas after weeds are removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-25).

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**
Common. Over much of the islet, especially where *Schinus* is not. First observed in 2002 by LeGrande. First collected during this survey. Could be removed in high value sites.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-62).

***Chloris gayana* -- Fingergrass -- (Poaceae) -- Alien**
Not observed during this survey. First observed in 2002 by LeGrande.

***Christella* sp. -- Wood fern -- (Thelypteridaceae) -- Alien**
Rare. Small plant found on sheer wall. First collected during this survey.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-9).

***Chrysopogon aciculatus* -- Golden beardgrass -- (Poaceae) -- Questionably Indigenous**
Not observed during this survey. First collected by Fosberg in 1937. Collected again by St. John in 1947.
31 Jan 1937, Fosberg, F.R. (#13586), Labeled as noxious weed by U.S. Dept. of Ag., BISH 118389.
17 May 1947, St. John, H. (#s.n.), Labeled as noxious weed by U.S. Dept. of Ag., BISH 17722.

***Coccinia grandis* -- Ivy gourd -- (Cucurbitaceae) -- Alien**
Occasional. Scattered patches. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before this pesky vine becomes more widespread.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-54).

***Cocos nucifera* -- Coconut -- (Arecaceae) -- Polynesian**
Rare. Half dozen trees mainly on the west side. The leaves showed signs of feeding damage by the endemic moth *Omiodes blackburni*. Plantings have been present since at least the early 1980's. Observed in 2002 by LeGrande. It has yet to be collected from Mokolii.

***Crotalaria incana* -- Fuzzy rattlepod -- (Fabaceae) -- Alien**
Rare. A few plants near coast on south side. First collected during this survey. Could be hand pulled.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-17).

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**
Not observed during this survey. First collected by Fosberg in 1937.
31 Jan 1937, Fosberg, F.R. (#13579), BISH 626127.

***Cyperus javanicus* -- Ahu awa -- (Cyperaceae) -- Indigenous**
Common. Scattered patches near coast, especially windward coastal margins. First collected by Rogers in 1947. Collected again in 1978 by Herbst. Also collected during this survey. This native sedge appears to be doing fine and will likely spread as non-natives are removed.
17 May 1947, Rogers, D.P. (#s.n.), BISH 17721.
24 May 1978, Herbst, D.R. (#6106), alt. 8 m, USNM 02921109.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-53).

***Cyperus* sp. -- Sedge -- (Cyperaceae) -- Indigenous**
Not observed during this survey. Observed in 2002 by LeGrande.

***Dactyloctenium aegyptium* -- Beach wire grass -- (Poaceae) -- Alien**
Rare. A few plants in open spots. First observed in 2002 by LeGrande. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-35).

***Desmodium incanum* -- Desmodium -- (Fabaceae) -- Alien**
Occasional. A few patches. First observed in 2002 by LeGrande. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-56).

***Desmodium triflorum* -- Desmodium -- (Fabaceae) -- Alien**
Occasional. A few small patches. First collected in 1937 by Fosberg. Collected again in 1938 by Neal. Also collected during this survey. Could be removed.
31 Jan 1937, Fosberg, F.R. (#13587), 3 m, BISH 55316.
24 Sep 1938, Neal, M.C. (#s.n.), BISH 448850.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-67.

***Digitaria ciliaris* -- Henry's crab grass -- (Poaceae) -- Alien**
Common. Scattered patches, especially on the east end. First collected during this survey. Could be removed in high value sites.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-60).

***Digitaria insularis* -- Sourgrass -- (Poaceae) -- Alien**
Dominant. Covers many open areas from just above the coast to the summit. First collected in 1945 by Munro. Observed by LeGrande in 2002. Collected again during this survey. Too widespread to easily remove from the entire islet. Could be removed in high value sites.
16 Dec 1945, Munro, G.C. (#3), BISH 631657.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-45).

***Digitaria setigera* -- Itchy crabgrass -- (Poaceae) -- Questionably Indigenous**
Occasional. What is likely this grass is scattered over the islet. First observed in 2002 by LeGrande. First collected during this survey.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-13).

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**
Occasional. Scattered patches. First collected during this survey. Could be removed before it becomes widespread.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-46).

***Emilia fosbergii* -- Pualele -- (Asteraceae) -- Alien**
Occasional. Here and there. First collected in 1937 by Fosberg. Observed in 2002 by LeGrande. Also collected during this survey. Will come and go.
31 Jan 1937, Fosberg, F.R. (#13575), 4 m, Dry slope, BISH 75072.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-41).

***Eragrostis ciliaris* -- Lovegrass -- (Poaceae) -- Alien**
Not observed during this survey. First collected by Herbst *et al.* in 1976.
6 Jun 1976, Herbst, D.R., J. Obata, D. Palmer, and L. Stemmermann (#5865), USNM 02776761.

***Erigeron bellioides* -- Fleabane -- (Asteraceae) -- Alien**
Rare. One plant found on northeast tip which was pulled.

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**
Rare. A few patches on east end. First collected by Rogers in 1947. Observed in 2002 by LeGrande. Collected again during this survey. Will likely spread as non-natives are removed.
17 May 1947, Rogers, D.P. (#s.n.), as *F. cymosa*. subsp. *umbellato-capitata*, BISH 17728.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-61).

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**
Occasional. A few patches in bare spots near coast. First observed in 2002 by LeGrande. First collected during this survey. An ephemeral plant of open disturbed sites. Will come and go.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-58).

***Heteropogon contortus* -- Pili -- (Poaceae) -- Questionably Indigenous**
Common. Scattered over much of the islet from the coast to the summit. First observed in 2002 by LeGrande. First collected during this survey. Seed could be scattered.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-69).

***Indigofera suffruticosa* -- Indigo -- (Fabaceae) -- Alien**
Rare. A few small plants. First observed in 2002 by LeGrande. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-1).
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-22).

***Ipomoea indica*-- Koali awa -- (Convolvulaceae) -- Indigenous**
Rare. One plant near coast on south side. First collected by Fosberg in 1937. Collected again during this survey. Will likely spread as non-natives are removed.
31 Jan 1937, Fosberg, F.R. (#13591), 5 m, BISH 47495.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-27).

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) -- Indigenous**
Occasional. A few patches near coast. First collected by Fosberg in 1937. Observed by LeGrande in 2002. Collected again during this survey. Will likely spread as non-natives are removed.
31 Jan 1937, Fosberg, F.R. (#13580), 2 m, BISH 47461.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-26).

***Ipomoea* sp. -- Morning glory -- (Convolvulaceae) -- Indigenous**
Not observed during this survey. First observed in 2002 by LeGrande.

***Jacquemontia ovalifolia* subsp. *sandwicensis* -- Pau o hiiaka -- (Convolvulaceae) -- Endemic**
Rare to occasional. Near coast on southeast side. First collected by Rock in 1909. Collected again in 1937 by Fosberg. Observed in 2002 by LeGrande. Collected again during this survey. This colorful vine will likely increase as non-natives are removed.
20 Jan 1909, Rock, J.F.C. (#1302), BISH 122042.
31 Jan 1937, Fosberg, F.R. (#13584), 4 m, BISH 47680.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-40).

***Lantana camara* -- Lantana -- Verbenaceae -- Alien**
Dominant. Dense thickets over most of the islet. First collected by Fosberg in 1937. Collected again in 1967 by an unidentified collector. Observed in 2002 by LeGrande. Collected again during this survey. Could be removed from high value sites, with the ultimate goal of complete removal from the entire islet.
31 Jan 1937, Fosberg, F.R. (#13583), BISH 71954.
12 May 1967, Unknown (#s.n.), BISH 584752.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-59).

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**
Rare. One plant near coast on north side. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before it spreads.

19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-37).

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**
Rare. A few small patches near the coast on the east side. First collected by Fosberg in 1937. Observed in 2002 by LeGrande. Collected again during this survey. Will likely increase as non-natives are removed.
31 Jan 1937, Fosberg, F.R. (#13588), BISH 69734.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-64).

***Macroptilium lathyroides* -- Cow pea -- (Fabaceae) -- Alien**
Occasional. Near coast on south side. First collected during this survey. Could be hand pulled.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-16).

***Malvastrum coromandelianum* -- Malvastrum -- (Malvaceae) -- Alien**
Rare. A few plants on the south side. First observed in 2002 by LeGrande. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-15).

***Melinis repens* -- Natal red top -- (Poaceae) -- Alien**
Occasional. Scattered patches. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before it becomes more widespread.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-24).

***Mimosa pudica* -- Sensitive plant, sleeping grass -- (Fabaceae) -- Alien**
Rare. One patch near coast on east side. First observed in 2002 by LeGrande. First collected during this survey.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-19).

***Nephrolepis* sp. -- Nianiau -- (Nephrolepidaceae) -- Alien**
Rare. One plant on sheer north wall. First collected during this survey. This spiny plant could be removed before it spreads.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-6).

***Nicotiana tabacum* -- Tobacco -- (Solanaceae) -- Alien**
Rare. A few seedlings on northwest side near coast. First observed in 2002 by LeGrande. First collected during this survey. Could be removed if more popped up.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-32).

***Opuntia ficus-indica* -- Panini -- (Cactaceae) -- Alien**
Rare. about a half dozen plants in sheer areas. First observed in 2002 by LeGrande. First observed in 2002 by LeGrande. Would be difficult, but nice to remove the existing plants before they spread.

***Oxalis corniculata* -- Yellow wood sorrel -- (Oxalidaceae) -- Questionably Polynesian**
Rare. A few patches. First collected by Fosberg in 1937. Observed in 2002 by LeGrande. Collected again during this survey.
31 Jan 1937, Fosberg, F.R. (#13589), 3 m, BISH 61323.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-21).

***Panicum fauriei* var. *carteri* -- Hawaiian panic grass -- (Poaceae) -- Endemic**
Rare. A dozen large plants and a few dozen small plants near the coast on the east side in an open pebbly / sandy area. Some plants starting to brown off. Mixed with *Sporobolus pyramidatus*. First collected in 1917 by Rock. Collected again in 1941 by Hosaka. Collected by Herbst *et al.* in 1976. Collected again in 1978 by Herbst who saw as many as 207 individuals after a wet spring. His notes for two collections made in 1978 are given here. Collection #6104: "About 12 ft. Rocky ledge on north side of islet, growing in shallow sandy gravelly soil...Colony of about 180 plants in area about 50 ft by 40 ft. Most plants restricted to about 1/3 of this area." Collection #6105: "About 10 ft. On northwestern edge of spur on northern side of islet. In shallow sandy gravelly soil...27 plants." In 2002, Maya LeGrande wrote the following of *Panicum fauriei* var. *carteri*. "The population of *Panicum fauriei* var. *carteri* is located on the NE side of the islet (facing away from the main shore of Oahu). There is a point on the north-east side of Mokolii that is partially separated from the rest of the islet by a gulley. The *Panicum* is located on the main islet side of the gulch, or the south side of the gulch on a outcropping of exposed rock, as well as in a shallow depression A line of rocks have been placed alongside the main foot trail that circumnavigates the islet to separate the plants in the depression from foot traffic. The author counted 31 live individuals and 3 dead and dried individual clumps of grass. All of the live plants appeared to be in flower and fruit. Part of one plant was collected for DNA extraction and voucher material. DNA will be accessioned into the Hawaiian Plant DNA Library at the University of Hawaii Botany Department, and the voucher will be accessioned at BISH." Mokolii islet is designated critical habitat for this federally endangered species. Plants like *Sporobolus pyramidatus* and others have the potential to displace the *Panicum* at this location and should be removed if they found in the territory of the *Panicum*. Removing common native plants such as naupaka that wander into the *Panicum* area may also one day become necessary. This grass could be spread to other suitable areas of the islet, such as the partially separated point to the east of the current population, where Herbst saw this grass in 1978, through seed throwing or out-planting. This grass may spread on its own as larger plants around it are removed. It could also be spread to other offshore islets of Oahu to help ensure the survival of this endangered species.

21 Apr 1917, Rock, J.F.C. (#12766), USNM 00836134.
06 Nov 1941, Hosaka, E.Y., (#2611), 3m, Rocky ledge on north end of islet. Rare., BISH 576675, 576676, 576676.2.
6 Jun 1976, Herbst, D.R., J. Obata, D. Palmer, and L. Stemmermann (#5865), 3 m, USNM 02776760.
24 May 1978, Herbst, D.R. (#6104, #6105), alt. 4 m, USNM 0292113.

***Panicum maximum* -- Guinea grass -- (Poaceae) -- Alien**
Rare. One giant plant under coconuts. This grass has the potential to cover much more area and should be removed before it spreads further. Can either be dug out or controlled with a foliar application of herbicide. Still needs to be collected.

***Paspalum scrobiculatum* -- Ricegrass -- (Poaceae) -- Questionably Indigenous**
Not observed during this survey. First collected in 1937 by Fosberg.

31 Jan 1937, Fosberg, F.R. (#13594), 4 m, BISH 120080.

***Passiflora foetida* -- Love-in-a-mist -- (Passifloraceae) -- Alien**

Rare. A few vines half way up south slope. First observed in 2002 by LeGrande. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-12).

***Passiflora suberosa* -- Huehue haole -- (Passifloraceae) -- Alien**
Occasional. Scattered over the islet, especially the south and west side. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-20).

***Phyllanthus debilis* -- Phyllanthus -- (Euphorbiaceae) -- Alien**
Not observed during this survey. First observed in 2002 by LeGrande.

***Phymatosorus grossus* -- Lauae -- (Polypodiaceae) -- Alien**
Occasional. Scattered in understory. First observed in 2002 by LeGrande. First collected during this survey. Could be removed in high value sites, though it may be hard.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-57).

***Pithecellobium dulce* -- Opiuma, Manila tamarind -- (Fabaceae) -- Alien**
Rare. One tree and a bunch of seedlings. First observed in 2002 by LeGrande. First collected during this survey. This spiny tree that can be invasive in low moist areas could be removed before it spreads further.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-65).

***Plectranthus parviflorus* -- Ala ala wai nui wahine -- (Lamiaceae) -- Indigenous**
Rare. Scattered plants on sheer north wall. First observed in 2002 by LeGrande. First collected during this survey. Will likely spread on its own when non-natives are removed. Can also spread through direct sticking.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-10).

***Pluchea carolinensis* -- Sourbush -- (Asteraceae) -- Alien**
Occasional. Scattered patches. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before it spreads further.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-51).

***Pluchea indica* -- Indian fleabane -- (Asteraceae) -- Alien**
Common. Over much of the islet. First observed in 2002 by LeGrande. First collected during this survey. Could be selectively removed in high value areas.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-50).

***Pluchea x fosbergii* -- Hybrid pluchea -- (Asteraceae) -- Alien**
Occasional. Scattered patches. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-52).

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Not observed during this survey. First collected in 1937 by Fosberg. Could be looked for in future surveys, and if not found, could be re-introduced from other Oahu islets.
31 Jan 1937, Fosberg, F.R. (#13595), BISH 681466.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Rare. A few plants. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before it spreads further, and to minimize potential for hybridization with the native *P. lutea*.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-44).

***Psidium guajava* -- Guava -- (Myrtaceae) -- Alien**
Occasional. Scattered plants, especially half way up south part of islet. First observed in 2002 by LeGrande. First collected during this survey. Could be removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-3).

***Psilotum nudum* -- Moa -- (Psilotaceae) -- Indigenous**
Not observed during this survey. First and only observation in 1937 by Fosberg.
31 Jan 1937, Fosberg, F.R. (#3568), 4 m, BISH 72.

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**
Occasional. Locally abundant on the north tip forming low shrubs near the coast. First observed in 2002 by LeGrande. First collected during this survey. Will likely spread on its own as non-natives are removed. May need to be selectively controlled in some high value sites, such as the *Panicum fauriei* flats.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-33).

***Schefflera actinophylla* -- Octopus tree -- (Araliaceae) -- Alien**
Rare. One small plant on sheer wall on north side. First collected during this survey. Was pulled, but the root could not be completely removed and will require follow up control. Could be looked for and removed when found. Successful control often requires herbicide.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-11).

***Schinus terebinthifolius* -- Christmasberry -- (Anacardiaceae) -- Alien**
Dominant. A dense thicket covers most of the islet. First observed in 2002 by LeGrande. First collected during this survey. Could be selectively controlled in high value areas.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-2).

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Occasional. Forming mats near the coast. First collected during this survey. Will likely spread as non-natives are removed.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-47).

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Common. Near coast, especially on east end. First collected in 1937 by Fosberg. Collected again in 1947 by Rogers. Observed in 2002 by LeGrande. Collected during this survey. Will likely spread as non-natives are removed.
31 Jan 1937, Fosberg, F.R. (#13570, 13571), 4 m, BISH 57902, 57897.
17 May 1947, Rogers, D.P. (#s.n.), BISH 17725.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-39).

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

Occasional. Scattered plants. First collected in 1937 by Fosberg. Observed in 2002 by LeGrande. Collected again during this survey. Will likely spread as non-natives are removed.

31 Jan 1937, Fosberg, F.R. (#13577), 4 m, BISH 570113.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-42).

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Rare. First collected in 1937 by Fosberg. Observed in 2002 by LeGrande. Collected again during this survey. Could be removed in high value sites.

31 Jan 1937, Fosberg, F.R. (#13585), 4 m, BISH 121524.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-38).

***Sphagneticola trilobata* -- Wedelia -- (Asteraceae) -- Alien**
Not observed during this survey. First observed in 2002 by LeGrande. Could be removed if found in future surveys.

***Sporobolus indicus* -- Dropseed -- (Poaceae) -- Alien**
Rare. One small patch on south side of what appeared to be this grass. First observed in 2002 by LeGrande. First collected during this survey. Could be removed before it spreads.

19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-48).

***Sporobolus pyramidatus* -- Dropseed -- (Poaceae) -- Alien**
Rare. Scattered patches on east end near coast. First collected during this survey. This diminutive grass is mixed in with the *Panicum fauriei*, presumably preferring the same habitat. This grass could be removed to allow the *P. fauriei* to continue to flourish.

19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-34).

***Stachytarpheta dichotoma* -- Vervain -- (Verbenaceae) -- Alien**
Not observed during this survey. First observed in 2002 by LeGrande.

***Stachytarpheta jamaicensis* -- Jamaica vervain -- (Verbenaceae) -- Alien**
Common. Here and there. First observed in 1938 by Neal. Collected during this survey. Could be selectively removed in high value areas.

24 Sep 1938, Neal, M.C. (#s.n.), BISH 448839.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-43).

***Stachytarpheta urticifolia* -- Vervain -- (Verbenaceae) -- Alien**
Rare. What appeared to be this species. First collected during this survey. Could be selectively removed in high value areas.

19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-7).

***Tephrosia purpurea* var. *purpurea*-- Ahuhu -- (Fabaceae) -- Polynesian**
Occasional. Scattered patches. First collected in 1937 by Fosberg. Collected again by Rogers in 1947. Observed in 2002 by LeGrande. Collected again during this survey. This species could be allowed to persist, as it has cultural value. It could also be selectively removed in high value areas.

31 Jan 1937, Fosberg, F.R. (#13576), 5 m, BISH 56179.
17 May 1947, Rogers, D.P. (#s.n.), BISH 17724.

19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-68).

***Terminalia catappa* -- Tropical almond, false kamani -- (Combretaceae) -- Alien**
Occasional. Half dozen large trees mainly near the coast. First observed in 2002 by LeGrande. First collected during this survey. These large trees make nice shade. A few could be left to persist. That said, this species can become invasive, and individuals in high value areas may need to be removed.

19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-66).

***Tournefortia argentea* -- Beach heliotrope -- (Boraginaceae) -- Alien**
Occasional. Scattered plants near coast, especially on north side. First observed in 2002 by LeGrande. Still needs to be collected. Could be removed. This species can provide good seabird nesting for some species, but these are not species likely to be found on the frequently visited islet of Mokolii. This species can become aggressive, especially in littoral situations.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**
Rare. Scattered plants, especially on south side. First collected by Fosberg in 1937. Observed in 2002 by LeGrande. Collected again during this survey. This species will likely spread as non-natives are removed.

31 Jan 1937, Fosberg, F.R. (#13574), 5 m, BISH 70275.
19 Apr 2005, Starr, F., K. Starr, & D. Smith (#050419-14).

KAPAPA

Figure 33. Kapapa islet.

Overview

Kapapa is a small calcareous islet about 9.5 acres in size and reaches a height of 14 ft. (OIRC, 2005). Kapapa islet is located in Kaneohe bay approximately 2 miles offshore in the south central portion of the bay, north of Kekepa islet. The outer edges are sharp limestone and lithified dune outcrops with some sandy sections in the interior. The islet is accessible to the public with very little restrictions. Despite the lack of restrictions, many native plants still exist, mostly away from human dominated areas and near the ocean where native plants have a competitive advantage in the harsh salty conditions. We did a botanical survey on April 18, 2005. We boated to the islet and waded to shore then did walk through surveys for a few hours.

Vegetation

The islet is mostly made up of native species, especially near shore areas. Akulikuli (*Sesuvium portulacastrum*) and akiaki (*Sporobolus virginicus*) are found closest to the ocean. There are also a few milo (*Thespesia populnea*), mostly near the ocean on the southwest side. There are healthy patches of alena (*Boerhavia repens*) throughout the islet, several hinahina (*Heliotropium anomalum* var. *argenteum*) patches on the southeast side near the coast, and large patches of akiaki (*Sporobolus virginicus*), mostly near the margins. Scattered naupaka patches were observed over most of the islet. Central areas were mostly made up of ilima (*Sida fallax*), alena (*Boerhavia repens*) and pau o Hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*). On the south shore, there are some small patches of koali awa (*Ipomoea indica*) and kaunaoa (*Cuscuta sandwichiana*). Ihi

(*Portulaca lutea*) can be seen in some coastal areas. A few areas of non-native vegetation exists, such as near the landing, along the south shore, and in the central area. Bermuda grass (*Cynodon dactylon*) lawns were found just above the beach and along the south shore near the landing area. There was also some khaki weed (*Alternanthera pungens*) and New Zealand spinach (*Tetragonia tetragonioides*). Ironwood (*Casuarina glauca*) dominates the central area. Near the fishing shrine where ironwood was cleared from is a patch of sourbush (*Pluchea* spp.) and Spanish needles (*Bidens alba* var. *radiata*). Near the coast are a few sea grape and beach heliotrope (*Tournefortia argentea*). There is a small patch of pickle weed (*Batis maritima*) on the south side near the coast. During this survey, we observed a total of 41 species of plants. There were 13 (37%) native species and 26 (63%) non-native species. We made 38 plant collections.

Threats

Potential threats include increased visitation by humans. This would cause more trampling of natives, potential spread of camp fires, and other things associated with humans. Invasive non-native plants such as khaki weed, ironwood, sea grape, sourbush, sandbur, Spanish needles, pickle weed, and others have the potential to spread further and could be removed.

Restoration

There are vast areas of Kapapa that are completely native or close to it and these areas could serve as starting points for restoration. Weeds could be removed in these areas and the natives could be allowed to spread. A few weeds were found in limited distribution, such as sandbur, pickle weed, sea grape, and sourbush, and removal of them now could help prevent larger infestations in the future. Native plants that no longer occur on the islet could be re-introduced, such as anaunau (*Lepidium bidentatum* var. *o-waihiense*), nehe (*Lipochaeta integrifolia*), and pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*). Other native species could be introduced, either through spreading seeds or out-planting, such as maia pilo (*Capparis sandwichiana*), *Panicum fauriei* var. *carteri*, akoko (*Chamaesyce degeneri*), aweoweo (*Chenopodium oahuense*), and emoloa (*Eragrostis variabilis*). Existing native plants, including hinahina, akiaki (*Sporobolus virginicus*), and koali awa (*Ipomoea indica*) could be propagated and out-planted on Kapapa and other islets.

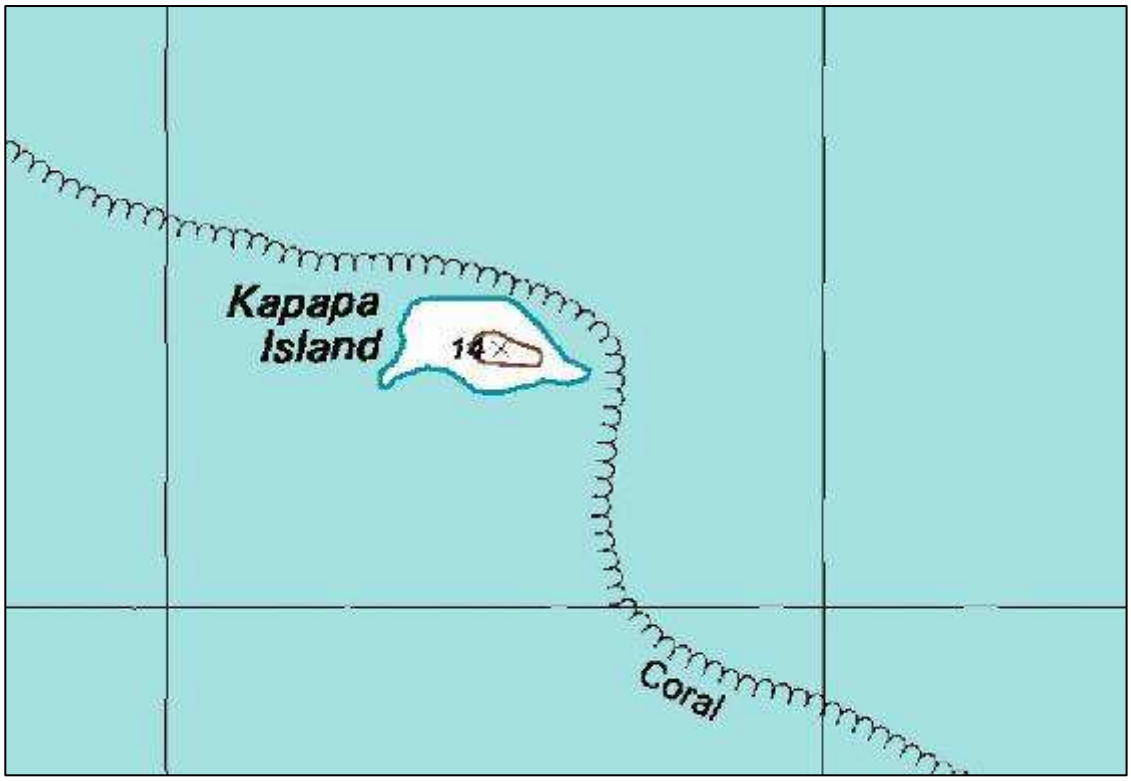

Figure 34. Kapapa map.

Figure 35. Interior with canopy of ironwood (*Casuarina equisetifolia* and *Casuarina glauca*) bordered by large patches of Bermuda grass (*Cynodon dactylon*) and ilima (*Sida fallax*) mixed with pau o Hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*).

Figure 36. View inland from coastal margins with akulikuli (*Sesuvium portulacastrum*) closest to ocean, scattered beach heliotrope and naupaka (*Scaevola taccada*) above, and ironwood in the interior.

Figure 37. Coastal margin on south side with akiaki (*Sporobolus virginicus*) closest to ocean and mixed akulikuli, alena (*Boerhavia repens*), and ilima herbland in interior.

Figure 38. Mixed pau o Hiiaka and ilima herblands bordered with beach heliotrope, ironwood, and naupaka.

Annotated Plant List -- Kapapa

***Aloe vera* -- Aloe -- (Agavaceae) -- Alien**

Rare. 5 x 5 m patch on south side. First collected during this survey. Could be removed before it spreads.

18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-51).

***Alternanthera pungens* -- Khaki weed -- (Amaranthaceae) -- Alien**

Occasional. Mixed in with other plants in center of islet. First collected by Herbst in 1978. Collected again during this survey. Could be removed, as it is a nuisance to humans.

24 May 1978, Herbst, D.R. (#6137), ca. 5 ft., BISH 421700.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-32).

***Batis maritima* -- Pickle weed -- (Bataceae) -- Alien**

Rare. One small patch on south side near ocean. First collected during this survey. Could be removed before it spreads.

18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-16).

***Bidens alba* var. *radiata* -- Spanish needle -- (Asteraceae) -- Alien**

Rare. Patch in center of islet where ironwood was cut. First collected during this survey. Could be removed before it spreads further.

18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-1).

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

Common to dominant. Forming large mats under partial shade. First collected by Fosberg and Egler in 1937. Collected again in 1978 by Herbst. Also collected during this survey. This species will likely spread on its own as non-natives are removed.

6 Jun 1937, Fosberg, F.R. (#14023, 14024), BISH 613436, 613445.
6 Jun 1937, Fosberg, F.R. and F.E. Egler, (#14023, 14024), 2 m, USNM 03142043, 03142063.
24 May 1978, Herbst, D.R. (#6129), 2 m, BISH 421693, USNM 02921193.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-32).

***Casuarina equisetifolia* -- Ironwood -- (Casuarinaceae) -- Alien**

Dominant. Covers much of the center of islet. First collected by Fosberg in 1937. Collected again by Neal in 1938 and by Herbst in 1978. Collected during this survey. A nice shade tree, yet highly invasive. This species could be selectively removed, especially the windward side. Starting control on the margins may increase the chances that plants re-growing in the place of removed ironwood are natives, rather than more weeds.

6 Jun 1937, Fosberg, F.R. (#14027, 14026), BISH 567812, 567813.
24 Sep 1938, Neal, M.C. (#s.n.) BISH 448777.
24 May 1978, Herbst, D.R. (#6120), BISH 421704.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-50).

***Casuarina glauca* -- She oak -- (Casuarinaceae) -- Alien**

Dominant. What appeared to be this species was observed forming thickets in the central portion of the islet mixed in with *C. equisetifolia*. It is likely that both species (*C. equisetifolia* and *C. glauca*) are present and both have been collected in the past. First collected by Fosberg in 1937. We did not collect this species during this survey. See *C. equisetifolia* discussion above.

6 Jun 1937, Fosberg, F.R. (#14026), BISH 567813.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**
Rare. One plant on west side that was pulled. First collected by Fosberg in 1937. Collected again during this survey. This species is not yet established widely over the islet. Detecting plants early along with rapid response will help keep it that way.
6 Jun 1937, Fosberg, F.R. (#14015), 2 m, Occasional at one station 50 feet in diameter, BISH 118228.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-17).

***Chamaesyce prostrata* -- Prostrate spurge -- (Euphorbiaceae) -- Alien**
Not observed during this survey. First collected by Herbst in 1978.
24 May 1978, Herbst, D.R. (#6125), 2 m, BISH 421709, USNM 02921268.

***Chenopodium murale* -- Lamb's quarters -- (Chenopodiaceae) -- Alien**
Not observed during this survey. Included in on-line species list (OIRC, 2005). Could be hand pulled if found.

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**
Rare. A few plants on south side. First collected in 1978 by Herbst. Collected again during this survey. Will likely spread as non-natives are removed.
24 May 1978, Herbst, D.R. (#6115), 2 m, BISH 421675.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-25).

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**
Rare. A few patches on west margin. First collected by Herbst in 1978. Collected again during this survey. Could be selectively removed in high value sites.
24 May 1978, Herbst, D.R. (#6111), 2 m, BISH 421688, USNM 02921106.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-34).

***Coccoloba uvifera* -- Sea grape -- (Polygonaceae) -- Alien**
Rare. One small patch on west tip. First collected by Herbst in 1978. Collected again during this survey. Could be removed before it spreads. This species has the potential to become quite invasive.
24 May 1978, Herbst, D.R. (#6124), 2 m, BISH 421708, USNM 02921267.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-48).

***Cocos nucifera* -- Coconut -- (Arecaceae) -- Polynesian**
Rare. One recently planted. No collections were made. No *Omiodes blackburni* damage seen. As with other offshore islets, coconuts could be tolerated as they are aesthetic to some, and provide potential host opportunity for a native moth, *Omiodes blackburni,* or they could be removed, as they can become invasive in some situations.

***Cordia subcordata* -- Kou -- (Boraginaceae) -- Indigenous**
Not observed during this survey. First collected by Herbst in 1978.
24 May 1978, Herbst, D.R. (#6113), BISH 421690.

***Cuscuta sandwichiana* -- Kaunaoa -- (Cuscutaceae) -- Endemic**
Rare. A patch on ilima on south side. First collected by Herbst in 1978. Collected again during this survey. Will likely spread as non-natives are removed.

24 May 1978, Herbst, D.R. (#6118), 2 m, BISH 421678, USNM 02921100.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-38).

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**
Occasional. Large patch near landing. First collected by Fosberg in 1937. Collected again in 1978 by Herbst. Also collected during this survey. Could be left, as it is comfortable to humans and burrowing seabirds, or it could be removed, as it is highly invasive.

6 Jun 1937, Fosberg, F.R. (#14022), BISH 118473.
24 May 1978, Herbst, D.R. (#6126), 2m, BISH 421710, USNM 02921190.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-20).

***Digitaria insularis* -- Sourgrass -- (Poaceae) -- Alien**
Rare. One plant in ironwood clearing. First collected during this survey. Could be removed before it spreads.

18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-22).

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**
Rare to occasional. On lee side of ironwood on west side of islet. First collected by Fosberg in 1937. Collected again in 1978 by Herbst. Also collected during this survey. Could be removed before it spreads.

6 Jun 1937, Fosberg, F.R. (#14007), BISH 118856.
24 May 1978, Herbst, D.R. (#6128), BISH 4216692.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-21).

***Emilia fosbergii* -- Pualele -- (Asteraceae) -- Alien**
Occasional. A few plants on south side. First collected by Fosberg in 1937. Collected again in 1978 by Herbst. Also collected during this survey. Could be removed in high value sites.

6 Jun 1937, Fosberg, F.R. (#14006), BISH 75064.
24 May 1978, Herbst, D.R. (#6110), 2 m, BISH 421687, USNM 02921105.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-33).

***Eragrostis amabilis* -- Lovegrass -- (Poaceae) -- Alien**
Rare to occasional. On lee side of ironwood on west side of islet. First collected during this survey. Could be removed in high value sites.

18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-19).

***Eragrostis variabilis* -- Emoloa -- (Poaceae) -- Endemic**
Not observed during this survey. Included on a species list (OIRC, 2005). Seeds from other islets could be spread.

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**
Rare. A few patches on west end. First collected by Herbst in 1978. Collected again during this survey. Will likely spread as non-natives are removed.

24 May 1978, Herbst, D.R. (#6121), as *F. cymosa* subsp. *umbellato-capitata*, BISH 421705.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-40).

***Heliotropium anomalum* var. *argenteum* -- Hinahina -- (Boraginaceae) -- Endemic**

Occasional. Scattered plants on south side. First collected in 1937 by Fosberg. Collected again in 1938 by Neal, in 1978 by Herbst, and during this survey. Will likely spread as non-natives are removed.

6 Jun 1937, Fosberg, F.R. (#14016, 14013), BISH 43180, 43181.
24 Sep 1938, Neal, M.C. (#s.n.) BISH 448848.
24 May 1978, Herbst, D.R. (#6130), BISH 421694.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-24).

***Hibiscus tiliaceus* -- Hau -- (Malvaceae) -- Questionably Indigenous**

Not observed during this survey. First collected by Egler in 1937. Collected again by Herbst in 1978.

6 Jun 1937, Egler, F.E. (#37-301), Found occasionally - abundant below parent trees, BISH 57638.
24 May 1978, Herbst, D.R. (#6107), 2 m, USNM 02921107.

***Ipomoea indica* -- Koali awa -- (Convolvulaceae) -- Indigenous**

Occasional. A large patch sprawling over vegetation on south side. First collected in 1937 by Fosberg. Collected in 1978 by Herbst. Collected during this survey. Will likely spread as non-natives are removed.

6 Jun 1937, Fosberg, F.R. (#14014), BISH 47496.
24 May 1978, Herbst, D.R. (#6123), 2 m, BISH 421707, USNM 02921266.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-15).

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) -- Indigenous**

Not observed during this survey. First collected in 1937 by Fosberg. May re-colonize on its own. Could be re-introduced.

6 Jun 1937, Fosberg, F.R. (#14009), BISH 47464.

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

Dominant. Large patches across much of islet. First collected in 1937 by Fosberg and Egler who described it as frequent. Collected again in 1978 by Herbst. Collected during this survey. Will likely spread as non-natives are removed.

6 Jun 1937, Fosberg, F.R. (#14012), frequent, BISH 47692.
6 Jun 1937, Fosberg, F.R. and F.E. Egler, (#14012), USNM 02155858.
24 May 1978, Herbst, D.R. (#6134), 2 m, BISH 421698, USNM 02921111.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-36).

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

Not observed during this survey. First collected by Fosberg in 1937.

6 Jun 1937, Fosberg, F.R. (#14010), BISH 71952.

***Lepidium bidentatum* var. *o-waihiense* -- Anaunau -- (Brassicaceae) -- Indigenous**

Not observed during this survey. First collected in 1932 by Wilder. Collected again in 1938 by Neal. This indigenous coastal plant could be reintroduced to Kapapa through out-planting or seed sowing.

31 Jan 1932, Wilder, G.P. (#s.n.), BISH 121871.
24 Sep 1938, Neal, M.C. (#s.n.) BISH 685117, 448847.

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**

Not observed during this survey. First collected in 1978 by Herbst.

24 May 1978, Herbst, D.R. (#6108), 2 m, BISH 421685, USNM 02921108.

***Lipochaeta* [syn. *Melanthera*] *integrifolia* -- Nehe -- (Asteraceae) -- Endemic**
Not observed during this survey. First collected by Fosberg and Egler in 1937. Could be looked for again, and if not found, it could be re-introduced.
6 Jun 1937, Fosberg, F.R. (#14010), BISH 75726.
6 Jun 1937, Egler, F.E. (#37-17), BISH 75724.

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**
Common. Scattered over much of islet. First collected by Herbst in 1978. Collected again during this survey. Will likely spread as non-natives are removed.
24 May 1978, Herbst, D.R. (#6122), 2 m, USNM 02921269
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-35).

***Paspalum vaginatum* -- Seashore paspalum -- (Poaceae) -- Alien**
Occasional. Forming mats on south side of islet. First collected during this survey. Could be removed, though it is difficult to successfully do so.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-18).

***Passiflora suberosa* -- Huehue haole -- (Passifloraceae) -- Alien**
Not observed during this survey. First collected by Herbst in 1978.
24 May 1978, Herbst, D.R. (#6114), 2 m, BISH 421691, USNM 02921103.

***Pluchea carolinensis* -- Sourbush -- (Asteraceae) -- Alien**
Occasional. In center of islet where ironwood was cut. First collected during this survey. Could be removed before it spreads.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-27).

***Pluchea indica* -- Indian fleabane -- (Asteraceae) -- Alien**
Occasional. A patch on south side. First collected by Herbst in 1978. Collected again during this survey. Could be removed before it spreads.
24 May 1978, Herbst, D.R. (#6117), 2 m, BISH 421677, USNM 02921099.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-26).

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Common. Scattered here and there in open areas. First collected by Fosberg and Egler in 1937. Collected again by Herbst in 1978. Collected during this survey. Will likely spread as non-natives are removed.
6 Jun 1937, Fosberg, F.R. (#14035), BISH 681472.
6 Jun 1937, Egler, F.E. (#37-71), BISH 75724, 6769.
24 May 1978, Herbst, D.R. (#6135), BISH 421699.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-42).

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Occasional. Scattered patches. First collected by Fosberg in 1937. Collected by Herbst in 1978. Collected again during this survey. Could be selectively removed in high value areas, such as *P. lutea* patches.
6 Jun 1937, Fosberg, F.R. (#14034, 14031), BISH 63892, 63893.
24 May 1978, Herbst, D.R. (#6116), BISH 421676
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-30).

***Portulaca pilosa* -- Portulaca -- (Portulacaceae) -- Alien**
Occasional. A few patches in open spots. First collected during this survey. Could be removed.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-29).

***Reichardia picroides* -- Reichardia -- (Asteraceae) -- Alien**
Not observed during this survey. First collected by Fosberg in 1937.
6 Jun 1937, Fosberg, F.R. (#14017), BISH 121407.

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**
Occasional. A few patches. First collected in 1978 by Herbst. Collected again during this survey. Will likely spread as non-natives are removed.
24 May 1978, Herbst, D.R. (#6132), 2 m, BISH 421696.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-47).

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Common to dominant. Dominates coastal portions. First collected by Egler in 1937. Collected again in 1978 by Herbst. Also collected during this survey. Will likely spread as non-natives are removed.
6 Jun 1937, Egler, F.E. (#37-31), BISH 6771.
24 May 1978, Herbst, D.R. (#6136), 2 m, BISH 421702, USNM 02921095.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-44).

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Dominant. Forming large patches inland. First collected by Fosberg in 1937. Collected again by Herbst in 1978. Also collected during this survey. Will likely spread as non-natives are removed.
6 Jun 1937, Fosberg, F.R. (#14008), BISH 57900.
24 May 1978, Herbst, D.R. (#6119), 2 m, BISH 421703, USNM 02921272.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-37).

***Sidastrum micranthum* -- Sidastrum -- (Unknown) -- Alien**
Rare. One patch in ironwood clearing. First collected during this survey. Could be removed.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-23).

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**
Rare. A few plants on south side. First collected during this survey. Will likely spread as non-natives are removed.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-46).

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Occasional. A few areas with established patches. First collected by Herbst in 1978. Could be selectively removed in high value areas.
24 May 1978, Herbst, D.R. (#6127), 2 m, BISH 421711, USNM 02921191.

***Sporobolus pyramidatus* -- Dropseed -- (Poaceae) -- Alien**
Rare. One patch on south side of islet. First collected during this survey. Could be removed.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-28).

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**
Common. Forming mats on north and east side, especially near coast. First collected by Herbst in 1978. Collected again during this survey. Will likely spread as non-natives are removed

24 May 1978, Herbst, D.R. (#6133), BISH 421697.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-43).

***Stachytarpheta jamaicense* -- Vervain -- (Verbenaceae) -- Alien**
Occasional. Scattered plants. First collected by Herbst in 1978. Collected again during this survey. Could be selectively removed in high value areas.

24 May 1978, Herbst, D.R. (#6109), BISH 421686.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-39).

***Tetragonia tetragonioides* -- New Zealand spinach -- (Aizoaceae) -- Alien**
Occasional. Here and there. First collected during this survey. Could be removed.

18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-45).

***Thespesia populnea* -- Milo -- (Malvaceae) -- Questionably Indigenous**
Occasional. A few stunted patches on north west part of islet. First collected by Herbst in 1978. Collected again during this survey. Could be kept or removed.

24 May 1978, Herbst, D.R. (#6112), 2 m, BISH 421689, USNM 02921101.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-31).

***Tournefortia argentea* -- Beach heliotrope -- (Boraginaceae) -- Alien**
Common. Found on margins of islet. First collected by Fosberg in 1937. Collected by Herbst in 1978. Collected by Munro in 1946. Collected during this survey. Could be removed.

6 Jun 1937, Fosberg, F.R. (#14036), BISH 43282.
8 Jun 1946, Munro, G.C.. (#131, BISH 631655.
24 May 1978, Herbst, D.R. (#6131), 2 m, BISH 421695.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-49).

KEKEPA

Figure 39. Kekepa islet.

Overview

Kekepa islet (Mushroom Rock), located in southern Kaneohe bay near the Kaneohe Marine Corps air station and south of Kapapa islet, is approximately 2 acres in size and 20 ft. in elevation (OIRC, 2005). Kekepa is a small roundish islet made out of a raised limestone reef. It is wave worn at the base and is shaped like a mushroom, making access somewhat difficult. We did a botanical survey of the islet on April 18, 2005. We boated from Heeia boat ramp, were dropped off, and swam to shore on the northwestern side, then walked around the base of the islet to the southern end where we were able to climb up a crack onto the islet. We spent about a half hour on the islet and did walk through surveys. The islet is fairly pristine and is mostly covered with native plant species. There was a small weedy area on the north side, but not very much and most of the weeds were scattered amongst the native vegetation. We saw two pairs of wedge-tailed shearwaters (*Puffinus pacificus*) nesting in a few cracks. We also flushed one kolea (*Pluvialis fulva*). Many honey bees (*Apis mellifera*) were observed visiting flowers.

Vegetation

The islet is mostly covered with native species. Ilima (*Sida fallax*) and ohelo kai (*Lycium sandwicense*) dominate most of the islet. Akulikuli (*Sesuvium portulacastrum*) is found closest to the ocean. There are scattered ihi (*Portulaca lutea*) and alena (*Boerhavia repens*) throughout most of the islet. About a dozen or so maia pilo (*Capparis sandwichiana*) were observed scattered about the islet, along with a few hinahina

(*Heliotropium anomalum* var. *argenteum*), naupaka (*Scaevola taccada*), and akoko (*Chamaesyce degeneri*). There are a few weeds located on the north side of the islet. This is the only islet where this species of akoko is currently known. During our survey, we found a total of 13 plant species. There were 9 (69%) native species and 4 (31%) non-native species. We collected all 13 plant species.

Threats

Aside from surf over topping the islet, there are a few non-native plants on Kekepa which could transform the composition of the islet. A few non-native plants exist on the north side of the islet including two plants of sandbur (*Cenchrus echinatus*), which were pulled, though follow up will be necessary to ensure successful removal. Chinese violet (*Asystasia gangetica*) was also found. There was too much to pull in our short stay, though we estimate that a team of two could probably remove all plants in one day, with follow up control done as needed. We also found a few pockets of Spanish needles (*Bidens alba* var. *radiata*) and pulled most of them, though follow up control will likely be needed. There was only one *Sonchus oleraceus* plant which we pulled. The islet is practically weed free and access is limited due to the shape of the islet. A bit of control with occasional monitoring should help keep it that way.

Restoration

The weeds could be removed with relatively little time and effort. A few native species, including the akoko and the maia pilo occur on the islet and could be propagated and out-planted on other islets nearby. Occasional monitoring should be done to catch other invasive weed species early. Other rare native species, such as *Panicum fauriei* var. *carteri*, *Portulaca villosa*, and others could be out-planted or seeds could be thrown. The islet is an abundant source of pure *Portulaca lutea* (no non-native *Portulaca oleracea* present to form hybrids) which could be propagated for out-planting on other islets.

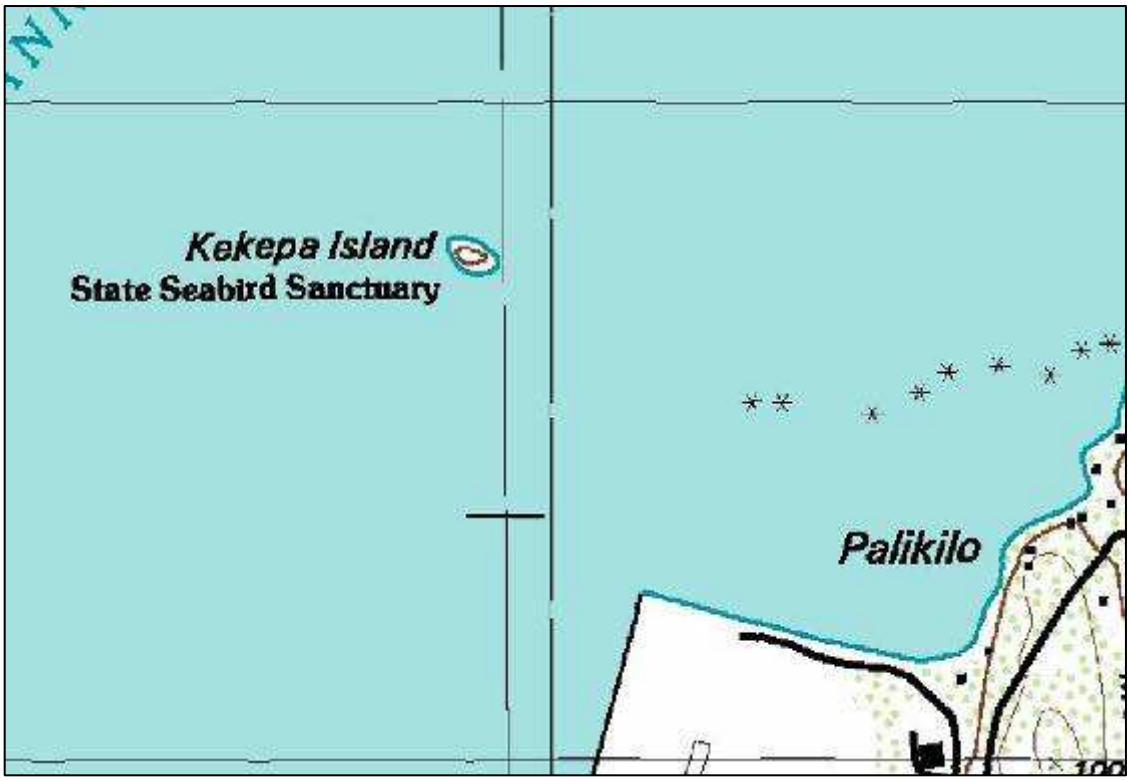

Figure 40. Kekepa map.

Figure 42. Sharp limestone with akulikuli (*Sesuvium portulacastrum*) mats.

Figure 43. Mixed akulikuli, ohelo kai (*Lycium sandwicense*), ihi (*Portulaca lutea*) herbland, with scattered akoko (*Chamaesyce degeneri*).

Figure 44. Flowering maia pilo (*Capparis sandwichiana*) mixed with ilima.

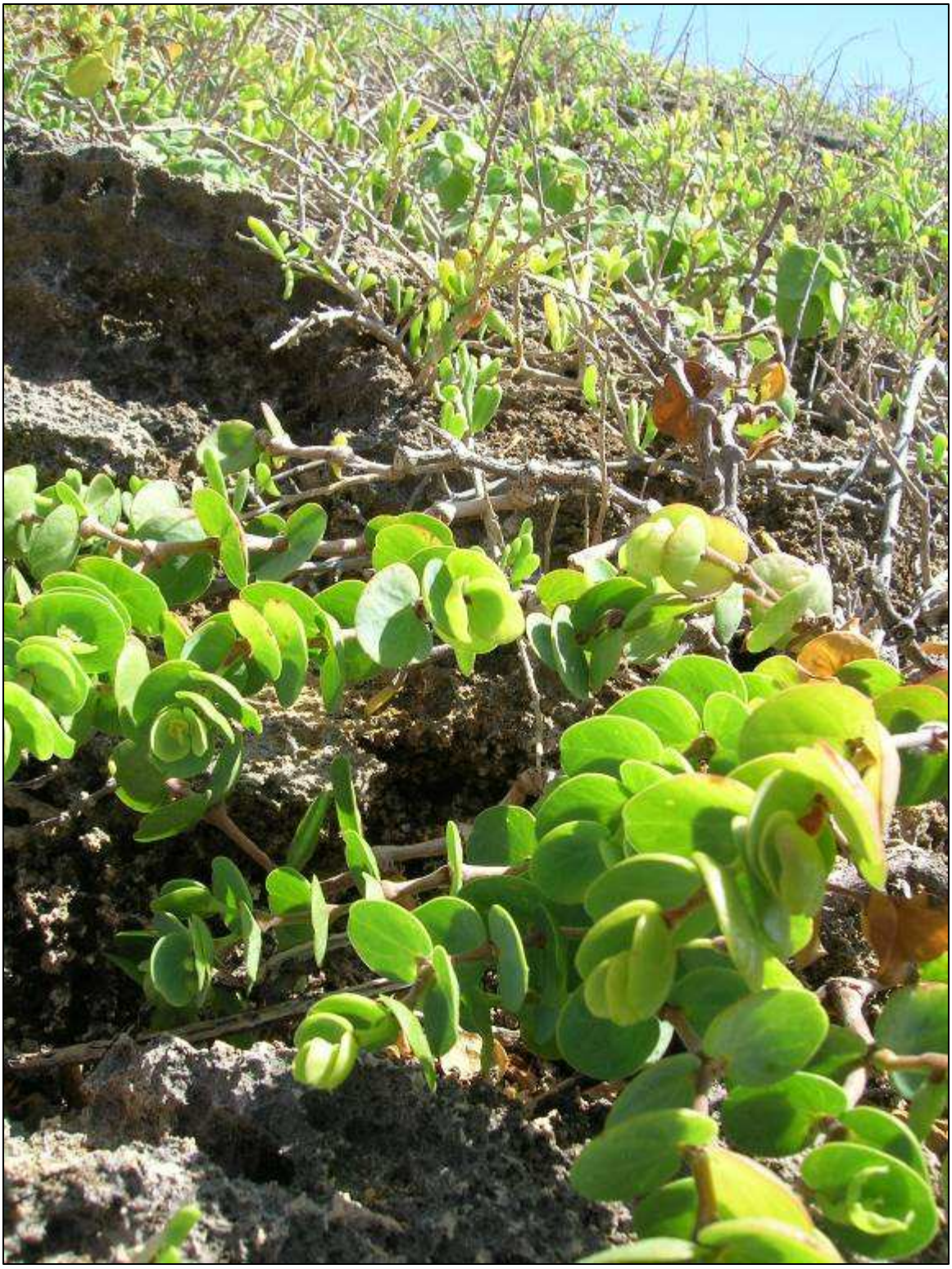

Figure 45. Akoko (*Chamaesyce degeneri*) scattered patches near summit.

Annotated Plant List -- Kekepa

***Asystasia gangetica* -- Chinese violet -- (Acanthaceae) -- Alien**
Occasional to common. Getting a foothold. Mixed in with native on north part of islet. Some pulled, but more remains. First collected during this survey. This aggressive vine could be removed before it spreads.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-1).

***Bidens alba* var. *radiata* -- Spanish needles -- (Asteraceae) -- Alien**
Rare. Small patch on top. One medium plant with a half dozen seedlings which were all pulled. First collected during this survey. Could be removed before it spreads.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-13).

***Boerhavia repens* -- Alena -- (Nyctaginaceae) -- Indigenous**
Occasional. Scattered here and there. First collected by Fosberg in 1937. Collected again in 1976 by Herbst. Also collected during this survey. Will likely spread as non-natives are removed.
25 Jul 1937, Fosberg, F.R. (#14250), 4 m, USNM 03142051.
6 Jun 1976, Herbst, D.R. (#5860), BISH 496488.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-3).

***Capparis sandwichiana* -- Maia pilo -- (Capparaceae) -- Endemic**
Occasional. Scattered, about 12+ patches. First collected by Fosberg in 1937. Collected again by Herbst in 1976 and during this survey. Will likely spread as non-natives are removed.
25 Jul 1937, Fosberg, F.R. (#14255), 4 m, BISH 46085.
6 Jun 1976, Herbst, D.R. (#5855).
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-6).

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**
Rare. Two plants, both pulled. First collected during this survey.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-2).

***Chamaesyce celastroides* var. *amplectens* -- Akoko -- (Euphorbiaceae) -- Endemic**
Not observed during this survey. First collected by Fosberg in 1937.
25 Jul 1937, Fosberg, F.R. (#14256), 4 m, BISH 49609; USNM 02159903

***Chamaesyce degeneri* -- Akoko -- (Euphorbiaceae) -- Endemic**
Occasional. Scattered patches found, especially on summit. First collected in 1976 by Herbst. Collected again during this survey. Will likely spread as non-natives are removed.
6 Jun 1976, Herbst, D.R. (#5853).
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-8).

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**
Not observed during this survey. First collected by Herbst in 1976.
6 Jun 1976, Herbst, D.R. (#5852).

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**
Not observed during this survey. First collected by Herbst in 1976. Will likely spread as non-natives are removed.

6 Jun 1976, Herbst, D.R. (#5858), BISH 496491.

***Heliotropium anomalum* var. *argenteum* -- Hinahina -- (Boraginaceae) -- Endemic**
Common. Green form, mostly on windward side. A fair amount of recently dead skeletons seen. First collected during this survey. Will likely spread as non-natives are removed.

6 Jun 1976, Herbst, D.R. (#5861), BISH 496489.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-7).

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**
Dominant. Covers the entire islet, forming sprawling mats. First collected in 1976 by Herbst. Collected again during this survey. Will likely spread as non-natives are removed.

6 Jun 1976, Herbst, D.R. (#5857).
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-10).

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Common. Scattered over islet. Some really old, gnarled looking plants. First collected by Herbst in 1976. Collected again during this survey. Will likely spread as non-natives are removed.

6 Jun 1976, Herbst, D.R. (#5859), BISH 496492.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-9).

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**
Occasional. A few small patches. A fair amount of recently dead specimens. First collected during this survey. Will likely spread as non-natives are removed.

6 Jun 1976, Herbst, D.R. (#5864), BISH 496487.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-4).

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Common. On margins and scattered patches on summit. First collected in 1976 by Herbst. Collected again during this survey. Will likely spread as non-natives are removed.

6 Jun 1976, Herbst, D.R. (#5862).
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-5).

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Dominant. Covers most of the islet. An interesting triangle leaf form was observed. First collected by Fosberg in 1937. Collected again in 1976 by Herbst. Collected again during this survey. Will likely spread as non-natives are removed.

25 Jul 1937, Fosberg, F.R. (#14252), BISH 57901.
6 Jun 1976, Herbst, D.R. (#5854).
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-12).

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Rare. One plant which was pulled. First collected by Herbst in 1976. Collected again during this survey. Could be removed before it spreads.

6 Jun 1976, Herbst, D.R. (#5856), BISH 496490.
18 Apr 2005, Starr, F., K. Starr, & D. Smith (#050418-11).

MOKU MANU

Figure 46. Moku Manu islet.

Overview

Moku Manu (Bird Island) is a pair of islets, with a larger south islet, and a smaller north islet, both located a fair ways out to sea, north of Mokapu Pt. The double islet is the eroded remnant of a tuff cone and associated lava flow (MacDonald *et al.*, 1983). The combined land area is approximately 21 acres. The main western part is 1,350 feet long, 700 feet wide, and has a maximum elevation of 202 ft. (OIRC, 2005). On Feb. 28, 2006, we landed by helicopter at the beach on the west end of the south island, and did a walk through botanical survey. We were accompanied by Ethan Shiinoki, Eric VanderWerf, Roger Helm, David Preston, Sheldon Plentovich, Jaap Eijzenga, and Heather Eijzenga, who did bird and insect surveys. David Smith arranged and oversaw the joint survey. The larger south islet is basically a sparsely vegetated aweoweo (*Chenopodium oahuense*) and nohu (*Tribulus cistoides*) shrub and herb land. It appears that the vegetation comes and goes relative to the rainfall. This past winter was dry in Dec./Jan. then became rainy in Feb. As a result, there were lots of dead plant skeletons and lots of freshly germinated seedlings. The island's flora appears to be relatively small in number of species compared to the island's size. It is also still mostly native dominated. Perhaps both can be attributed to the difficulty in landing on the island. Though we did not visit the north islet, we did scan it for plants using binoculars from the east summit of the south islet. The annotated checklist includes descriptions of plants for the south islet except where noted. A few brief notes on wildlife. We observed one sea turtle off the north side of the south islet. Numerous nesting seabirds were observed. Sooty terns were already on eggs. Gray backed terns were also present. Noddies were also on eggs, some

with chicks. Red footed boobies were nesting in aweoweo. Brown boobies were nesting in akulikuli on the southeast tip and also near nohu and bare ground in other areas. Masked boobies were also seen nesting on the islet's plateau. One Nazca booby was observed on eggs. There were boobies and frigate birds in aweoweo. Sooty terns were mostly in bare areas. A flock of akekeke were observed near the shore on the southeast tip. Opelu and flying fish were seen regurgitated by the seabirds. Two Christmas shearwaters were observed just below the east summit. A couple of dead birds were observed wrapped with monofilament.

Vegetation

During our survey, we found 14 species of plants, 5 were native, 9 were non-native. The few natives that were present made up the majority of the biomass, especially aweoweo and nohu, which were the two dominant species forming a shrubland throughout the islet. The other native species were not nearly as widespread and were usually restricted to small areas. Akulikuli (*Sesuvium portulacastrum*) formed a large patch near the ocean on the southeast tip. Alena (*Boerhavia repens*) was found in a small patch just upslope from the akulikuli. Ohelo kai (*Lycium sandwicense*) was also found in a small patch on the southwest side about the same distance upslope. Numerous seedlings were observed for most species. Seedlings of nohu and aweoweo were found in the thousands, most still in cotyledon stage. There were a few areas of hard tuff that had no soil and no vegetation growing there. The sheer tuff cliffs were also bare, with some moss on the north side. Non-native species were found occasionally throughout the islet, with pigweed (*Portulaca oleracea*), wiregrass (*Eleusine indica*), and amaranth (*Amaranthus viridis*) being more common, but still nowhere near as dominant as aweoweo and nohu. A few non-natives were first collected during this survey. Several species observed in previous surveys were not observed, including both native species, such as ilima (*Sida fallax*), enaena (*Heliotropium curassavicum*), and pua kala (*Argemone glauca*), and non-native species, such as Australian saltbush (*Atriplex semibaccata*).

Threats

Moku Manu is extremely remote and hard to get to, this was our 4th attempt at landing on the islet, the previous three by boat, which is why this islet is so well preserved and supports so many species of breeding seabirds. It may also be the reason why there are so few non-native plants present. Of the non-native plants that were present, none were dominant. Several non-native species were collected for the first time during this survey, including sandbur (*Cenchrus echinatus*), buffel grass (*Cenchrus ciliaris*), sow thistle (*Sonchus oleraceus*), and bristly fox-tail (*Setaria verticillata*). These non-native species are still fairly localized and do not seem to be causing trouble for seabird nesting. On other islets, some of these species have taken over large areas. It is not certain if these species represent large threats or not. Suppression of some of these species would help, though it is so hard to get to the islet and there are so many birds that would be disturbed, that it may not be worth it. Ants were observed throughout the islet. There was no sign of nohu biological control agents (stem boring beetles) which wipes out nohu populations elsewhere in the main Hawaiian Islands. Without the bio-control present, Moku Manu now represents one of the largest stands of nohu in the main islands.

Restoration

Restoration efforts would have to be weighed against the fact that Moku Manu is extremely difficult to get to and land on and that human presence will only disrupt seabird nesting and increase opportunity for non-native organisms to hitch a ride to the island. That said, the following restoration efforts could be employed if desired. One endangered plant, akoko (*Chamaesyce kuwaleana*), was previously observed in 1937 by Fosberg. At the time of the original survey, only one plant was found on the west summit. The plant was not re-located during recent surveys. However, plants still occur in the Waianae Mts., and if desired, could be propagated and out-planted on Moku Manu. Bare areas where no birds are nesting could be re-vegetated, and invasive non-native plants could be removed.

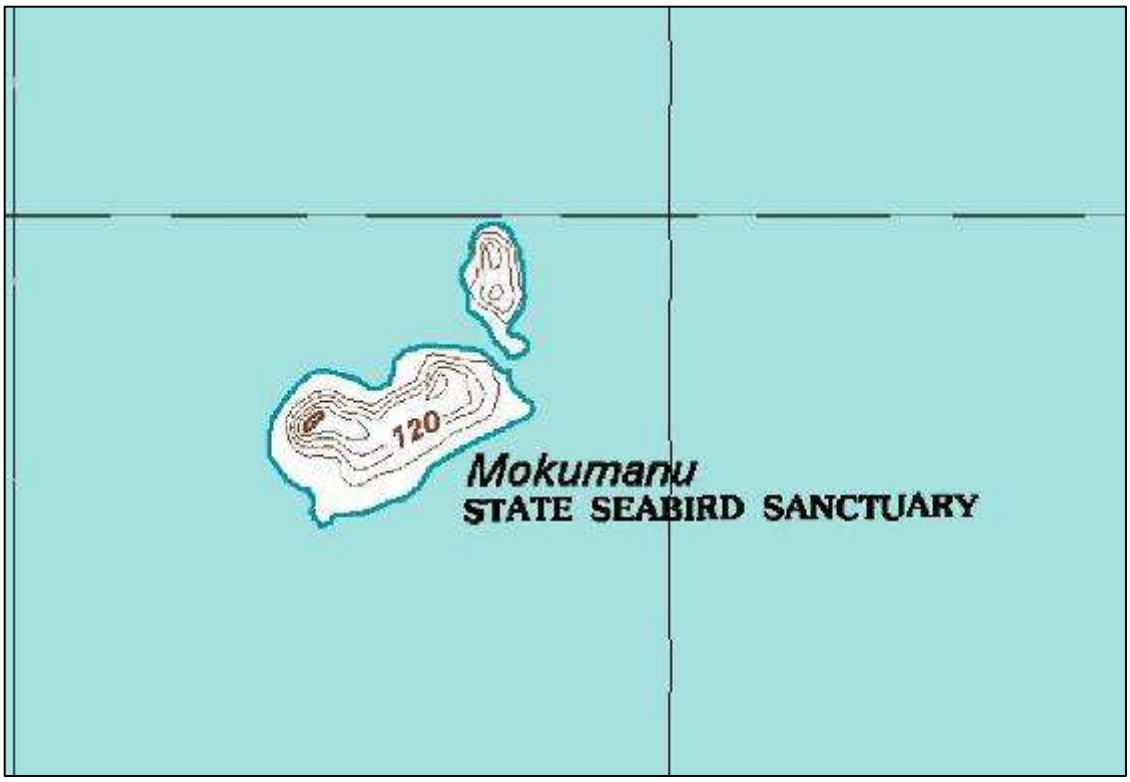

Figure 47. Moku Manu map.

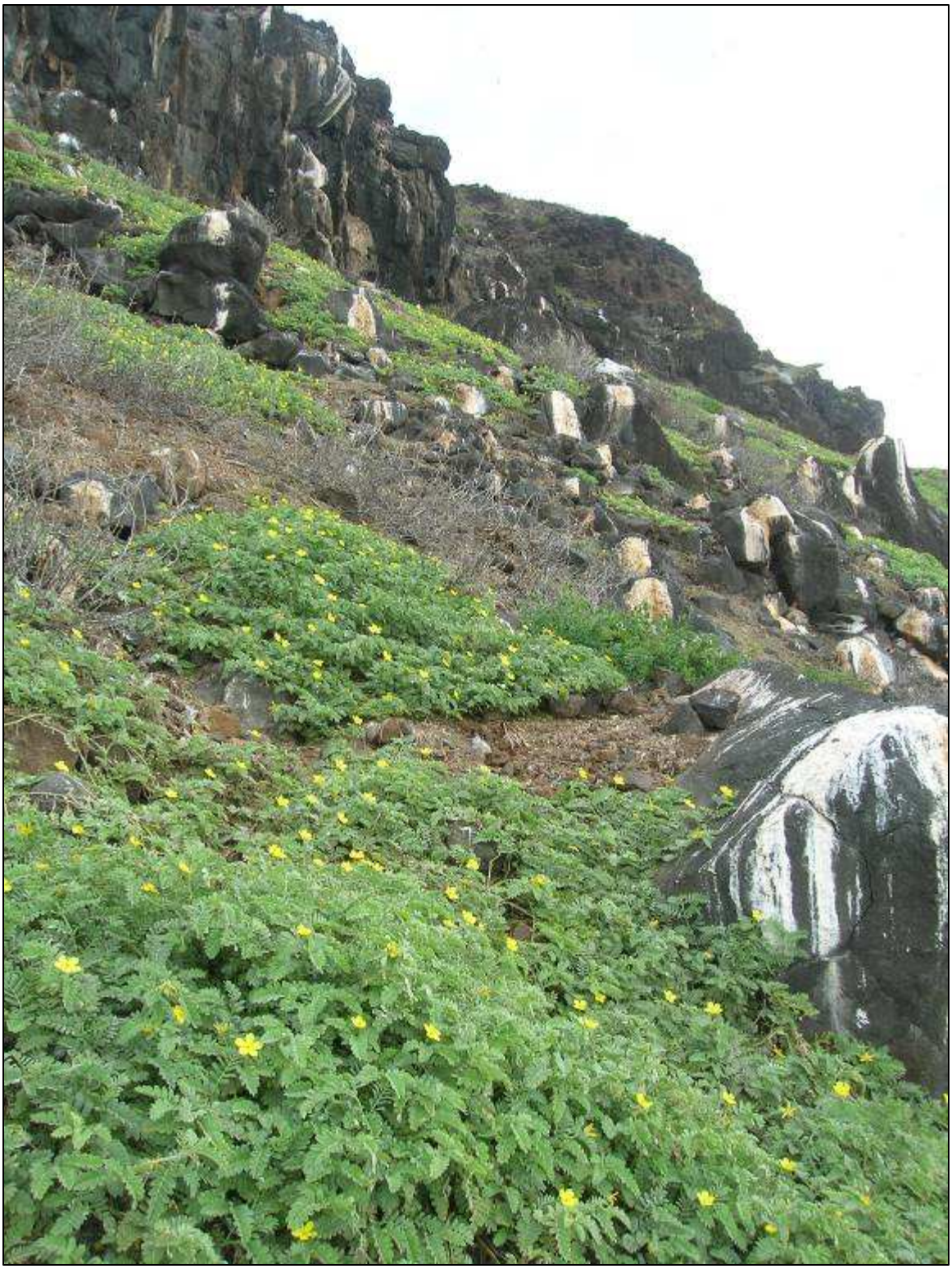

Figure 48. South slope with patches of nohu (*Tribulus cistoides*), dead aweoweo (*Chenopodium oahuense*) shrubs, and guano covered rocks.

Figure 49. Southeast tip with akulikuli herbland (*Sesuvium portulacastrum*).

Figure 50. Aweoweo / nohu shrubland on east summit of south islet with view of north islet.

Figure 51. Aweoweo / nohu shrubland and view west summit.

Figure52. Sheer north slope with little vegetation on west tuff section and aweoweo / nohu shrubland on east lava section.

Annotated Plant List -- Moku Manu

***Amaranthus viridis* -- Slender amaranth -- (Amaranthaceae) -- Alien**

Common. Here and there, in cracks, and mixed in with other vegetation. First collected by Munro in 1937. Also collected in 1937 by Neal. Collected again during this survey.

29 May 1937, Munro, G.C. (#s.n.), south slope, larger islet, BISH 448804, 448802.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448844.
28 Feb. 2006, Starr, F. and K. Starr (#060228-06), south islet, BISH.

***Argemone glauca* -- Pua kala -- (Papavaraceae) -- Endemic**

Not observed during this survey. First collected by Fosberg in 1937.

18 Jun 1937, Fosberg, F.R. (#14095), guano covered basalt rocks, 40 m, BISH 488569.

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

Not observed during this survey. First collected in 1937 by Fosberg and Neal.

18 Jun 1937, Fosberg, F.R. (#14071), south islet, BISH 46892.
18 Jun 1937, Fosberg, F.R. (#14101), 40 m, BISH 46868.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448841, USNM 03217894.

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

Rare. One patch on east tip. Many seedlings beneath adult plants and nearby. First collected by Fosberg and Egler in 1937. Collected again during this survey.

18 Jun 1937, Fosberg, F.R. and F.E. Egler (#14085), S islet, USNM 03142056.
28 Feb. 2006, Starr, F. and K. Starr (#060228-02), south islet, BISH.

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

Rare. One plant on north slope. One small patch on south slope. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-13), south islet, BISH.

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

Occasional. Scattered patches. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-09), south islet, BISH.

***Chamaesyce kuwaleana* -- Akoko -- (Euphorbiaceae) -- Endemic**

Not observed during this survey. First collected by Fosberg in 1937. Listed as an endangered species (Wagner *et al.* 1999). This species still occurs in the Waianae Mts. and could be reintroduced if desired.

18 Jun 1937, Fosberg, F.R. (#14092), south islet, summit of west end of islet, thin guano soil on basaltic rock, prostrate shrub, one plant only, 60 m, BISH 49608.

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**

Dominant. Many dead shrubs throughout islet. Also many live bushes and numerous seedlings observed. Dead plants and branches were being blown around and getting pushed around in surf. Live and dead parts of plants were observed being used as nest material for seabirds. Boobies, especially red footed boobies, were observed nesting in shrubs. First collected by Munro in 1937. Also collected in 1937 by Fosberg and by Neal. Collected again during this survey. What appeared to be this species was observed on the north islet (viewed from east summit of south islet through binoculars) as dominant.

29 May 1937, Munro, G.C. (#s.n.), south slope, well vegetated larger islet on steep basalt slope, BISH 448825, USNM 03217906.
18 Jun 1937, Fosberg, F.R. (#14077), south islet, commonest plant on island, booby nests typically built on top of small plants, ca 60 m, BISH 47006, 47004, 11563.
18 Jun 1937, Fosberg, F.R. (#14085), north islet, 40 m, guano covered basaltic rocks, shrub up to 1 m tall, BISH 47020.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448781, USNM 03217910.
28 Feb. 2006, Starr, F. and K. Starr (#060228-05), south islet, BISH.

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**

Rare. Scattered patches on north and west slope. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-14), south islet, BISH.

***Digitaria ciliaris* -- Henry's crab grass -- (Poaceae) -- Alien**

Not observed during this survey. First collected by Fosberg in 1937.

18 Jun 1937, Fosberg, F.R. (#14076), south islet, summit of island, one clump only, dead, used as bird nest, BISH 118679.

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

Rare. One clump observed on north slope. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-12), south islet, BISH.

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**

Occasional to common. Here and there in scattered patches. Dead clumps of what appeared to be this grass were found over much of the islet. First collected by Fosberg in 1937. Collected again during this survey.

18 Jun 1937, Fosberg, F.R. (#14079), south islet, occasionally found near summit, mainly dead, 60 m, BISH 118860.
18 Jun 1937, Fosberg, F.R. (#14097), north islet, 40 m, BISH 118861.
28 Feb. 2006, Starr, F. and K. Starr (#060228-08), south islet, BISH.

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**

Not observed during this survey. First collected by Fosberg in 1937.

18 Jun 1937, Fosberg, F.R. (#14074), south islet, BISH 43252.

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

Rare. One sprawling patch, a few meters on a side on southwest slope near coast. Flowers and fruits present. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-03), south islet, BISH.

***Myoporum sandwicense* -- Naio -- (Myoporaceae) -- Endemic**

Not observed during this survey. First collected by Munro in 1938 and 1940.

21 Jun 1938, Munro, G.C. (#s.n.), BISH 58800.
3 Oct 1940, Munro, G.C. (#s.n.), rocks, creeping, BISH 58801.

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

Not observed during this survey. First collected in 1937 by Fosberg and Neal.

18 Jun 1937, Fosberg, F.R. (#14094), south islet, BISH 119863.
18 Jun 1937, Fosberg, F.R. (#14083), south islet, occasional, near summit, mostly dead, 60 m, BISH 119901.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448778.

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**

Not observed during this survey. First collected by Fosberg in 1937.

18 Jun 1937, Fosberg, F.R. (#14107), N islet, BISH 681471.

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

Common. Here and there with scattered patches. No flowers present, but it appeared to be *Portulaca oleracea*. First collected in 1937 by Fosberg and Neal. Collected again during this survey. What appeared to be this species was observed on the north islet (viewed from east summit of south islet through binoculars) as occasional to common with patches and lots of seedlings on the south slope.

18 Jun 1937, Fosberg, F.R. (#14103), north islet, found throughout island, BISH 63894.
18 Jun 1937, Fosberg, F.R. (#14080), south islet, BISH 63877.
18 Jun 1937, Fosberg, F.R. (#14072), south islet, BISH 63886.
18 Jun 1937, Fosberg, F.R. (#14075), south islet, BISH 63882.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448845.
28 Feb. 2006, Starr, F. and K. Starr (#060228-07), south islet, BISH.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**

Occasional. The only plant growing on large section of island near coast on southeast tip. First collected in 1937 by Munro and Neal. Collected again during this survey.

29 May 1937, Munro, G.C. (#s.n.), south slope of larger islet, on steep basalt slope, BISH 448824.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448843.
28 Feb. 2006, Starr, F. and K. Starr (#060228-04), south islet, BISH.

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

Occasional. Scattered plants, couple patches, mostly on south slope. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-11), south islet, BISH.

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

Not observed during this survey. First collected in 1937 by Fosberg and Neal. Collected again in 1947 by Rogers.

18 Jun 1937, Fosberg, F.R. (#14096), N islet, spreading, semi-prostrate shrub, flowers orange, 40 m, BISH 57903, USNM 02159894.
18 Jun 1937, Fosberg, F.R. (#14102), north islet, BISH 57889.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448779.
10 May 1947, Rogers, D.P. (#s.n.), SW islet, BISH 17719.

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

Not observed during this survey. First collected by Munro in 1937. Also collected by Fosberg and Neal in 1937.

29 May 1937, Munro, G.C. (#s.n.), south slope, larger islet, BISH 448826.
18 Jun 1937, Fosberg, F.R. (#14082), south islet, BISH 70099.
18 Jun 1937, Fosberg, F.R. (#14098), north islet, BISH 70110.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448842.

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

Occasional. Scattered mostly on north facing cliffs. First collected during this survey.

28 Feb. 2006, Starr, F. and K. Starr (#060228-10), south islet, BISH.

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

[Syn. *Solanum lycopersicon* var. *cerasiforme*]. Not observed during this survey. First collected by Fosberg in 1937.

18 Jun 1937, Fosberg, F.R. (#14100), north islet, BISH 69769.

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**

Not observed during this survey. First collected in 1937 by Fosberg and Neal. Collected again in 1947 by Rogers.

18 Jun 1937, Fosberg, F.R. (#14086), south islet, near landing place, BISH 120487.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448780, USNM 03217909.
10 May 1947, Rogers, D.P. (#s.n.), SW islet, BISH 17720.

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

Dominant. Basically everywhere. Found throughout islet. Patches with flowers and fruit. Numerous seedlings near patches on slopes. Used in booby nests. Did not observe any sign of the introduced biological control agents, *Microlarinus* spp. This appears to be the largest continuous stand of nohu left in the main Hawaiian Islands. First collected by Munro in 1937. Also collected in 1937 by Fosberg in Neal. Collected again in 1947 by Rogers. Collected again during this survey. What appeared to be this species was observed on the north islet (viewed from east summit of south islet through binoculars) as dominant and present on the summit.

29 May 1937, Munro, G.C. (#s.n.), south slope, larger islet, well vegetated, on steep basalt slope, BISH 448805.
18 Jun 1937, Fosberg, F.R. (#14091), south islet, occasional throughout island, 50 m, BISH 72413.
18 Jun 1937, Fosberg, F.R. (#14099), N islet, 40 m, prostrate, flowers bright yellow, fruit immature, BISH 72412.
18 Jun 1937, Neal, M.C. (#s.n.), larger islet or SW islet, BISH 448840.
10 May 1947, Rogers, D.P. (#s.n.), SW islet, BISH 17718.
28 Feb. 2006, Starr, F. and K. Starr (#060228-01), south islet, BISH.

MOKOLEA

Figure 53. Mokolea rock.

Overview

Mokolea (Birdsh*t Rock) is located in Kailua Bay and consists of columnar-jointed melilite nephelinite lava that apparently came from a cinder cone that has now eroded away (MacDonald *et al*., 1983). The basaltic rocks of Mokolea are heavily influenced by surf. Mokulea rock is approximately .4 acres in size and attains a maximum height of 15 ft. (OIRC, 2005). A botanical survey of Mokolea islet was done on Feb. 23, 2005. We boated to the islet in the morning, swam to the rock, and did a brief walk through survey.

Vegetation

The vegetation of Mokolea rock is sparse and mostly restricted to the upper portions of the tallest hump. Mokolea is mostly barren on the large (north) outcrop and is totally barren on the smaller (south) outcrop. During our survey, we found 4 species of plants, 2 (50%) were native, ohelo kai (*Lycium sandwicense)* and akulikuli (*Sesuvium portulacastrum*), and 2 (50%) were non-native, seashore paspalum (*Paspalum vaginatum*) and pigweed (*Portulaca oleracea*). The seashore paspalum was previously not recorded and was collected during this survey. No *Portulaca lutea* was observed.

Threats

There is not too much that threatens the plants on this rock. A few beer cans were found at the top of the rock, so human presence is a slight threat, though due to restricted access, probably not very serious. Ants, which were noted on the islet, could affect seabirds. High surf likely occasionally removes much off the islet.

Restoration
The native plants seem to be holding their own on this small rock. If desired, the non-native *Portulaca oleracea* could be removed and replaced with the native *Portulaca lutea*. The same could be done for the non-native *Paspalum vaginatum*, which could be replaced with *Sporobolus virginicus*. The rock could be visited occasionally to check for new invasive non-native plants. The ants could be eradicated.

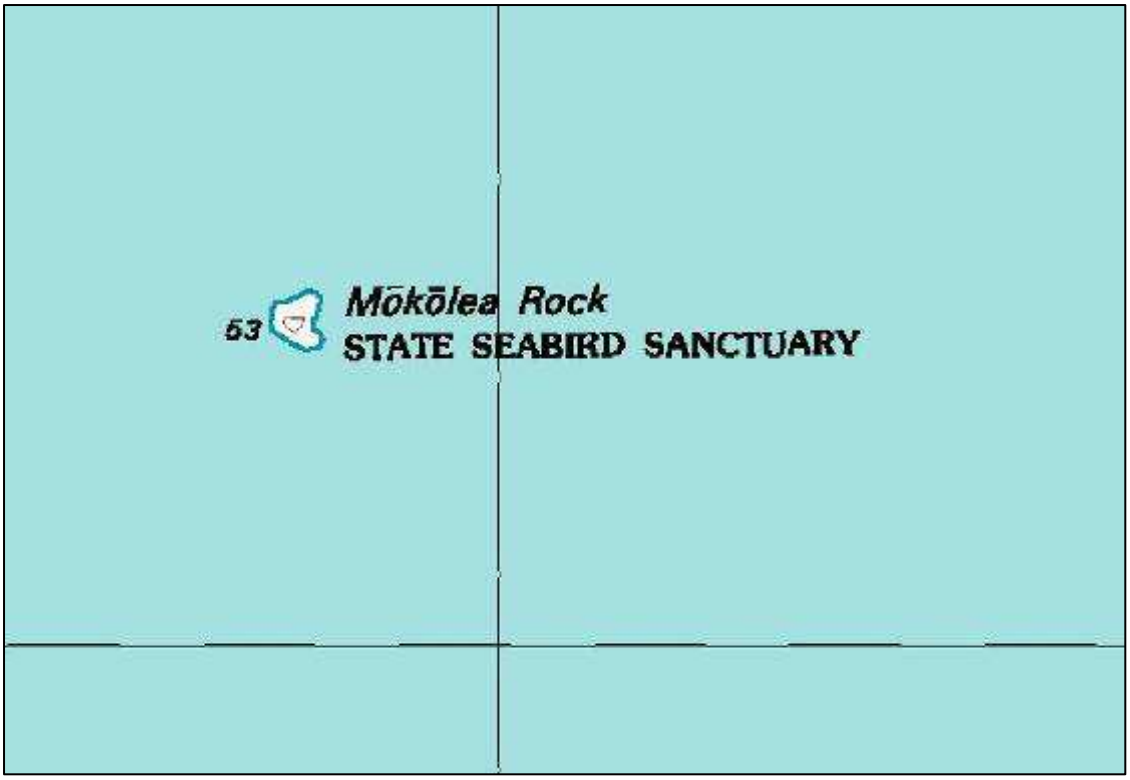

Figure 54. Mokolea map.

Figure 55. Mokolea orthophoto.

Annotated Plant List -- Mokolea

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

Occasional to common. Climbing on rocks. Patches in between rocks on top of main hump on islet. First and only collection by Dranga in 1924. Collected again by Herbst in 1978. This species seems to be doing fine on Mokolea. No actions are recommended other than routine monitoring.

25 Feb 1924, T. Dranga (#1239), BISH 69746.
7 Feb 1978, Herbst, D.R. (#6035).

***Paspalum vaginatum* -- Seashore paspalum -- (Poaceae) -- Alien**

Rare. 1 clump of what appeared to be this grass was found on the summit. No fertile material was found. First collected during this survey. No actions are recommended other than routine monitoring.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-1).

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

Rare to occasional. Scattered here and there on summit. First collected by Fosberg in 1937. Collected again by Herbst in 1978. No actions are recommended other than routine monitoring.

18 Jun 1937, Fosberg, F.R. (#14109), BISH 63880.
7 Feb 1978, Herbst, D.R. (#6037), BISH 421607.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**

Occasional. Forming patches in between rocks on summit. First collected in 1978 by Herbst. This species seems to be doing fine on Mokolea. No actions are recommended other than routine monitoring.

7 Feb 1978, Herbst, D.R. (#6036), BISH 421609.

POPOIA

Figure 56. Popoia islet.

Overview

Popoia (Flat Island) is fairly close to the main island of Oahu, located in Kailua Bay and consists of raised limestone with a rocky surface and sink holes. It is a small islet approximately 3.7 acres in size, is flat in shape, and reaches a maximum elevation of 10 ft. (OIRC, 2005). A botanical survey of Popoia islet was done on Feb. 23, 2005. We boated to the islet in the morning, waded to the sandy cove on the southwest side of the islet, and did a brief walk through survey until after lunch. The islet is accessible to the public. There is one beach where landings are made and informal coastal trails. This small flat islet is made of raised limestone is extremely exposed to the salty and harsh oceanic conditions. The islet is mostly covered with native plants, with the exception of a few weed patches on the southwest side.

Vegetation

The vegetation of Popoia is mostly a low growing herbland made up predominantly of native plant species, including akulikuli (*Sesuvium portulacastrum*), ihi (*Portulaca lutea*), and alena (*Boerhavia repens*). Maia pilo (*Capparis sandwichiana*) is interspersed throughout the herbland and is very prostrate. There are a few small patches of hinahina (*Heliotropium anomalum* var. *argenteum*) on the north side. Aweoweo (*Chenopodium oahuense*) forms a shrubland, especially in the western interior. Koali awa (*Ipomoea indica*) sprawls on shrubs and on the ground, especially in the central and western portions of the islet. A few weedy patches exist on the south western side near the landing and facing Kailua. There is a patch of pickle weed (*Batis maritima*) and just

beyond the beach landing there were a few plants each of sandbur (*Cenchrus echinatus*), haole koa (*Leucaena leucocephala*), and ivy gourd (*Coccinia grandis*). Other non-natives are scattered about the islet, mostly in disturbed areas. A total of 29 plant species were found on Popoia during our survey. There were 15 (52%) native species and 14 (48%) non-native species. We collected 10 plant species, all were non-native.

Threats

Threats to native plants on Popoia include trampling by humans and introduction of aggressive non-native plants. Proper signage that clearly states undesired activities along with clearly designated trails will help to keep human threats to a minimum. The islet is small enough that if certain weeds were found in a timely manner and removed, large infestations might be avoided. Incipient weeds on Popoia include: pickle weed, sandbur, button mangrove (*Conocarpus erectus*), ivy gourd, wiregrass (*Eleusine indica*), haole koa, and pigweed (*Portulaca oleracea*). Target incipient weeds could be included in a "have you seen these plants on Popoia Islet" poster which enlists workers, volunteers, and community members who frequently visit the islet in identification and removal efforts. With such a small area, even more widespread weeds, such as Chinese violet (*Asystasia gangetica*), could be reduced significantly through persistent weeding. Weeding could begin in the more native portions of the windward side and work towards the weedier leeward sides. A system of regular monitoring for new weeds could focus on landings, trails, and other high traffic areas. A few non-native fruit eating birds including blue faced doves and cattle egrets were observed on the islet all day. These have the potential to introduce weeds such as ivy gourd to the islet. Big headed ants (*Pheidole megacephala*) are present and research is underway to explore their effects on islet biota.

Restoration

The native plants are doing quite well on this small islet, especially on the windward side of the islet. Restoration work could start in these areas and work towards the leeward side, which is more weedier/less pristine. The islet is a holdout for *Portulaca lutea*, which has quickly become more rare through hybridization with the non-native *Portulaca oleracea*. If desired, the non-native *Portulaca oleracea* could be removed and replaced with the native *Portulaca lutea*. Other native plants suitable to the environment, such as ohai (*Sesbania tomentosa*) could be out-planted to add diversity. Seeds, such as emoloa (*Eragrostis variabilis*) and aweoweo (*Chenopodium oahuense*) could be spread. Native plants that were previously recorded from Popoia, but are no longer there could be reintroduced, including pau o hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*), button sedge (*Fimbristylis cymosa*), native panic grass (*Panicum faurei*), and nehe (*Lipochaeta integrifolia*). Some weeds, such as swinecress (*Coronopus didymus*) were coming up in sandy pockets within the limestone reef. These could be hand pulled and native seeds could be thrown in afterwards. There is an anchialine pond that could provide habitat for native damselfly or pinau ula (*Megalagrion xanthomeles*) restoration.

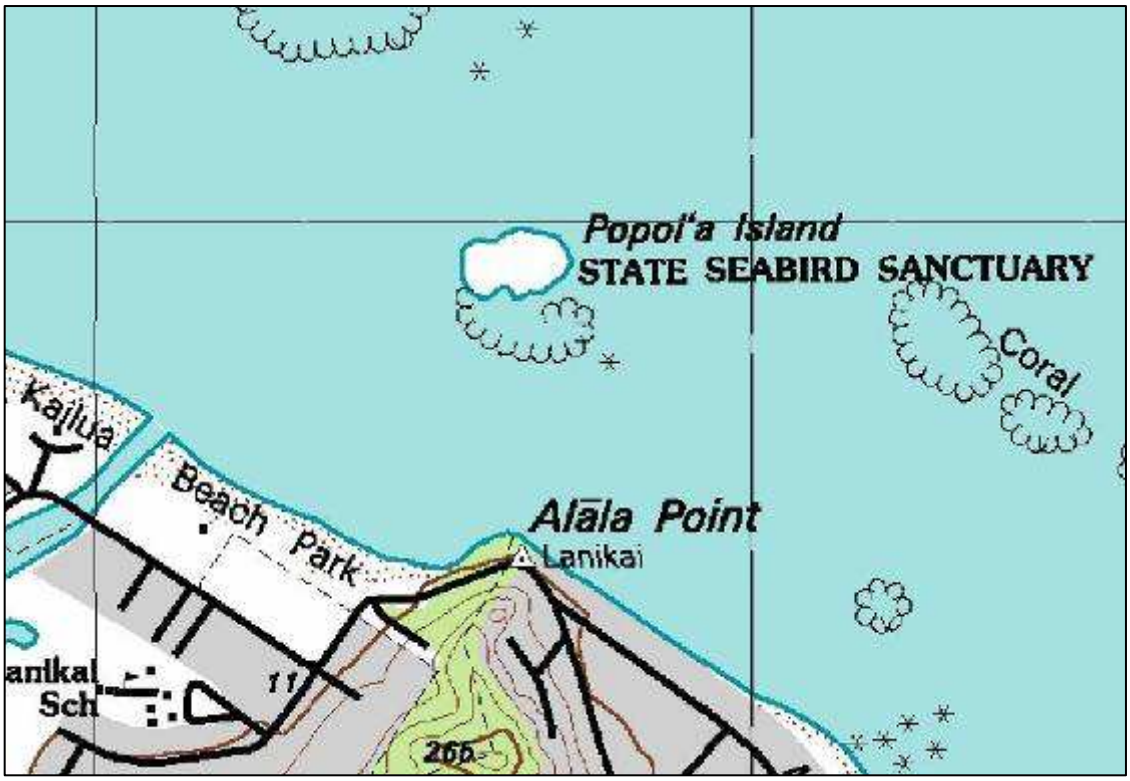

Figure 57. Popoia map.

Figure 58. Popoia orthophoto.

Figure 59. Pickleweed (*Batis maritima*) on raised limestone.

Figure 60. Anchialine pond with akulikuli mats in limestone sinkhole.

Figure 61. Mixed akiaki and akulikuli with scattered hinahina (*Heliotropium anomalum* var. *argenteum*).

Figure 62. Landing and kayakers with coastal trail and aweoweo (*Chenopodium oahuense*) shrubland inland.

Annotated Plant List -- Popoia

***Asystasia gangetica* -- Chinese violet -- (Acanthaceae) -- Alien**

Common. Scattered patches, especially in central part of islet, generally found in association with aweoweo. First collected in 1978 by Herbst. This colorful vine can be aggressive, and if left unchecked, could blanket much of Popoia. Small infestations can be hand pulled. Large patches and stubborn tap roots may require herbicide.

7 Feb 1978, Herbst, D.R. (#6032), BISH 421606.

***Batis maritima* -- Pickle weed -- (Bataceae) -- Alien**

Uncommon. One patch near landing about 15m x 15m in size. First recorded by OIRC website (OIRC, 2005). First collected during this survey. This species is a pest elsewhere and could likely transform the entire islet. Currently, it is still restricted to a small portion of the islet. Pickle weed is very difficult to pull by hand, but can be readily removed with herbicide.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-8).

***Boerhavia acutifolia* [syn. *glabrata*] -- Alena -- (Nyctaginaceae) -- Indigenous**

Not observed during this survey. First and only collection by Stokes in 1915. *Boerhavia* is a taxonomically challenging genus. There is much confusion about how to distinguish species. Genetic work on the *Boerhavia* of Oahu offshore islets would make an interesting study.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 60735.

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

Common. Found throughout islet, where it sprawls in and out of vegetation. This coastal species with sticky fruits was first collected by Fosberg in 1933, and was collected again by Herbst in 1978. Alena is doing well on Popoia, no action seems necessary other than monitoring of status and distribution. A larvae of the non-native hawk-moth *Hyles lineata* (white-lined sphinx) was found near *B. repens* in the central portion of Popoia. This moth has a wide host range, and may have been eating the *Boerhavia* or some other plant (*Ipomoea*, *Chenopodium*, *Portulaca*).

26 Mar 1933, Fosberg, F.R. (#10554), 2 m, USNM 03142058.
7 Feb 1978, Herbst, D.R. (#6022), USNM 02921253.

***Capparis sandwichiana* -- Maia pilo -- (Capparaceae) -- Endemic**

Occasional to common. Growing in sinkholes and twining in vegetation. Very prostrate. Seedlings seen in bare areas at base of sinkholes. *Pieris rapae* (cabbage looper) ovipositing on leaves. Feeding damage likely attributed to this introduced butterfly noted on leaves. Native Plutellid moth feeding damage not noted on leaves. Many fragrant flowers present. Ants noted visiting flowers. No fruits seen. First collected by Fosberg in 1932. Collected again by Perlman and Hill in 1992. Collected again by Herbst in 1978. Popoia is a stronghold for this species. It would likely also do well on other islets.

8 Nov 1932, Fosberg, F.R. (#8891), BISH 46087.
13 Feb 1992, Perlman, S. & Hill, B. (#12558), 2 m, USNM 03252197.
7 Feb 1978, Herbst, D.R. (#6021).

***Carica papaya*-- Papaya -- (Caricaceae) -- Alien**

Rare. One plant found near landing, likely the result of someone's lunch being tossed in the bushes. First collected during this survey. This tasty fruit likely won't become invasive, and could be tolerated, or could be removed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-4).

***Casuarina equisetifolia* -- Ironwood -- (Casuarinaceae) -- Alien**

Rare. One small seedling found near landing and pulled. First collected during this survey. This hardy tree could transform this islet if left unchecked. It should be looked for on a regular basis and removed when found. Small plants can be hand pulled.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-2).

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

Uncommon. A few patches in interior near landing that were pulled and bagged. First collected in 1978 by Herbst. Collected again during this survey. This is yet another species that could transform the vegetation on Popoia. The spiny burs of this grass stick to people, making re-invasion of this heavily visited islet a real likelihood, and necessitating regular monitoring and control.

7 Feb 1978, Herbst, D.R. (#6016), BISH 421507.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-6).

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**

Common. Found around islet, especially western interior, where it becomes somewhat dominant. First collected by Stokes in 1915. Collected again by Fosberg in 1936 and by an unknown collector in 1967. Collected again by Herbst in 1978. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 47017.

8 Nov 1932, Fosberg, F.R. (#8892), BISH 46985.

1 Nov 1936, Fosberg, F.R. (#13298), BISH 47010.

12 May 1967, Unknown collector (#s.n.), BISH 584753.

7 Feb 1978, Herbst, D.R. (#6026).

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**

Not observed during this survey. First and only collection in 1936 by Fosberg. This grass, which is common on other Oahu offshore islets, could be watched for and hand pulled when found.

25 Jan 1936, Fosberg, F.R. (#12838), 3 m, BISH 118333, USNM 02487690.

***Coccinia grandis* -- Ivy gourd -- (Cucurbitaceae) -- Alien**

Rare to uncommon. A couple plants growing together on north central part of islet. Stems were cut and stumps were treated with Brush-B-Gon (garlon). No insect damage noted. First collected during this survey. This vigorous vine has the ability to over run the vegetation of Popoia. It will likely continue to occasionally show up on the offshore islets of Oahu, brought in by non-native fruit eating birds flying back and forth to the main island, where this vine is common. It is much easier to get rid of ivy gourd if it is found early.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-3).

***Conocarpus erectus* -- Button mangrove -- (Combretaceae) -- Alien**

Rare. One plant on south side of islet that was pulled. First collected during this survey. This silver leaved tree is commonly cultivated in Lanikai and other coastal areas around Hawaii. It will occasionally show up on these islets. It does not spread too quickly, and can be hand-pulled when young.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-10).

***Coronopus didymus* -- Swinecress -- (Brassicaceae) -- Alien**

Rare to uncommon. 2 x 2m patch with numerous individuals on west side near coast, growing in sands inside limestone hole. First collected during this survey. All the plants were pulled. Follow up will be necessary, as it had gone to seed. This diminutive herb could likely become ubiquitous on Popoia if left unchecked.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-7).

***Cuscuta sandwichiana* -- Kaunaoa -- (Cuscutaceae) -- Endemic**

Not observed during this survey. First collected in 1915 by Stokes. This native parasitic vine could be re-introduced. It "hosts" on many plants, native and non-native, though its' preferred host, the native beach morning glory vine or pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*), is not known from the islet.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 47267.

***Cyanthillium* [syn. *Vernonia*] *cinerea* -- Little ironweed -- (Asteraceae) -- Alien**

Not observed during this survey. First and only collection in 1915 by Stokes.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 121749.

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**

Not observed during this survey. First and only collection in 1978 by Herbst. Bermuda grass can become highly invasive, and should be looked for on Popoia. Hand pulling is generally not effective against Bermuda grass, which usually requires multiple herbicide applications to completely remove.

7 Feb 1978, Herbst, D.R. (#6018), BISH 421505.

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

Not observed during this survey. First and only collection in 1978 by Herbst.

7 Feb 1978, Herbst, D.R. (#6015), BISH 421506.

***Echinochloa colona* -- Jungle-rice -- (Poaceae) -- Alien**

Not observed during this survey. First and only collection in 1915 by Stokes.

1915, Stokes, J.F.G. (#s.n.), BISH 118804.

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**

Uncommon. A few plants in interior near landing that were pulled and bagged. First collected in 1936 by Fosberg. This species is not super invasive, but can do well in high traffic areas. It could be watched for and pulled when found.

1 Nov 1936, Fosberg, F.R. (#13296), BISH 118862.

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**

Not observed during this survey. Seeds could be spread. First collected (both subsp.) by Stokes in 1915. Collected (as *F. cymosa*) by Fosberg in 1933.

26 Mar 1933, Fosberg, F.R. (#10557), 2 m, USNM 03154312.

Fimbristylis cymosa subsp. *umbellato-capitata*
Nov 1915, Stokes, J.F.G. (# s.n.), BISH 117211, 117192.
Fimbristylis cymosa subsp. *spathacea*
Nov 1915, Stokes, J.F.G. (# s.n.), BISH 117192.

***Heliotropium anomalum* var. *argenteum* -- Hinahina -- (Boraginaceae) -- Endemic**
Occasional. Found on north part, near coast, in association with akulikuli and ihi. Plants appear to be the greener form. First collected by Stokes in 1915. Collected again by Fosberg in 1932, 1933, and 1936. Collected by Herbst in 1978. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.

Nov 1915, Stokes, J.F.G. (# s.n.), BISH 43215, 43214, 43210, 43208.
8 Nov 1932, Fosberg, F.R. (#8885), BISH 43260.
26 Mar 1933, Fosberg, F.R. (#10581), BISH 43198.
15 Feb 1936, Fosberg, F.R. (#12883), BISH 43224.
15 Feb 1936, Fosberg, F.R. (#12871), BISH 43202.
7 Feb 1978, Herbst, D.R. (#6029), BISH 421612, USNM 02921211.

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**
Rare. One plant at landing. First collected by Stokes in 1915. Collected again by Fosberg in 1934 and by Herbst in 1978. This ephemeral species of disturbed sites is barely hanging on at Popoia. Despite that no action seems necessary other than monitoring of status and distribution.

Nov 1915, Stokes, J.F.G. (# s.n.), BISH 43232.
28 Jan 1934, Fosberg, F.R. (#10588), BISH 43248.
7 Feb 1978, Herbst, D.R. (#6030), BISH 421611.

***Ipomoea indica* -- Koali awa -- (Convolvulaceae) -- Indigenous**
Occasional to common. Established in center of islet, especially west end. First collected in 1915 by Stokes. Collected in 1933 by Fosberg. Collected again in 1978 by Herbst. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.

Nov 1915, Stokes, J.F.G. (# s.n.), BISH 47470, 47471.
26 Mar 1933, Fosberg, F.R. (# 10582), 2 m, BISH 47579, USNM 02431418.
7 Feb 1978, Herbst, D.R. (#6023, 6024 as form *alba*).

***Ipomoea littoralis* -- Morning glory -- (Convolvulaceae) -- Questionably Indigenous**
Not observed during this survey. Reported in OIRC website (OIRC, 2005).

***Jacquemontia ovalifolia* subsp. *sandwicensis* -- Pau o hiiaka -- (Convolvulaceae) -- Endemic**
Not observed during this survey. First collected in 1915 by Stokes. Collected again in 1933 by Fosberg. This trailing native vine would likely do well on Popoia. It could be out-planted and seeds could be thrown to re-introduce it to the islet. Seeds and cuttings of pau o hiiaka could be collected from nearby sources such as Mokulua North, Mokulua South, and Kaohikaipu for restoration efforts.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 122037.
Nov 1915, Stokes, J.F.G. (#s.n.), BISH 47690.
26 Mar 1933, Fosberg, F.R. (#10585), BISH 122014.

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**

Uncommon. A few small trees in interior near landing. Seed pods were bagged, stems were cut, and stumps were treated with Brush-B-Gon (garlon). First collected during this survey.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-5).

***Lipochaeta* [syn. *Melanthera*] *integrifolia* -- Nehe -- (Asteraceae) -- Endemic**

Not observed during this survey. First collected in 1914 by Forbes. Collected again in 1933 by Fosberg. This endemic yellow flowered groundcover could be out-planted or seeds could be thrown to re-introduce it to the islet. Nehe seeds and cuttings could be collected from nearby sources, such as Mokulua South and Kaohikaipu for restoration efforts.

Apr 1914, Forbes, C.N. (#2194.O), BISH 75739.
26 Mar 1933, Fosberg, F.R. (#10556) BISH 24548, 75738.

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

Common. Scattered around islet, especially east end. Ripe red fruits observed. First collected by Stokes in 1915. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 69725.
7 Feb 1978, Herbst, D.R. (#6025), BISH 421502.

***Malvastrum coromandelianum* -- Malvastrum -- (Malvaceae) -- Alien**

Not observed during this survey. First collected in 1915 by Stokes.

Nov 1915, Stokes, J.F.G. (# s.n.), BISH 57802.

***Panicum fauriei* -- Hawaiian panic grass -- (Poaceae) -- Endemic**

Not observed during this survey. First collected in 1933 by Fosberg who noted, "2 m". Collected again in 1936 by Fosberg who noted, "3 m". Collected again in 1938 by Munro and in 1939 by Neal. This endemic grass could be out-planted or seeds could be thrown to re-introduce it to the islet. *Panicum fauriei* seeds could be collected from nearby sources, such as Mokolii Islet for restoration efforts.

29 Mar 1933, Fosberg, F.R. (#10551), 2 m, USNM 02184852, BISH 516933.
25 Jan 1936, Fosberg, F.R. (#12837), 3 m, USNM 02184853, BISH 516928.
30 May 1938, Munro, G.C. (#s.n.), BISH 458146.
9 Apr 1939, Neal, M.C. (#s.n.) BISH 641020, 641021.

***Paspalum vaginatum* -- Seashore paspalum -- (Poaceae) -- Alien**

Uncommon to occasional. A few patches of what appeared to be this grass was found on the northwest side near coast, where it was growing out of coralline crevices. No fertile material seen. First collected during this survey. This may be the same grass referred to as "*Pennisetum clandestinum*" by Herbst (see below), fertile material should be collected if found to help confirm the identification. *P. vaginatum* has been popularized as a bank stabilizer in Hawaii and has spread from plantings to wet lowland areas. It is difficult but possible to get rid of with a combination of hand pulling and herbicide.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-9).

***Passiflora foetida* -- Love-in-a-mist -- (Passifloraceae) -- Alien**

Not observed during this survey. First and only collection in 1915 by Stokes. See discussion of Mokuauia for more details.

Nov 1915, Stokes, J.F.G. (#s.n.), BISH 61421.

***Pennisetum clandestinum* -- Kikuyu grass -- (Poaceae) -- Alien**
Not observed during this survey. First and only collection in 1978 by Herbst who noted, "noxious weed". See discussion of *Paspalum vaginatum* above.
7 Feb 1978, Herbst, D.R. (#6034), noxious weed, BISH 421604

***Pluchea carolinensis* -- Sourbush -- (Asteraceae) -- Alien**
Not observed during this survey. First and only collection in 1978 by Herbst. This species could likely do well on Popoia, and should be looked for during regular surveys.
7 Feb 1978, Herbst, D.R. (#6019), BISH 421510

***Pluchea indica* -- Indian fleabane -- (Asteraceae) -- Alien**
Not observed during this survey. First collected by E.H. Bryan Jr. in 1949. Collected again in 1978 by Herbst. As with the other *Pluchea* spp., this species could likely do well on Popoia, and should be looked for during regular surveys.
3 Sep 1949, Bryan, E.H. Jr. (#s.n.), BISH 642148.
7 Feb 1978, Herbst, D.R. (#6028), BISH 421614.

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Occasional to common. Here and there, especially on the southeast side, where it grows in coralline crevices, and in mats in association with akulikuli and hinahina. Probably first collected by Stokes (no date given, but likely 1915). Collected again by F.R. Fosberg in 1932 and 1933, by V.O. Fosberg in 1937, and by Herbst in 1978. Ihi has recently become more rare in the Hawaiian archipelago, yet is doing quite well on Popoia, one of the last stronghold for this species. The native *P. lutea* is closely related to the non-native *P. oleracea*, from which it can be distinguished by having larger flowers, containing numerous (>12 - 50) stamens. *P. lutea* and *P. oleracea* are both present on Popoia, and they likely hybridize. To retain the pure genetics of *P. lutea*, *P. oleracea* could be removed from Popoia, through a combination of hand pulling and herbicide, to reduce potential hybridization. Plants from Popoia could be used as source materials for restoration of other islets where *P. lutea* used to historically exist, such as Kaohikaipu. Genetic work on the *Portulaca* of Oahu offshore islets would make an interesting study.
No date, Stokes, J.F.G. (#s.n.), BISH 681465, 63832.
8 Nov 1932, Fosberg, F.R. (# 8884), BISH 63831.
26 Mar 1933, Fosberg, F.R. (#10573), BISH 681474.
27 Mar 1937, Fosberg, V.O. (#101), BISH 681470.
7 Feb 1978, Herbst, D.R. (#6031), BISH 421610.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Occasional. Mostly on west side of islet near beach and landing. First collected by Fosberg in 1936. Also collected by Stokes, no date, and by Herbst in 1978. *P. oleracea* can be distinguished by having small flowers with <12-15 stamens. This non-native *P. oleracea* hybridizes with *P. lutea* and in many places has replaced the native *Portulaca*, which is now rare in distribution due to the hybrid contamination. *P. oleracea* could be removed by hand pulling once properly identified with flowers. *P. lutea* still exists on Popoia and *P. oleracea* should be removed in order to preserve the native ihi.
No date, Stokes, J.F.G. (#s.n.), BISH 63884.

25 Jan 1936, Fosberg, F.R. (#12836), BISH 63887.
7 Feb 1978, Herbst, D.R. (#6014).

***Rhizophora mangle* -- Mangrove -- (Rhizophoraceae) -- Alien**
Not observed during this survey. First collected by Herbst in 1978. This plant could be put on a "have you seen these plants on Popoia" poster to increase detection efforts. Seeds were seen floating in the waters offshore and it is not inconceivable that mangrove could again be found on Popoia.
7 Feb 1978, Herbst, D.R. (# 6012), BISH 421512.

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**
Occasional. Small plants on margins, a couple patches on the north side. First collected by Herbst in 1978. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.
7 Feb 1978, Herbst, D.R. (#6033), BISH 421605.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Dominant. Found over entire islet, especially east end, where it grows in vast mats, draping the coralline shelves. A very compact "jelly bean" form can be found on the more exposed sights of Popoia. First collected in 1915 by Stokes. Collected in 1932 by Fosberg and in 1978 by Herbst. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.
Feb 1915, Stokes, J.F.G. (#s.n.), BISH 20167.
Nov 1915, Stokes, J.F.G. (#s.n.), BISH 685066.
8 Nov 1932, Fosberg, F.R. (#8889), BISH 20156.
7 Feb 1978, Herbst, D.R. (#6027), BISH 421613.

***Setaria verticillata* -- Bristly foxtail -- (Poaceae) -- Alien**
Not observed during this survey. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst.
25 Jan 1936, Fosberg, F.R. (# 12840), 3 m, BISH 120409, USNM 02487287.
7 Feb 1978, Herbst, D.R. (#6017).

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Uncommon. One plant observed on south interior. First collected by Fosberg in 1936.
15 Feb 1936, Fosberg, F.R. (#12882), BISH 57946.

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**
Occasional. Found in "sinkholes". First collected by Herbst in 1978. This species has been considered native by some and non-native by others. We are currently leaning towards treating this species as native, though the true story is likely more complicated. From a management perspective, at this point, it could be monitored.
7 Feb 1978, Herbst, D.R. (#6010), BISH 421513.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Occasional. Here and there, nowhere dominant. First collected in 1933 by Fosberg. Collected again in 1936 by Fosberg and in 1978 by Herbst. This annual sprouts up after rains, and generally grows where other plants allow it to. It can be hand pulled.
26 Mar 1933, Fosberg, F.R. (#10583), BISH 121507.
15 Feb 1936, Fosberg, F.R. (#12882), BISH 57946.

7 Feb 1978, Herbst, D.R. (#6011), BISH 421514.

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**
Occasional. On margins, especially the east side. Probably first collected (no date given, but likely 1915) by Stokes. Collected again in 1932 by Fosberg and in 1978 by Herbst. This species seems to be doing fine on Popoia and no action seems necessary other than monitoring of status and distribution.

No date, Stokes, J.F.G. (#s.n.), BISH 120501.
8 Nov 1932, Fosberg, F.R. (#8888), BISH 120509.
7 Feb 1978, Herbst, D.R. (#6013), BISH 421615, USNM 02921212.

***Terminalia catappa* -- Tropical almond, false kamani -- (Combretaceae) -- Alien**
Not observed during this survey. First observed by Herbst in 1978. Could be hand pulled if found again as this species can arrive by seeds floating on the ocean.

7 Feb 1978, Herbst, D.R. (#6038).

***Thespesia populnea* -- Milo -- (Malvaceae) -- Questionably Indigenous**
Occasional. A few thickets on west interior. The trees form a thicket of mostly dead gnarled branches 2 m tall. Live growth from the base is about 1 m tall. First collected by Stokes in 1915. Collected again by Fosberg in 1932 and 1933. Collected again by Herbst in 1978. The questionably indigenous milo tree can become invasive in some situations, such as anchialine ponds, but seems to be held in check on Popoia.

Nov 1915, Stokes, J.F.G. (# s.n.), BISH 58069.
8 Nov 1932, Fosberg, F.R. (# 8886), BISH 58065.
26 Mar 1933, Fosberg, F.R. (# 10558), BISH 58067.
7 Feb 1978, Herbst, D.R. (#6020).

***Tournefortia argentea* -- Beach heliotrope -- (Boraginaceae) -- Alien**
Uncommon. Small plants here and there, especially on margins. First collected on this survey. Plants pulled. This hardy non-native tree can provide great structure for certain bird species, such as red-footed boobies and frigates. For that reason, *Tournefortia* trees are often left in bird colonies if a similar functioning native is not around. However, these tree preferring birds also prefer areas without human disturbance, and are therefore unlikely to want to colonize the frequently visited islet of Popoia. Bird species recorded breeding on Popoia include wedge-tailed shearwaters and Bulwer's petrels, both of which nest on and in the ground and don't need trees. Given all that, it would make sense to remove *Tournefortia* when found on Popoia. Small plants can be hand pulled.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-11).

***Tribulus cistoides* -- Nohu -- (Zygophyllaceae) -- Indigenous**
Rare. One plant near landing, presumably from seed sown by DLNR staff. This colorful native with spiny fruits still needs to be collected from Popoia.

MOKULUA NORTH

Figure 38. Mokulua north.

Overview

The Mokulua Islets, located in Kailua Bay off the coast of Lanikai, are two islets, Mokulua North and Mokulua South, both totaling 24 acres in size (OIRC, 2005). Mokulua North (Mokulua nui, two humps) is a large volcanic cone approximately 1000 ft. long by 800 ft. wide and attains a maximum elevation of 225 ft. (OIRC, 2005). Mokulua north has sheer cliffs on the north, east, and southeast sides, with a steep slope down to a sandy beach on the west side. We surveyed Mokulua north on Feb. 24, 2005. We took a boat to the islet and swam to the sandy beach on the west side of the islet. The survey began after lunch and lasted a few hours. We surveyed around the coastal areas, but could not reach the east side due to its precipitous sheer slope. We also surveyed across and up the southwestern flank to the summit, then down the ridge to the north hump, then down the northwest slope back to the beach.

Vegetation

The vegetation of Mokulua north is much like the vegetation of Mokulua south with most of the native vegetation found on the sheer windward cliffs and the western flanks mostly composed of non-native grasses. On the beach on the west side is a stand of kiawe that has been there since at least 1946 when Fosberg collected it. On the coast is a mix of native plants including akulikuli (*Sesuvium portulacastrum*, naupaka (*Scaevola taccada*), akiaki (*Sporobolus virginicus*), and ilima (*Sida fallax*). On sheer cliffs on the eastern side there are native plants such as emoloa (*Eragrostis variabilis*), pua kala (*Argemone glauca*), aweoweo (*Chenopodium oahuense*), and naupaka (*Scaevola taccada*) with some

non-natives, such as Spanish needles (*Bidens alba* var. *radiata*), lantana (*Lantana camara*), and some haole koa (*Leucaena leucocephala*). On the summit hump there is naupaka, pau o hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicense*), and sandbur (*Cenchrus echinatus*). Near the saddle between the summit and north hump are patches of nehe (*Lipochaeta integrifolia*), ohelo kai (*Lycium sandwicense*), and a few ironwood trees (*Casuarina glauca*). The north hump had one clump of pili grass (*Heteropogon contortus*) and was a mix of natives including ilima, pau o hiiaka, and emoloa and non-natives including coast buttons (*Tridax procumbens*) and Spanish needles. The western flank was dominated by sandbur, swollen fingergrass (*Chloris barbata*), wiregrass (*Eleusine indica*), and Bermuda grass (*Cynodon dactylon*), with native plants growing under and in between grasses including ilima, pau o hiiaka, and alena (*Boerhavia repens*). During this survey, we observed a total of 37 plant species. There were 17 (46%) native species and 20 (54%) non-native species. We collected 12 plant species.

Threats

During drought years, most plants go dormant, and erosion becomes a threat, especially to nesting seabirds whose burrows tend to collapse in areas of erosion. After heavy winter rains, the non-native grasses, sandbur, swollen fingergrass, wiregrass, and Bermuda grass, have become dominant on the western flank. There are a few other invasive weeds on the islet, including haole koa and lantana. Weed removal efforts should focus in areas where native plants are present and should be done incrementally to limit erosion.

Restoration

Native plants still remain on Mokulua north, especially in windward sheer areas and near the coast. There are even some native plants under the grasses on the western flank. Restoration could start and focus in these areas and work toward more weedier areas. Existing native plants on the islet could be enhanced through weeding, spreading seeds, and out-plantings. Native grasses (*Panicum fauriei* and *Panicum torridum*) and other plants that have been collected in the past but are no longer present, such as ohai (*Sesbania tomentosa*), Vigna (*Vigna o-wahuensis*), hinahina (*Heliotropium anomalum* var. *argenteum*), and anaunau (*Lepidium bidentatum* var. *o-waihiense*), could be re-introduced through out-planting. Seeds of existing plants such as aweoweo and emoloa could be spread after weed removal. Pili grass, which was once "dominant" on the islet could be super-seeded and more bales could be set out to help control erosion. Out-plantings of naupaka, naio (*Myoporum sandwicense*), and other species could continue.

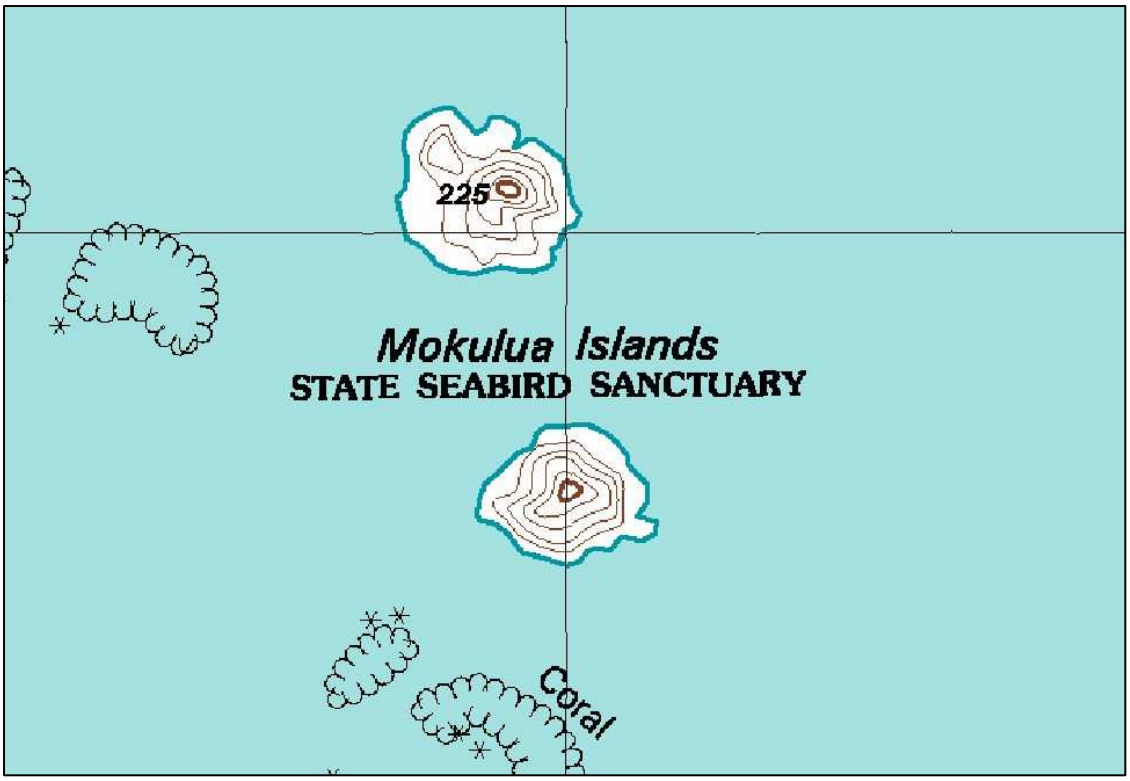

Figure 64. Mokulua map.

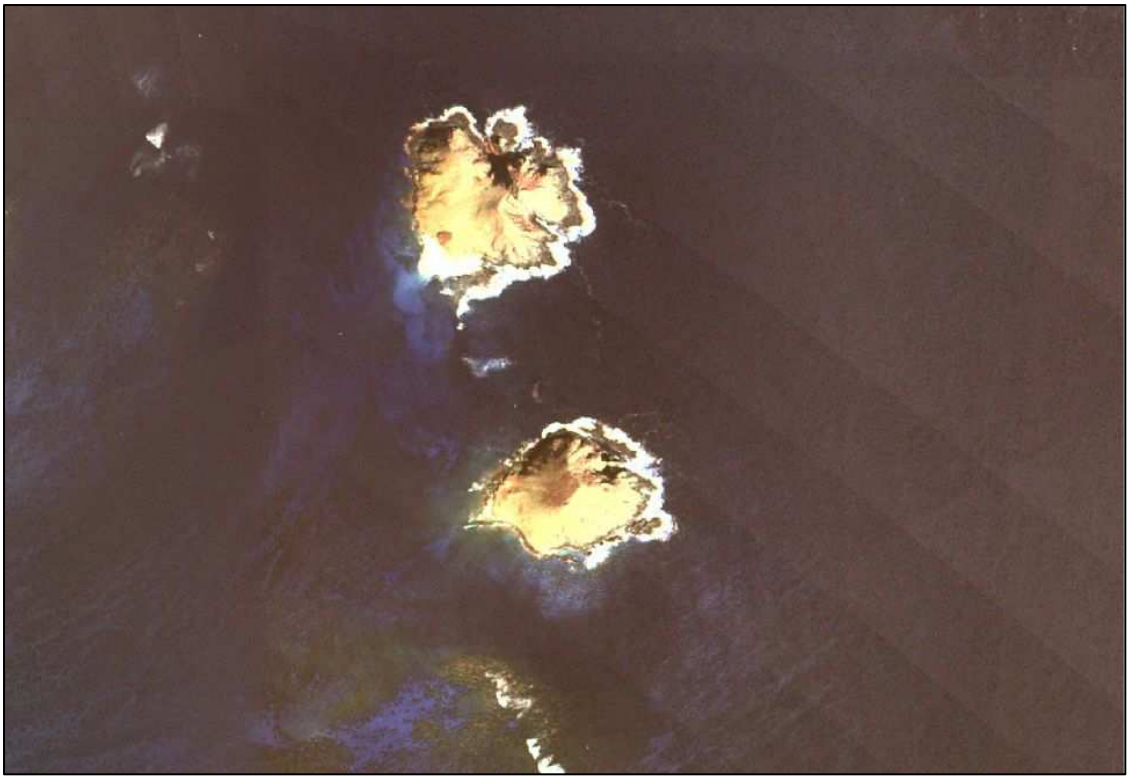

Figure 65. Mokulua orthophoto.

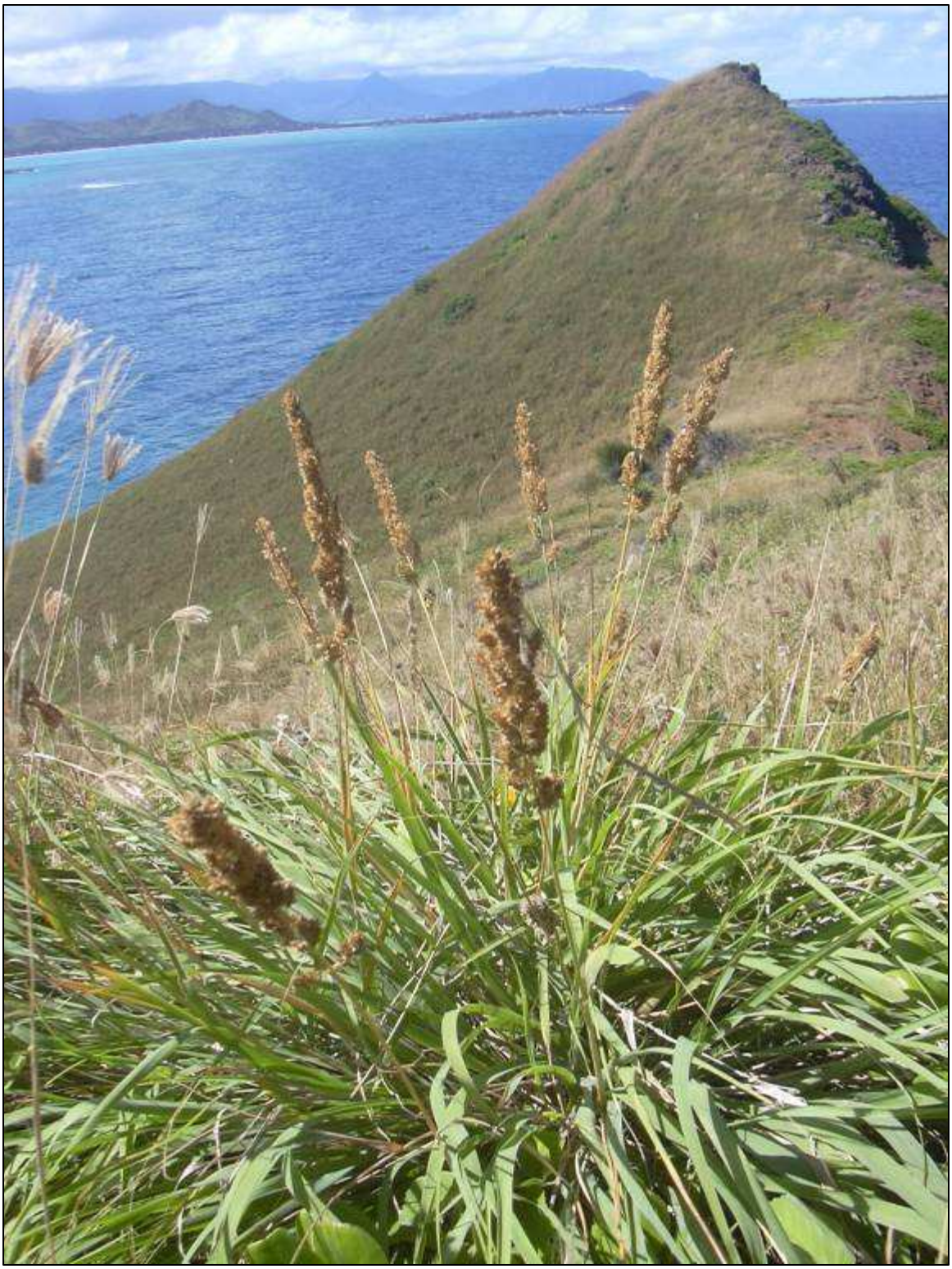

Figure 66. Emoloa (*Eragrostis variabilis*) near summit.

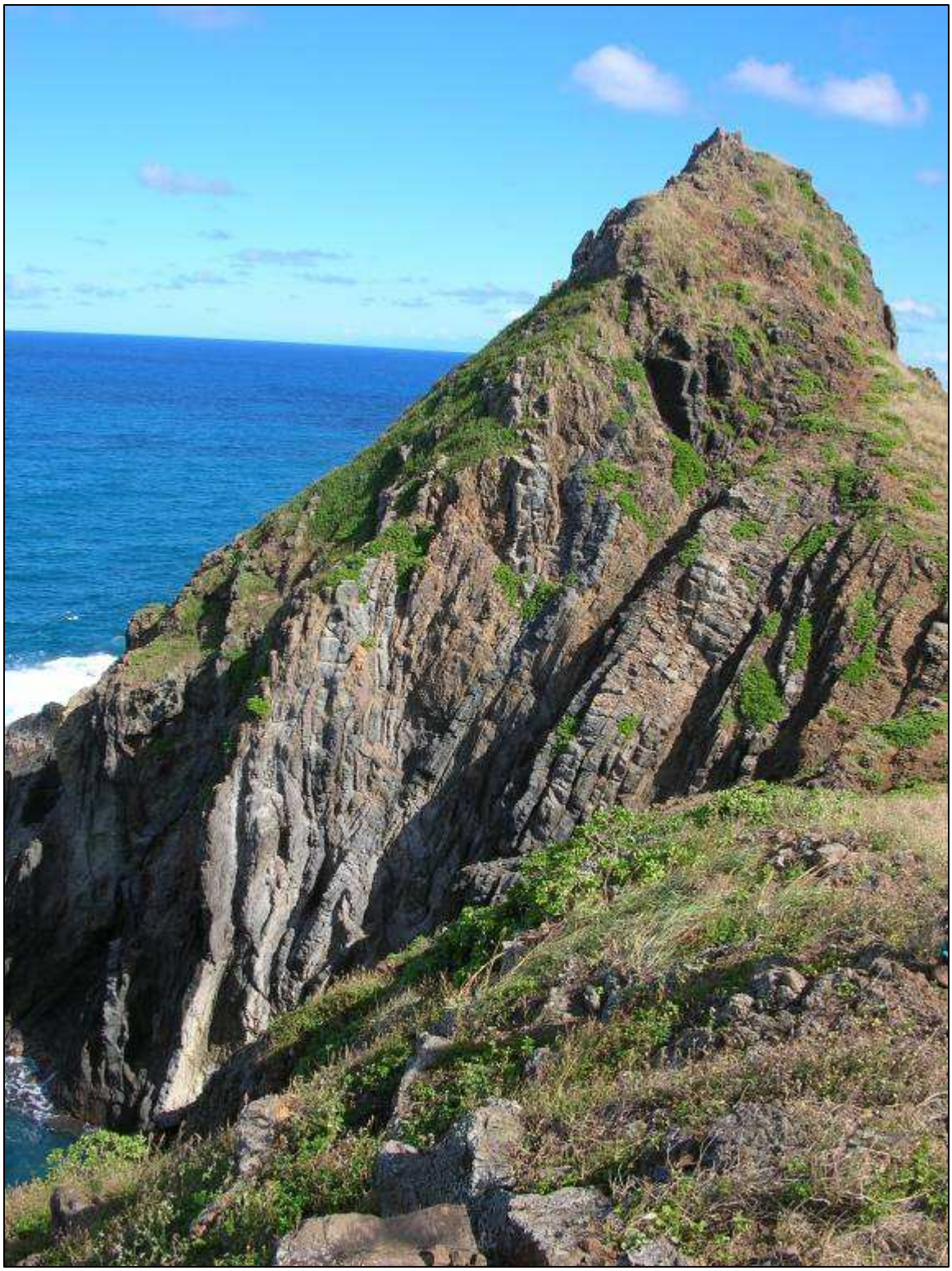

Figure 67. Sheer windward cliffs with native vegetation.

Annotated Plant List -- Mokulua north

***Ageratum conyzoides* -- Ageratum-- (Asteraceae) -- Alien**

Not observed during this survey. First collected in 1936 by Fosberg. This small herb with purple flowers is common on some exposed parts of Manana. It could be looked for in future monitoring and hand pulled if found.

16 Feb 1936, Fosberg, F.R. (#12937), 55m, Rock ledges on steep slope, BISH 73209.

***Argemone glauca* -- Pua kala -- (Papavaraceae) -- Endemic**

Occasional. Scattered plants on east slope. First collected by Neal in 1936. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south. Seeds could be spread to other areas of the islet.

14 Jun 1936, Neal, M.C. (#s.n.), BISH 424222.

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

Rare to occasional. A few patches in open areas. First collected by Herbst in 1978. Collected again during this survey. It can be hand pulled.

7 Feb 1978, Herbst, D.R. (#5994), USNM 02921251

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-16).

***Bidens alba* var. *radiata* -- Spanish needle -- (Asteraceae) -- Alien**

Common to dominant. Found over most of islet, especially on east slope / cliffs. First collected during this survey. This species would be difficult to remove from the entire islet, but could be hand pulled in areas being returned to natives.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-21).

***Boerhavia coccinea* -- Boerhavia -- (Nyctaginaceae) -- Alien**

Rare to occasional. A few clumps on north summit. First collected during this survey.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-20).

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

Occasional to common. Here and there in open areas and mixed with grasses. First collected by Egler in 1937. Collected again in 1964 by Long who noted, "N peak, E side on slopes" and in 1978 by Herbst.

22 Aug 1937, Egler, F.E. (#37-255), BISH 60755, BISH 505915.

1 May 1964, Long, C.R. (#1675), N peak, E side on slopes, USNM 00090527.

7 Feb 1978, Herbst, D.R. (#5989), BISH 421536, USNM 02921242.

***Casuarina glauca* -- She oak -- (Casuarinaceae) -- Alien**

Dead. Two dead trees on summit saddle. First collected in 1946 by Fosberg. Collected again in 1964 by Long who noted, "West side, common on middle of slope", and in 1978 by Herbst.

13 Oct 1946, Fosberg, F.R. (#27112), BISH 416929.

1 May 1964, Long, C.R. (#1667), West side, common on middle of slope, USNM 02659678.

7 Feb 1978, Herbst, D.R. (#5997), BISH 421527.

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

Common to dominant. Found over most of islet. First collected by Fosberg in 1936. Collected again in 1937 by Egler, in 1964 by Long who noted, "Near beach west side", and in 1978 by Herbst.

16 Feb 1936, Fosberg, F. (#12922), 2m, Top of sandy beach, BISH 118223.
22 Aug 1937, Egler, F.E. (#37-256), On volcanic soil, rare, BISH 118250.
1 May 1964, Long, C.R. (#1651), Near beach west side, USNM 02659946.
7 Feb 1978, Herbst, D.R. (#5986), BISH 421538, USNM 02921244.

***Chamaesyce hirta* -- Hairy spurge -- (Euphorbiaceae) -- Alien**

Not observed during this survey. First collected by Egler in 1937.

22 Aug 1937, Egler, F.E. (#37-253), pili grassland on basaltic soil, BISH 49942.

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**

Occasional. Plant found near coast on west slope and on the steep walls of the east side of the islet. First collected in 1964 by Long who noted, "seaward slope of S peak". Collected again by Long who noted, "On east sides" and "E side of islet, slope facing beach". Also collected in 1978 by Herbst.

1 May 1964, Long, C.R. (#1660), Seaward slope of S peak., BISH 121972, USNM 02659585.
1 May 1964, Long, C.R. (#1666), On east sides of islet, slope facing beach, Common on slope, BISH 190948, 121970, USNM 02659570.
7 Feb 1978, Herbst, D.R. (#5983), BISH 421599.

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**

Dominant. Present over most of islet. First collected (as *C. barbata*) in 1936 by Fosberg. Collected again by Herbst in 1978. Collected during this survey.

16 Feb 1936, Fosberg, F.R. (#12944), BISH 118331.
7 Feb 1978, Herbst, D.R. (#5987), BISH 421515.
24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-15).

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

Not observed during this survey. First collected by Egler in 1937 who noted, "Rare, summit".

22 Aug 1937, Egler, F.E. (#37-254), Rare, summit, BISH 75153.

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**

Common. Scattered patches in open areas. First collected by Egler in 1937 who noted, "Locally common".

22 Aug 1937, Egler, F.E. (#37-258), Locally common, BISH 118446.

***Dactyloctenium aegyptium* -- Beach wire grass -- (Poaceae) -- Alien**

Occasional to common. Scattered patches in exposed places. First collected in 1936 by Fosberg who noted, "30 m". Collected again in 1978 by Herbst.

16 Feb 1936, Fosberg, F.R. (#12934), 30 m, Dry slopes, BISH 118491, USNM 02487675.
7 Feb 1978, Herbst, D.R. (#5988), BISH 421537.

***Desmodium triflorum* -- Desmodium -- (Fabaceae) -- Alien**

Not observed during this survey. First collect in 1936 by Fosberg.

16 Feb 1936, Fosberg, F.R. (#12941), 40m, Bare ridge, saddle, BISH 55323.

***Digitaria ciliaris* -- Henry's crab grass -- (Poaceae) -- Alien**

Rare to occasional. One ridges. First collected by Herbst in 1978.

7 Feb 1978, Herbst, D.R. (#6006), BISH 421519
7 Feb 1978, Herbst, D.R. (#6002), BISH 421523, USNM 02921248.

***Digitaria insularis* -- Sourgrass -- (Poaceae) -- Alien**
Occasional. Found at south summit. First collected in 1964 by Long who noted, "On slope above beach, many burrowing shearwaters".
1 May 1964, Long, C.R. (#1657), On slope above beach, many burrowing shearwaters, BISH 639988, USNM 02659516.

***Digitaria setigera* -- Itchy crabgrass -- (Poaceae) -- Questionably Indigenous**
Rare. What appeared to be this species was found on the north summit. First collected during this survey.
24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-18).

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**
Common. Found over most of islet. First collected during this survey.
24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-14).

***Emilia fosbergii* -- Pualele -- (Asteraceae) -- Alien**
Rare. A few plants in open areas. First collected by Fosberg in 1936. Collected again in 1978 by Herbst.
16 Feb 1936, Fosberg, F.R. (#12917), BISH 75063.
7 Feb 1978, Herbst, D.R. (#6003), BISH 421522.

***Eragrostis variabilis* -- Emoloa -- (Poaceae) -- Endemic**
Common. Found in open areas on ridges, especially on south and east slopes. Regeneration (small plants) seen. First collected in 1964 by Long who noted, "E side, near NE peak of islet", "E side tussock, near NE peak of islet", and "W slope, 200 yards above beach". Collected in 1978 by Herbst. This native grass could be further promoted through seed-tossing and out-planting.
1 May 1964, Long, C.R. (#1665), E side tussock, near NE peak of islet, BISH 51597, USNM 02659438.
1 May 1964, Long, C.R. (#1680), W slope, 200 yards above beach, BISH 51599, USNM 02659439.
7 Feb 1978, Herbst, D.R. (#5996), BISH 421531.

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**
Not observed during this survey. First collected by Neal in 1936. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south.
14 Jun 1936, Neal, M.C. (#s.n.), BISH 424225.

***Gamochaeta* [Gnaphalium] *purpureum* -- Purple cudweed -- (Asteraceae) -- Alien**
Not observed during this survey. Observed in 1936 by Fosberg.
16 Feb 1936, Fosberg, F.R. (#12939), 50m, Rock ledges on steep slopes, BISH 75353.

***Heliotropium anomalum* var. *argenteum* -- Hinahina -- (Boraginaceae) -- Endemic**
Not observed during this survey. First collected in 1936 by Fosberg.
16 Feb 1936, Fosberg, F.R. (#12945), 5m, Flat rock surface, BISH 43199.

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**

Rare. In saddle. Observed in 1937 by Egler. Collected again in 1964 by Long and in 1978 by Herbst.

22 Aug 1937, Egler, F.E. (#37-257), Locally frequent. Near the sea on volcanic soil, BISH 43256.
1 May 1964 Long, C.R. (#1673), N peak, USNM 02659433.
7 Feb 1978, Herbst, D.R. (#6004), BISH 421521.

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

Rare. Bales seen in gullies. One plant on north hill. Observed in 1936 by Fosberg who noted, "Dominant" and "10 m". Collected again in 1978 by Herbst. This species could continue to have seeds thrown, bales placed, and plants planted. Eventually, it may be able to regain its former dominance over other non-native grasses such as *Cenchrus*.

16 Feb 1936, Fosberg, F.R. (#12916), Dominant, 10 m, BISH 119318, USNM 02487336.
7 Feb 1978, Herbst, D.R. (#6000), BISH 421525, USNM 02921249.

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) -- Indigenous**

Not observed during this survey. First collected in 1936 by Fosberg.

16 Feb 1936, Fosberg, F.R. (#12942), BISH 47462.

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

Common. Found near coast, mixed in with grasses on west slope, on ridges, and on north and south summits. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst.

16 Feb 1936, Fosberg, F.R. (#12931), BISH 122000.
7 Feb 1978, Herbst, D.R. (#5984), BISH 421598, USNM 02921195.

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

Rare. A few plants on summit and east slope. First collected in 1936 by. Collected again in 1964 by Long who noted, "W slope near N peak". Collected again in 1978 by Herbst. Plants could be hand pulled and bagged or treated with an herbicide.

16 Feb 1936, Fosberg, F.R. (#12924), BISH 71955.
1 May 1964, Long, C.R. (#1663), W slope near N peak, USNM 02659717.
7 Feb 1978, Herbst, D.R. (#5999), BISH 421526.

***Lepidium bidentatum* var. *o-waihiense* -- Anaunau -- (Brassicaceae) -- Indigenous**

Not observed during this survey. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south. First collected by Neal in 1936.

14 Jun 1936, Neal, M.C. (#s.n.), BISH 424233.

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**

Occasional. West slope and scattered around islet. First collected in 1946 by Fosberg. Collected again in 1964 by Long who noted, "Slope above beach". Plants could be hand pulled and bagged or treated with an herbicide.

13 Oct 1946, Fosberg, F.R. (#27114), One small plant seen in slope of volcanic ash or weathered tuff, BISH 416927.
1 May 1964, Long, C.R. (#1659), Slope above beach, USNM 02659498.

***Lipochaeta* [syn. *Melanthera*] *integrifolia* -- Nehe -- (Asteraceae) -- Endemic**

Occasional. East side near summit by gully on rocky outcrop. Few patches in saddle. First collected in 1936 by Fosberg. Collected again in 1964 who noted "On N peak, rocky E face slope". Collected again in 1978 by Herbst. This species appears to be doing well on Mokulua N. It will likely spread as non-natives around it are removed.

16 Feb 1936, Fosberg, F.R. (#12929), 5m, Grassy slope, BISH 75735.
1 May 1964, Long, C.R. (#1674), On N peak, USNM 02659396.
1 May 1964, Long, C.R. (#1676), On N peak, rocky E face slope, BISH 51456, USNM 02659397.
7 Feb 1978, Herbst, D.R. (#5991), BISH 421534, USNM 02921240.

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

Occasional. Patches near coast and on summit saddle. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst. This species will likely spread as non-natives are removed. No action recommended other than routine monitoring.

16 Feb 1936, Fosberg, F.R. (#12940), BISH 69731.
7 Feb 1978, Herbst, D.R. (#5993), BISH 421530.

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

Not observed during this survey. First collected by Herbst in 1978.

7 Feb 1978, Herbst, D.R. (#6008).

***Malvastrum coromandelianum* -- Malvastrum -- (Malvaceae) -- Alien**

Not observed during this survey. First collect in 1936 by Fosberg.

16 Feb 1936, Fosberg, F.R. (#12935), Rock ledges, BISH 57809.

***Merremia aegyptia* -- Hairy morning glory -- (Convolvulaceae) -- Questionably Naturalized**

Rare. One plant found in kiawe patch near landing which was pulled. First collected during this survey. This hairy vine can become quite invasive. It could be looked for during routine surveys and pulled when found.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-24).

***Myoporum sandwicense* -- Naio -- (Myoporaceae) -- Endemic**

Occasional. Scattered plants found around islet that were planted. First collected during this survey.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-25).

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

Rare. 1 clump on north summit. First collected during this survey.

Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-19).

***Panicum fauriei*--Hawaiian panic grass -- (Poaceae) -- Endemic**

Not observed during this survey. First collect by Herbst in 1978.

7 Feb 1978, Herbst, D.R. (#6009), BISH 421516.

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

Not observed during this survey. First collected in 1978 by Herbst.

7 Feb 1978, Herbst, D.R. (#6009), USNM 02921252.

***Paspalum vaginatum* -- Seashore paspalum -- (Poaceae) -- Alien**

Rare. What appears to be this species found on south slope. First collected during this survey.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-22).

***Passiflora foetida* -- Love-in-a-mist -- (Passifloraceae) -- Alien**

Not observed during this survey. First collected in 1978.

7 Feb 1978, Herbst, D.R. (#6007), BISH 421518.

***Pluchea indica* -- Indian fleabane -- (Asteraceae) -- Alien**

Not observed during this survey. first collected by Herbst in 1978.

7 Feb 1978, Herbst, D.R. (#5992), BISH 421533, USNM 02921239.

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

Occasional to common. Scattered patches in exposed areas. First collected by Fosberg in 1936. Collected again by Herbst in 1978. Could be hand pulled and eventually replaced with *P. lutea* from Popoia.

16 Feb 1936, Fosberg, F.R. (#12921), 2m, Top of beach, BISH 63890.

7 Feb 1978, Herbst, D.R. (#5985), BISH 421603.

***Prosopis pallida* -- Kiawe -- (Fabaceae) -- Alien**

Rare. One patch near landing. First collected in 1946 by Fosberg who noted, "one clump on beach". It could be removed, though it apparently is a good nesting site for shearwaters, and hasn't moved in 60 yrs. Given that, no action is recommended other than routine monitoring.

13 Oct 1946, Fosberg, F.R. (#27113), One clump on beach, BISH 416928.

***Reichardia picroides* -- Reichardia -- (Asteraceae) -- Alien**

Not observed during this survey. First collected by Fosberg in 1936. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south.

13 Oct 1946, Fosberg, F.R. (#12919), BISH 121412.

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**

Common. Common on steeper slopes on south and east side. A few plants near coast and on west slope. First collected in 1946 by Fosberg. Collected again in 1964 by Long who noted, "W side", "N peak of islet, W slope". Collected in 1978 by Herbst. Out-plantings on west side near coast seem to be doing well and could be continued.

13 Oct 1946, Fosberg, F.R. (#27115), BISH 416926.

1 May 1964, Long, C.R. (#1652), W side, BISH 51374, USNM 02658898.

1 May 1964, Long, C.R. (#1672), N peak of islet, W slope, USNM 02658897.

7 Feb 1978, Herbst, D.R. (#6005), BISH 421520.

***Sesbania tomentosa* -- Ohai -- (Fabaceae) -- Endemic**

Not observed during this survey. First collected by Neal in 1936. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south. This rare attractive plant could be re-introduced through out-planting.

14 Jun 1936, Neal, M.C. (#s.n.), BISH 424215.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Occasional. Found near coast and on steep slopes. First collected in 1936 by Fosberg. Collected again in 1964 by Long.

16 Feb 1936, Fosberg, F.R. (#12925), BISH 20155
1 May 1964, Long, C.R. (#1671), BISH 452639, USNM 02659835.

***Setaria verticillata* -- Bristly foxtail -- (Poaceae) -- Alien**
Not observed during this survey. First collected in 1978 by Herbst.

7 Feb 1978, Herbst, D.R. (#5990), BISH 421535, USNM 02921241.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Common to dominant. Found over most of islet, generally mixed in with other plants. Forming large mats on west side of summit saddle. First collected in 1936 by Fosberg. Collected again in 1952 by Lamberton who noted, "South shore, West of sand beach on coral shelf". Collected in 1964 by Long. Collected in 1978 by Herbst. This species appears to be doing well on Mokulua N and will likely increase on its own as non-natives are removed. No further action recommended other than routine monitoring.

16 Feb 1936, Fosberg, F.R. (#12923), BISH 57947.
1 May 1964, Long , C.R. (#1653), BISH 638007, USNM 02659317.
1 May 1964, Long, C.R. (#1658), BISH 638009, USNM 02659327.
1 May 1964, Long, C.R. (#1662), Common on seaward slope of largest peak, BISH 638010, USNM 02659325.
9 Mar 1952, Lamberton, A.R.H. (#920), South shore, West of sand beach on coral shelf, BISH 612076
9 Nov 1952, Lamberton, A.R.H. (#921), South shore, West of sand beach on coral shelf, BISH 612083
9 Nov 1952, Lamberton, A.R.H. (#922), South shore, East of sand beach, BISH 497112
9 Mar 1952, Lamberton, A.R.H. (#923), South shore, West of sand beach on coral shelf, BISH 497111
9 Nov 1952, Lamberton, A.R.H. (#924), West of sand beach on coral shelf, BISH 612081
7 Feb 1978, Herbst, D.R. (#5995), BISH 421532, USNM 02921238.

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**
Not observed during this survey. First collected in 1936 by Fosberg.

16 Feb 1936, Fosberg, F.R. (#12938), Rock ledges on steep slope, BISH 70096.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Common. Found in open areas over most of islet. First collected in 1936 by Fosberg. Collected in 1964 by Long.

16 Feb 1936, Fosberg, F.R. (#12920), BISH 121508.
1 May 1964, Long, C.R. (#1669), BISH 460802.

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**
Occasional. Found near landing / coast on west end of islet. The "stay of hill" signs seem to help keep people from trampling it. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst. This species appears to be doing fine on Mokulua N. It will likely spread as non-natives around it are removed.

16 Feb 1936, Fosberg, F.R. (#12918), BISH 120512.
7 Feb 1978, Herbst, D.R. (#6001), BISH 421524.

***Stachytarpheta jamaicensis* -- Jamaica vervain -- (Verbenaceae) -- Alien**
Not observed during this survey. First collected in 1936 by Fosberg.

16 Feb 1936, Fosberg, F.R. (#12933), BISH 72002.

***Tribulus cistoides* -- Nohu -- (Zygophyllaceae) -- Indigenous**
Rare. One patch which was planted found just above landing on west slope. First collected during this survey. Could continue to spread seeds and plants.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-17).

***Tridax procumbens* -- Coat buttons -- (Asteraceae) -- Alien**
Rare to occasional. On ridges. First collected during this survey. Could be pulled and bagged.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-23).

***Vigna o-wahuensis* -- Vigna -- (Fabaceae) -- Endemic**
Not observed during this survey. Since there is no mention as to which islet (north or south) this species was collected on, it is included here for Mokulua north and will also be included for Mokulua south. First recorded by Oliveira in 1933 who noted, "10m", and "steep slope; on grass, *Emilia* and *Lantana*". Collected again in 1936 by Fosberg who noted, "10m", and "grassy slope". Collected again in 1938 by Oliveira who noted, "30m", and "Large patch on fairly steep slope of lower peak; twining on grass and *Lantana*". This now endangered vine could be re-introduced through out-planting or seed sowing.

12.vi.1933, Oliveira, J.M., (#s.n.), BISH 56266.
16 Feb 1936, Fosberg, F.R. (#12943), BISH 56265.
12.vi.1938, Oliveira, J.M., (#12018), BISH 56264.

***Waltheria indica* -- Uhaloa -- (Sterculiaceae) -- Questionably Indigenous**
Rare. A few plants on summit. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst.

16 Feb 1936, Fosberg, F.R. (#12926), 3m, flat above beach, BISH 70264.
7 Feb 1978, Herbst, D.R. (#5998), BISH 421528, USNM 0292125.

MOKULUA SOUTH

Figure 68. Mokulua south.

Overview

Mokulua South (Mokulua iki, one hump) is a large volcanic cone approximately 875 ft. long and 700 ft. wide with a maximum elevation of 150 ft. (OIRC, 2005). We surveyed Mokulua south on Feb. 23, 2005. We boated to the islet, and waded to the small rock and coral rubble beach on the west side of the islet. Mokulua South has sheer cliffs on the north, east, and southeast sides, with a steep slope down to a rock and coral rubble beach on the west side. The survey began after lunch and lasted a few hours. We surveyed around the coastal areas, but could not reach the east side due to its precipitous sheer slope. We also surveyed up the southern flank to the summit, then down the north ridge and back down the northwest slope.

Vegetation

The vegetation is a mix of native coastal plants near the shoreline and on sheer windward cliffs and non-native grasses on the western side. Native plants occurring on sheer windward cliffs include pua kala (*Argemone glauca*), pau o hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*), ohelo kai (*Lycium sandwicense*), naupaka (*Scaevola taccada*), akulikuli (*Sesuvium portulacastrum*), ilima (*Sida fallax*). The west flank was made up predominantly of sandbur (*Cenchrus echinatus*) and fingergrass (*Chloris barbata*). During our survey, we observed a total of 42 plant species. There were 18 (43%) native species and 24 (57%) non-native species. We made 23 collections.

Threats

During drought years, most plants go dormant, and erosion becomes a threat, especially to nesting seabirds whose burrows tend to collapse in areas of erosion. After heavy winter rains, the non-native grass, sandbur (*Cenchrus echinatus*) has become a dominant on the western flank. Very few natives remain in these areas. Weeds should be removed a little at a time in areas near native plants to keep erosion to a minimum. In high erosion areas, spraying with herbicide may be the preferred method. New plants should be periodically looked for, especially in high traffic areas.

Restoration

Native plants still remain on Mokulua south, especially in windward and near shore areas. These areas could be used as a focal point for restoration. Weeding and out-planting could start in these areas which could be expanded through restoration efforts. Previous plantings seem to be doing well. A few native plants are rare in distribution and we only found one of each plant, including the endemic plants emoloa (*Eragrostis variabilis*) and nehe (*Lipochaeta integrifolia*). The native ihi (*Portulaca lutea*) has been replaced by the non-native pigweed (*Portulaca oleracea*). Attempts could be made to eradicate the non-native while re-introducing the native. Seeds and cuttings of these rare native species could be gathered and spread to ensure survival of the species. If necessary, seeds and cuttings could also be gathered from nearby islets. A few pili (*Heteropogon contortus*) bales were set out in one erosion area, though no live plants were observed. Perhaps many more bales are needed to have an effect. Pili bales have been very successful on Kahoolawe where thousands have been set out. They have also had success with super-seeding aweoweo (*Chenopodium oahuense*) and emoloa (*Eragrostis variabilis*).

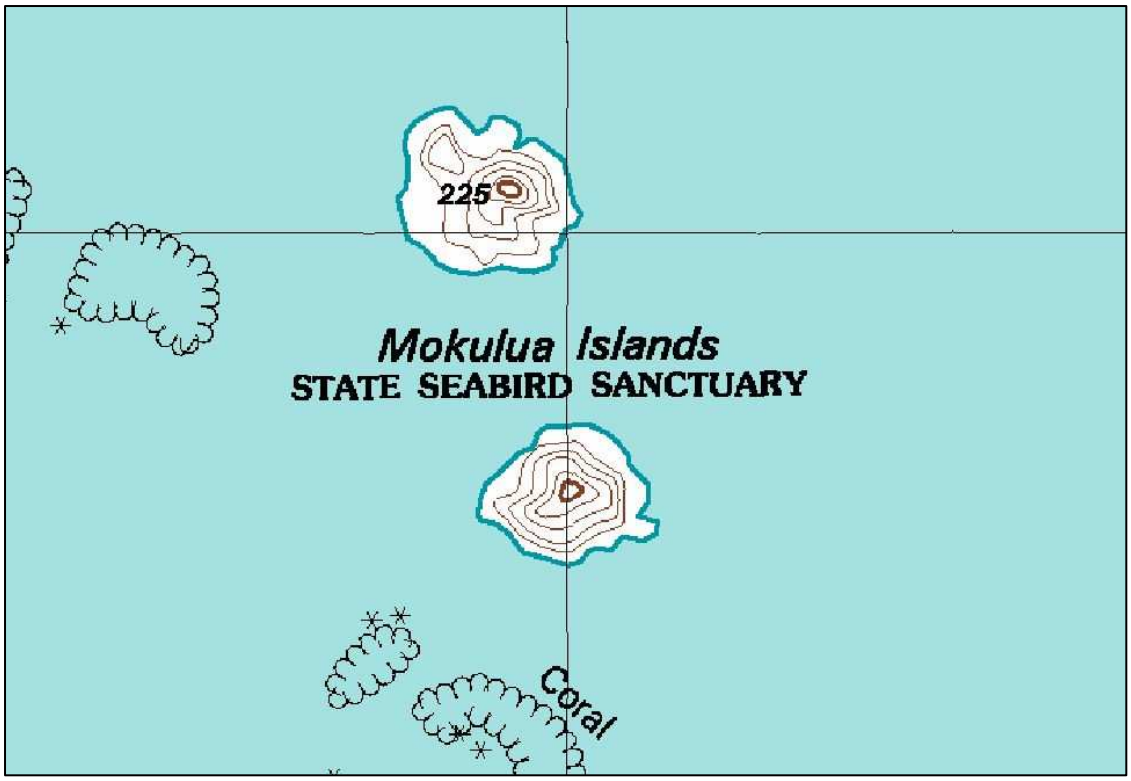

Figure 69. Mokulua map.

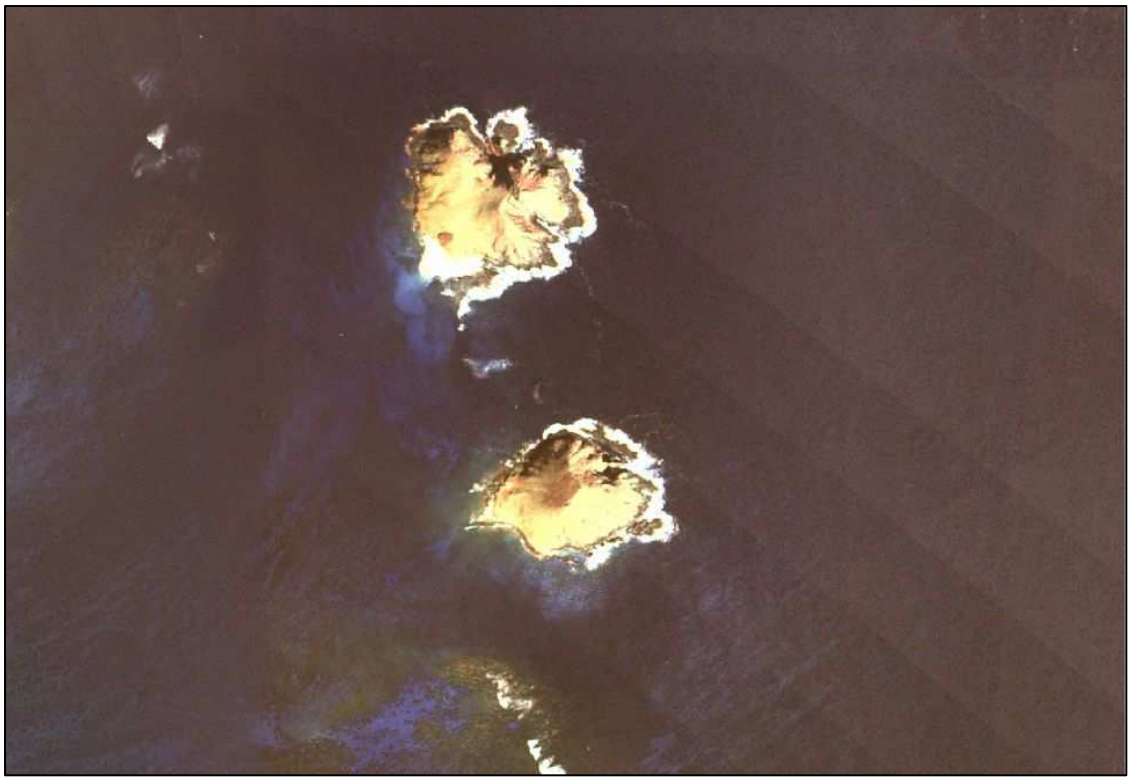

Figure 70. Mokulua orthophoto.

Figure 71. Mokulua South rocky coral rubble beach and sign. Hill covered with sandbur (*Cenchrus echinatus*).

Figure 72. Windward coastal area with naupaka and akulikuli.

Annotated Plant List -- Mokulua south

***Acacia farnesiana* -- Klu -- (Fabaceae) -- Alien**

Not observed during this survey. First collected in 1936 by Fosberg. It would be good to remove this spiny plant if found.

16 Feb 1936, Fosberg, F.R. (#12885), BISH 54427.

***Argemone glauca* -- Pua kala -- (Papavaraceae) -- Endemic**

Uncommon. About a dozen or so plants, especially in sheer areas of north and east sides. First collected by Neal, though no mention of which islet (north or south). Collected again during this survey. Listed on the OIRC website as "occasional, local". This species appears to be doing fine, no actions recommended other than routine monitoring.

14 Jun 1936, Neal, M.C. (#s.n.), BISH 424222.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-14).

***Bidens alba* var. *radiata* -- Spanish needle -- (Asteraceae) -- Alien**

Occasional to common. Found all over islet, especially east end. First collected during this survey. This species could be hand pulled near natives. It is especially important to control this species before it sets seed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-19).

***Boerhavia coccinea* -- Boerhavia -- (Nyctaginaceae) -- Alien**

Uncommon. A few plants on south slope. First collected during this survey. Can generally be hand pulled.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-17).

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

Occasional to common. Found in open sheer areas, near the coast, and along ridges mixed in with other plants. Listed on the OIRC website as "occasional". First collected during this survey. It will likely spread as non-natives are removed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-30).

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

Occasional. Here and there on ridges. First collected during this survey. This species can dominate dry areas, though it seems to not be competing very well against *Cenchrus*. It can be hand-pulled or sprayed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-20).

***Casuarina equisetifolia* -- Ironwood -- (Casuarinaceae) -- Alien**

Rare. Patches on southwest ridge. First collected during this survey. Could be removed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-15).

***Casuarina glauca* -- She oak -- (Casuarinaceae) -- Alien**

Occasional. Patches on summit and north ridge. First collected during this survey. Could be removed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-12).

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

Uncommon. A few patches on summit ridge. First collected during this survey. It will be interesting to see how *C. ciliaris* and *C. echinatus* duke it out. It can be hand pulled or sprayed.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-13).

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

Dominant. Covers most of west slope. Amazingly vigorous in places. First collected in 1936 by Fosberg. This species could be controlled near natives, basically working from the native dominated coast, windward sides, and ridges towards the *Cenchrus* dominated west slope. Care should be taken not to spread *Cenchrus* from islets that have it, such as the Mokuluas to islets that do not, such as Popoia and Manana.

16 Feb 1936, Fosberg, F.R. (#12912), 1m, pebbly beach, BISH 118221.

***Chamaesyce degeneri* -- Akoko -- (Euphorbiaceae) -- Endemic**

Not observed during this survey. First collected by Fosberg in 1936. Collected again in 1978 by Herbst. Could be re-introduced through out-planting.

16 Feb 1936, Fosberg, F.R. (#12890), 30m, Steep crumbly slope, BISH 49745, 49746.

7 Feb 1978, Herbst, D.R. (#5978), BISH 421601.

***Chamaesyce hirta* -- Hairy spurge -- (Euphorbiaceae) -- Alien**

Uncommon. A few plants in open areas. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst. Not the most aggressive plant, though it is opportunistic. It can be hand pulled.

16 Feb 1936, Fosberg, F.R. (#12906), 1m, Top of pebbly beach, BISH 49944.

7 Feb 1978, Herbst, D.R. (#5977), USNM 02921132.

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**

Rare. A couple plants on east slope. Still needs to be collected. This species could be spread by seed or planted.

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**

Dominant. Found on west slope, on steep to sheer slopes, and on the summit. *Chloris* covers much of the slopes that *Cenchrus* does not. First collected during this survey. This grass can be selectively hand pulled, or sprayed, away from native plants.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-33).

***Chrysopogon aciculatus* -- Chrysopogon -- (Poaceae) -- Questionably Indigenous**

Not observed during this survey. Collected in 1936 by Fosberg.

16 Feb 1936, Fosberg, F.R. (#12907), 2m, Top of pebbly beach, BISH 118391.

***Dactyloctenium aegyptium* -- Beach wire grass -- (Poaceae) -- Alien**

Rare to occasional. Common near landing and along south shore. First collected by in 1936 by Fosberg. Collected again during this survey.

16 Feb 1936, Fosberg, F.R. (#12905), 4 m, Slopes above beach, BISH 118490, USNM 02487674.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-32).

***Desmodium triflorum* -- Desmodium -- (Fabaceae) -- Alien**

Not observed during this survey. Collected by Fosberg in 1936.

16 Feb 1936, Fosberg, F.R. (#12886), Steep slope, BISH 55312.

Digitaria ciliaris **-- Henry's crab grass -- (Poaceae) -- Alien**
Rare. One patch on southeast slope. First collected during this survey. This morphologically plastic grass finds its way to the most remote spots. It can become dominant in wetter settings. This grass could be removed from areas being restored to natives.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-22).

Digitaria insularis **-- Sourgrass -- (Poaceae) -- Alien**
Uncommon. A few patches on summit ridge. First collected during this survey. This tall grass can be aggressive. Clumps can be hand pulled.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-18).

Echinochloa colona **-- Jungle rice grass -- (Poaceae) -- Alien**
Not observed during this survey. Previously collected by Fosberg in 1936.
10 Apr 1937, Fosberg, F.R. (#13695), 15m, Dry, eroded ridge, BISH 118802.

Emilia fosbergii **-- Pualele -- (Asteraceae) -- Alien**
Rare to occasional. A few plants near coast. First collected in 1936 by Fosberg. This diminutive herb with reddish flowers will pop up after rains. It generally doesn't bully other plants, and can be easily hand pulled.
16 Feb 1936, Fosberg, F.R. (#12895), BISH 75062.

Eragrostis variabilis **-- Emoloa -- (Poaceae) -- Endemic**
Rare. One plant on east slope. Listed on the OIRC website as "rare". Still needs to be collected. This species could be scattered by seeds, placed out in bales, or planted across the islet.

Fimbristylis cymosa **-- Button sedge -- (Cyperaceae) -- Indigenous**
Not observed during this survey. First collected by Neal, though no mention of which islet (north or south).
14 Jun 1936, Neal, M.C. (#s.n.), BISH 424225.

Heliotropium anomalum **var.** ***argenteum*** **-- Hinahina -- (Boraginaceae) -- Endemic**
Not observed during this survey. First collected in 1936 by Fosberg.
16 Feb 1936, Fosberg, F.R. (#12903), 1m, Broken rocks, BISH 43220.

Heliotropium curassavicum **-- Heliotrope -- (Boraginaceae) -- Indigenous**
Occasional. Near coast on south side. First collected in 1936 by Fosberg. This species appears to be doing fine. No actions recommended other than regular monitoring.
16 Feb 1936, Fosberg, F.R. (#12904), 2-15m, Talus, BISH 43254.

Heteropogon contortus **-- Pili -- (Poaceae) -- Questionably Indigenous**
Rare. Bales seen, no plants seen. First collected by in 1936 Fosberg who noted, "dominant". Listed on the OIRC website as "uncommon". Further seeding, experimenting with bales, and planting would allow this plant to once again flourish on this islet.
16 Feb 1936, Fosberg, F.R. (#12897), 10 m, Dominant, Grassy slope, BISH 119320, USNM 02487338.

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) -- Indigenous**
Rare. A few near landing. Also in cove on east end. First collected in 1936 by Fosberg. This species appears to being doing fine. No recommendations other than regular monitoring.
16 Feb 1936, Fosberg, F.R. (#12899), BISH 47463.

***Jacquemontia ovalifolia* subsp. *sandwicensis* -- Pau o hiiaka -- (Convolvulaceae) -- Endemic**
Occasional. Near coast. A few large mats found cascading down open ridges on southwest part of islet, where it is often the closet plant to the ocean. First collected in 1936 by Fosberg. Listed on the OIRC website as "occasional". This vine quickly covers ground and could be planted if the islet went bare again. This species appears to be doing fine, no action necessary other than routine monitoring.
16 Feb 1936, Fosberg, F.R. (#12889), 15 m, USNM 02155857.

***Lantana camara* -- Lantana -- Verbenaceae -- Alien**
Not observed during this survey. Observed in 1936 by Fosberg. Could be removed if found.
16 Feb 1936, Fosberg, F.R. (#12887), Grassy slope, BISH 71951.

***Lepidium bidentatum* var. *o-waihiense* -- Anaunau -- (Brassicaceae) -- Indigenous**
Not observed during this survey. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south. First collected by Neal in 1936.
14 Jun 1936, Neal, M.C. (#s.n.), BISH 424233.

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**
Occasional to common. A band near summit on west and south slopes. First collected in 1936 by Fosberg. Collected again in 1978 by Herbst. Some removal of this species has been done. This species could continue to be gradually removed. Small plants can be hand pulled. Larger plants may require herbicide.
16 Feb 1936, Fosberg, F.R. (#12896), Top of Beach, BISH 55578.
7 Feb 1978, Herbst, D.R. (#5977).

***Lipochaeta* [syn. *Melanthera*] *integrifolia* -- Nehe -- (Asteraceae) -- Endemic**
Rare. One patch on lower portion of sheer north slope. There also appeared to be a patch on the steep east wall near the summit. Observed in 1936 by Fosberg. This species could be promoted by plantings and seed tossing, especially in and near the sheer rocky portions.
16 Feb 1936, Fosberg, F.R. (#12911), 2m, Talus, BISH 75734.

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**
Occasional. Found along coast near landing, and on sheer areas, especially east end. Observed in 1936 by Fosberg. Listed on the OIRC website as "occasional". This plant will likely increase as non-natives are controlled.
16 Feb 1936 Fosberg, F.R. (#12910), BISH 69732.

***Macroptilium lathyroides* -- Cow pea -- (Fabaceae) -- Alien**
Not observed during this survey. Observed in 1936 by Fosberg. Not the most aggressive species. Could be pulled if found.

16 Feb 1936, Fosberg, F.R. (#12898), 4m, Slope above beach, BISH 55795.

***Merremia aegyptia* -- Hairy morning glory -- (Convolvulaceae) -- Questionably Naturalized**
Rare. One plant at landing that was pulled. First collected during this survey. This hairy ivy-leafed morning glory with small white flowers could cover much of this islet. It can be hand pulled. It is a heavy seeder, with long-lived seeds, so removal before it sets fruit is important.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-25).

***Myoporum sandwicense* -- Naio -- (Myoporaceae) -- Endemic**
Rare. One tree on west slope that was planted. Still needs to be collected.

***Oxalis corniculata* -- Yellow wood sorrel -- (Oxalidaceae) -- Questionably Polynesian**
Not observed during this survey. First collected in 1978 by Herbst. Occurring on nearby Mokulua N.

7 Feb 1978, Herbst, D.R. (#5981), BISH 771063.

***Panicum fauriei* -- Panic grass -- (Poaceae) -- Endemic**
Not observed during this survey. First collected by Fosberg in1936 and 1937. Collected again in 1978 by Herbst. This grass occurs on Mokolii, and likely other Oahu lowland locales, and could be reintroduced to some of the exposed areas on ridges or with windward aspects.

16 Feb 1936, Fosberg, F.R. (#12888), BISH 640669.
10 Apr 1937, Fosberg, F.R. (#13695), 15 m, BISH 458197, USNM 02184856.
7 Feb 1978, Herbst, D.R. (#5979), BISH 421602.

***Paspalum vaginatum* -- Seashore paspalum -- (Poaceae) -- Alien**
Uncommon. Possibly this species or *Sporobolus virginicus*, no fertile material. Healthy patches on southwest coast. First collected during this survey. Collecting fertile material would help clear up the ID.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-34).

***Passiflora foetida* -- Love-in-a-mist -- (Passifloraceae) -- Alien**
Occasional to common. Probably this species, no fertile material, had a foetid smell. Common on southeast slope where it twined up the grasses and formed a mat on the ground. Being visited by passion vine butterfly. First collected during this survey. This non-native vine can become aggressive. It can be hand pulled.

7 Feb 1978, Herbst, D.R. (#5982), BISH 421541.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-31).

***Passiflora suberosa* -- Huehue haole -- (Passifloraceae) -- Alien**
Rare. One plant on southeast slope that was pulled and bagged. First collected during this survey. This plant should be looked for during regular surveys, and pulled when found.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-29).

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Not observed during this survey. First collected in 1936 by Fosberg. Could be re-introduced from nearby Popoia. See discussion of this species on Popoia.
16 Feb 1936, Fosberg, F.R. (#12900), 2m, Slope above beach, BISH 63811.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Occasional. Scattered around islet, generally in open sites. First collected by Fosberg in 1936. See discussion of this species on Popoia.
16 Feb 1936, Fosberg, F.R. (#12893), 25m, Steep eroded ridge, BISH 63889.

***Reichardia picroides* -- Reichardia -- (Asteraceae) -- Alien**
Not observed during this survey. First collected by Fosberg in 1936. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south.
13 Oct 1946, Fosberg, F.R. (#12919), BISH 121412.

***Reichardia tingitana* -- Reichardia -- (Asteraceae) -- Alien**
Not observed during this survey. First collected in 1936 by Fosberg. A related species, *Reichardia picroides*, is found on Manana. *R. tingitana* has rays yellow with purple towards the base. *R. picroides* has rays yellow throughout. This species should be looked for and pulled when found.
16 Feb 1936, Fosberg, F.R. (#12908), Talus at base of cliff, BISH 121413.

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**
Occasional to common. There are a few plants on west slope near landing that were apparently planted. The are also large patches of naupaka cascading down the steep to sheer slopes of the north, east, and south sides of the islet. Listed on OIRC website as "occasional". First collected during this survey. This hardy native does well on the windward side of the islet, and is one of the only plants that can compete with sand bur (*Cenchrus*) on the leeward side of the islet. Additionally, wedge-tailed shearwaters and Bulwer's petrels utilize naupaka clumps for nesting sites. Given that, naupaka seems like a good candidate for further out-planting on Mokulua S. It could also be promoted by selective weed control near existing plants and by tossing seeds.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-27).

***Sesbania tomentosa* -- Ohai -- (Fabaceae) -- Endemic**
Not observed during this survey. First collected by Neal in 1936. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south. This rare attractive plant could be re-introduced through out-planting.
14 Jun 1936, Neal, M.C. (#s.n.), BISH 424215.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Occasional to common. Here and there near the coast and on sheer slopes. Often the closest plant to the ocean, especially on the south and east sides that receive large amounts of salt spray. First collected in 1936 by Fosberg. Listed on the OIRC website as

"occasional". This species seems to be doing fine on Mokulua S, no action seems necessary other than routine monitoring.
16 Feb 1936, Fosberg, F.R. (#12902), BISH 20154.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Occasional to common. Found here and there. First collected in 1936 by Fosberg. Listed on the OIRC website as "occasional". This species will likely increase on its own as non-natives are removed. It could also be planted.
16 Feb 1936, Fosberg, F.R. (#12913), BISH 57877.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Occasional. Found here and there. First collected in 1936 by Fosberg. Not the most aggressive plant, though it can be conspicuous at times. Can be hand-pulled.
16 Feb 1936, Fosberg, F.R. (#12914), BISH 121509.

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**
Uncommon. What is possibly this species or *Paspalum vaginatum* (no fertile material) was found in a series of healthy patches on the southwest coast, where it is often the closest plant to the ocean. First collected in 1936 by Fosberg. Listed on the OIRC website as "occasional". Collecting / photographing fertile material will help sure up the identification of these hardy patches. Akiaki is a very effective weed control barrier when established, and could likely hold its own against *Cenchrus*, especially near the coast. Additionally, akiaki generally stays green year-round, even when other grasses have dried out. This helps hold the soil in dry times. Hand weeding and selective spraying of weeds on the margins of the existing akiaki patches would enable them to "march" across the islet. Akiaki can be propagated by cuttings, and could be further planted in patches around the islet.
16 Feb 1936, Fosberg, F.R. (#12901), 5m, Sandy lower slopes, BISH 120511.

***Stachytarpheta jamaicensis* -- Jamaica vervain -- (Verbenaceae) -- Alien**
Rare. A few plants on south slope. First collected during this survey. This plant is generally not the most aggressive. It can be hand pulled.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-16).

***Tetragonia tetragonioides* -- New Zealand spinach -- (Aizoaceae) -- Alien**
Rare. There were 2 plants found and pulled near the landing. First collected during this survey. This species should be looked for and pulled when found.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-24).

***Trianthema portulacastrum* -- Trianthema -- (Aizoaceae) -- Alien**
Rare. A couple mature plants and a bunch of seedlings on south side near coast. First collected during this survey. This inconspicuous plant with red margins on the leaves was first recorded from Hawaii in 1976 (Wagner et al. 1999). It can be hand-pulled. There weren't too many.
23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-28).

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

Rare to occasional. A few patches along coast. From sown seeds from Kure Atoll. First collected during this survey. This species could be further promoted by seeds and plantings.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-26).

***Tridax procumbens* -- Coat buttons -- (Asteraceae) -- Alien**

Uncommon. On southeast slopes, generally in open areas. First collected in 1978 by Herbst. Collected again during this survey. Though listed as a federal noxious weed, this diminutive herb seldom bullies other plants. It can be hand pulled.

7 Feb 1978, Herbst, D.R. (#5980), BISH 421539

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-21).

***Vigna o-wahuensis* -- Vigna -- (Fabaceae) -- Endemic**

Not observed during this survey. Since there is no mention as to which islet (north or south) this species was collected on, it is included in this report for both Mokulua north and Mokulua south. First recorded by Oliveira in 1933 who noted, "10m", and "steep slope; on grass, *Emilia* and *Lantana*". Collected again in 1936 by Fosberg who noted, "10m", and "grassy slope". Collected again in 1938 by Oliveira who noted, "30m", and "Large patch on fairly steep slope of lower peak; twining on grass and *Lantana*". This now endangered vine could be re-introduced through out-planting or seed sowing.

12.vi.1933, Oliveira, J.M., (#s.n.), BISH 56266.

16 Feb 1936, Fosberg, F.R. (#12943), BISH 56265.

12.vi.1938, Oliveira, J.M., (#12018), BISH 56264.

***Vitex rotundifolia* -- Pohinahina -- (Verbenaceae) -- Indigenous**

Rare. One patch near landing. Planted. First collected during this survey. Though not previously known from the offshore islets, the one planted patch of this fragrant hardy native coastal plant with purple flowers appears to be doing well, despite living in a sea of *Cenchrus*. As long as it doesn't inhibit native seabird nesting, which it seemingly won't, there seems no reason not to further continue planting and tossing seeds of pohinahina.

23 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050223-23).

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

Rare. On south slope. First collected in 1936 by Fosberg. Listed on OIRC website as "uncommon". This species could be promoted through seeds.

16 Feb 1936, Fosberg, F.R. (#12891), BISH 70269.

MANANA

Figure 73. Manana islet.

Overview

Manana (Rabbit Island) lies offshore of Makapuu Point and is a tuff cone of palagonite built around two vents, each marked by a crater (MacDonald *et al*., 1983). Manana is the largest of the Oahu offshore islets and is approximately 67 acres in size, reaching a maximum elevation of 361 ft. (OIRC, 2005). We surveyed Manana on Feb. 25, 2005. We took a boat to the islet and swam to the olivine beach on the west side. The survey lasted all day. The tuff cone is gullied by erosion on the south side and the eastern side is sheer and windswept with a bench near the ocean. There is an olivine beach on the western shore and a steep slope that rises to a crater which is completely rimmed. Most of the native vegetation is restricted to the sheer windward slopes. The western slopes, main crater, and ridges are mostly dominated by non-native plants.

Vegetation

Native plants including naupaka (*Scaevola taccada*), pua kala (*Argemone glauca*), aweoweo (*Chenopodium oahuense*), and emoloa (*Eragrostis variabilis*) are found scattered on sheer windward cliffs, near summit areas, and near the coast. There are large monotypic areas of non-native species. The western flank is made up mostly of buffel grass (*Cenchrus ciliaris*) with a few scattered patches of golden crown-beard (*Verbesina encelioides*) and hairy morning glory (*Merremia aegyptia*). The floor of the crater is dominated by a mixture of golden crown-beard, spiny amaranth (*Amaranthus spinosus*), and buffel grass. The eroded valleys of the central crater have an occasional tobacco plant (*Nicotiana tabacum*) and sourbush (*Pluchea carolinensis*). The steep gullies above

erosion valleys have a few native species, including pua kala. Non-native plants such as spiny Achyranthes (*Achyranthes aspera*) are common along trails and on the steep rocky east side of the islet. A few natives occur on the east facing slope, including naupaka, akulikuli (*Sesuvium portulacastrum*), and alena (*Boerhavia repens*). During our survey, we observed a total of 42 plant species. There were 11 (26%) native species and 31 (74%) non-native. We collected 26 plant species.

Threats

The islet is dominated by non-native plants, some of which are fairly widespread, including golden crown-beard, spiny Achyranthes, spiny amaranth, and buffel grass. It would not be easy to remove all these species, though some species near trails, such as spiny Achyranthes could be controlled to reduce potential spread to other islets from hitch-hiking on workers using the trails. Weeding could also be focused in areas where natives were present. A few invasive weeds were found in low numbers and could be removed before they become widespread, including sourbush, haole koa (*Leucaena leucocephala*), *Reichardia picroides*, and ivy gourd (*Coccinia grandis*). A black night crown heron nest containing chicks was found in a *Pluchea* bush in the central crater. A few sandbur (*Cenchrus echinatus*) plants were found along a coastal trail used for monitoring birds. Plants were pulled and bagged. Invasive species such as sandbur could be looked for during routine work and removed when found.

Restoration

Though fairly weedy, there are still native plants left on Manana, especially near the coast and on sheer windward slopes. Restoration could focus in areas where native plants were present and work towards more weedier areas. Incipient weeds could be removed before they become more widespread. Out-planting and seed throwing could accompany weeding efforts. Native species present could be encouraged to increase by weeding around them. A native tree snail (*Succinea caduca*) is previously known from the crater area. Surveys could be done to determine whether this snail is still present.

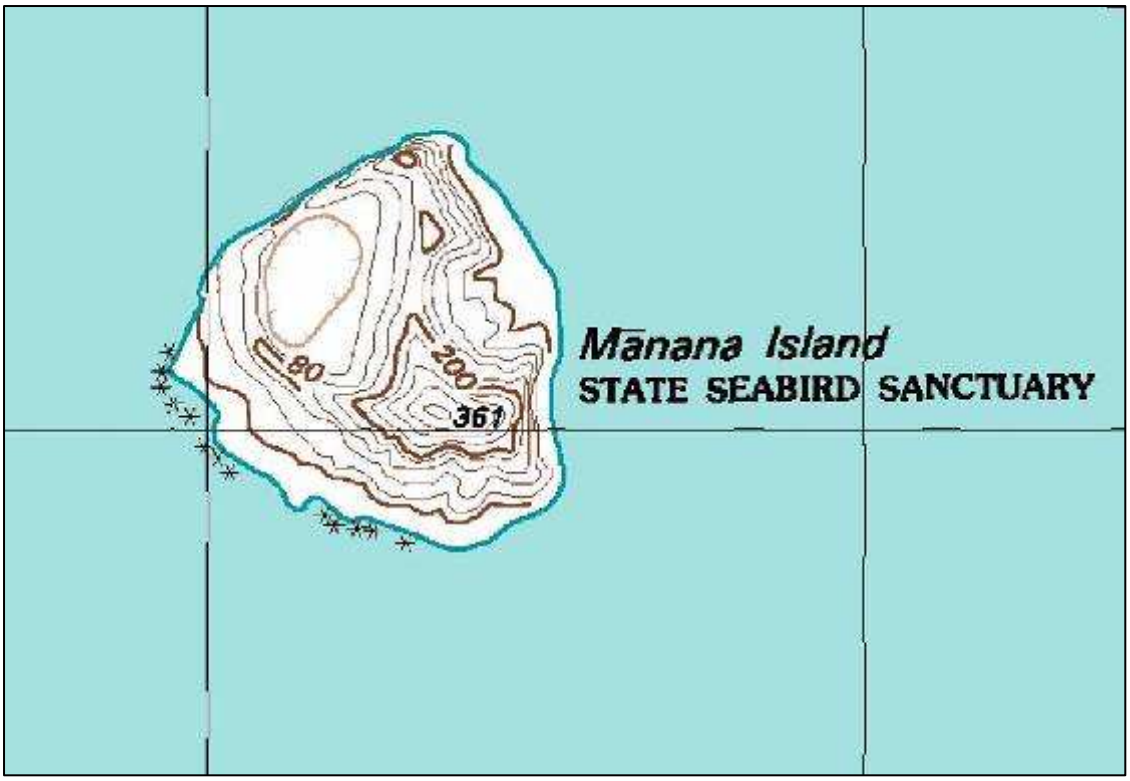

Figure 74. Manana map.

Figure 75. Manana orthophoto.

Figure 76. Western coast near beach and landing area with buffel grass (*Cenchrus ciliaris*) on windswept calcareous dunes.

Figure 77. Saddle between summit and north peak separating the main crater and the east slope.

Figure 78. Steep windward east slope and coastal bench.

Figure 79. View summit and main crater filled with of golden crown-beard (*Verbesina encelioides*) and dead coconut (*Cocos nucifera*) stumps.

Annotated Plant List -- Manana

***Achyranthes aspera* -- Achyranthes -- (Amaranthaceae) -- Alien**

Occasional to common. Found near shore, on east slope, and on ridges. First collected during this survey. This species is beginning to spread around the islet, but is likely too widespread to easily get rid of completely. It could be hand pulled or sprayed in areas being returned to natives and along trails. Care should be taken not to introduce this pesky plant to other Oahu offshore islets.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich,, & E. Shiinoki, (#050225-10).

***Ageratum conyzoides* -- Ageratum-- (Asteraceae) -- Alien**

Occasional. Found on ridges and other open areas, especially west walls of crater. First collected in 1936 by Fosberg who noted, "bottom of crater". Collected again in 1964 by Long who noted, "central portion of crater". Collected in 1979 by Strandtmann who noted, "higher elevations, scattered". Too widespread to remove completely, this species could be hand pulled or sprayed in areas being returned to natives.

18 Jan 1936, Fosberg, F.R. (#12822), Bottom of crater, 15 m, BISH 73204, 73218.
2 May 1964, Long, C.R. (#1695), Open soil areas, central portion of crater, BISH 51364, USNM 02659450.
12 Jun 1979, Strandtmann, R.W. (#s.n.) BISH 439589, 439593.
12 Jun 1979, Strandtmann, R.W. (#s.n.) Higher elevations, scattered, BISH 439595.

***Amaranthus spinosus* -- Spiny amaranth -- (Amaranthaceae) -- Alien**

Common. Co-dominant with *Verbesina encelioides* and *Cenchrus ciliaris* in crater floor. First collected by Strandtmann in 1979. Too widespread to control, this species could be hand pulled or sprayed in areas being returned to natives.

12 Jun 1979, Strandtmann, R.W. (#s.n.) BISH 439590, 439592.

***Amaranthus viridis* -- Slender amaranth -- (Amaranthaceae) -- Alien**

Occasional. Here and there, especially on east slope. First collected during this survey. This species could be hand pulled or sprayed in areas being returned to natives.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki, (#050225-1).

***Anagalis arvensis* -- Scarlet pimpernel -- (Primulaceae) -- Alien**

Not observed during this survey. First collected by Grant, no date given, but likely 1915. This species could be looked for during routine monitoring, and pulled if found.

No date, Grant, M.L. (#7294), BISH 101003.

***Argemone glauca* -- Pua kala -- (Papavaraceae) -- Endemic**

Occasional. Found on steep to sheer open areas. First collected in 1964 by Lamoureux. Collected again during this survey. This species appears to be doing fine. No actions recommended other than routine monitoring.

29 Feb 1964, Lamoureux, C.H. (#2583), as var. *glauca*, BISH 456697.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-15).

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

Not observed during this survey. First collected by Grant in 1934. Collected again in 1936 by Fosberg. Collected in 1964 by Lamoureux and by Long who noted, "along beach, W side", "E part", "Eastern sandy area". Could be looked for during routine monitoring.

26 Aug 1934, Grant, M.L. (#7295), BISH 100617.
18 Jan 1936, Fosberg, F.R. (#12826), Ledges on cliff, BISH 46870.

29 Feb 1964, Lamoureux, C.H. (#2581), Common on lower slopes, BISH 456696.
2 May 1964, Long, C.R. (#1682), N side, BISH 121964.
2 May 1964, Long, C.R. (#1682), Along beach, W side, USNM 0265956.
2 May 1964, Long, C.R. (#1684), E part, sand, BISH 121963.
2 May 1964, Long, C.R. (#1684), Eastern sandy area, USNM 02659563.

***Boerhavia coccinea* -- Boerhavia -- (Nyctaginaceae) -- Alien**
Occasional. Found in sheer and exposed areas such as the back walls of the gullies in the crater. First collected during this survey. Could be removed in areas being returned to natives.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-2).

***Boerhavia repens* -- Alena -- (Nyctaginaceae) -- Indigenous**
Common to occasional. A few patches in open areas on ridges and near coast. First collected in 1936 by Fosberg, who noted, "edge of crater". Collected again in 1964 by Lamoureux, again in 1964 by Long who noted "South side of crater", "E end of island, W side", "within crater", and in 1979 by Strandtmann. This species would likely spread on its own as non-natives are removed. Seems to be to doing fine, no actions recommended other than routine monitoring.

18 Jan 1936, Fosberg, F.R. (#12829), Edge of crater, 25 m, USNM 0314205.
18 Jan 1936, Fosberg, F.R. (#12830), 25 m, USNM 03142055.
29 Feb 1964, Lamoureux, C.H. (#2568), BISH 456663.
29 Feb 1964, Lamoureux, C.H. (#2573), BISH 456661.
2 May 1964, Long, C.R. (#1683), South side of crater, BISH 60657, USNM 00090529.
2 May 1964, Long, C.R. (#1688), E end of island, W side, BISH 60658, USNM 00090528.
2 May 1964, Long, C.R. (#1693), Within crater, USNM 00090530.
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439586, 439599, 439600.

***Cenchrus ciliaris* -- Buffel grass -- (Poaceae) -- Alien**
Dominant. Dominates almost all space on the west slope, shares dominance with *Verbesina* in the crater, and dominates many of the soil areas on the east slope. First collected during this survey. Management of this species on Manana will depend on available resources. A zero resource scenario basically accepts it as acceptable structure for wedge tailed shearwater nesting, despite the fact that it is non-native and precludes virtually all native plant growth over most of the islet. A bit more resources would allow for select removal in areas being returned to natives, such as near the coast, on ridges, and in open areas. Existing plantings and sown seeds, such as *Scaevola* and *Tribulus,* seem to be able to compete a bit with the buffel grass. Further out-planting of natives would likely make inroads on the buffel grass and help shift the flora towards native. An unlimited resources scenario could result in complete removal, as was done with *C. echinatus* on Laysan, though it should be done in phases so as not to expose too much soil at once.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-22).

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**
Rare. Two plants on trail near coast on northwest corner of islet. Plants were pulled and bagged. First collected in 1930 by Neal. Collected again in 1934 by Grant, in 1936 by Fosberg, in 1954 by Richardson, in 1964 by Lamoureux, in 1964 by Long who noted, "near beach", in 1979 by Strandtmann, and during this survey. This species is common

on other Oahu offshore islets. It should be looked for during routine work and pulled and bagged when found.

16 Mar 1930, Neal, M. (#s.n.), BISH 11826
26 Aug 1934, Grant, M. (#7296), BISH 639152
18 Jan 1936, Fosberg, F. (#12821), BISH 118249
18 Jan 1936, Fosberg, F. (#12821), 10 m, USNM 02487289
14 Mar 1954, Richardson, F. (#s.n.), BISH 118261, USNM 02549352.
29 Feb 1964, Lamoureux, C.H. (#2570), BISH 456662
2 May 1964, Long, C.R. (#1696), Near beach, USNM 02659967
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439565, 439568, 439569, 439570.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-8).

***Chamaesyce hirta* -- Hairy spurge -- (Euphorbiaceae) -- Alien**

Rare. One plant on north point hump. First collected in 1936 by Fosberg. Could be hand pulled in areas being returned to natives.

18 Jan 1936, Fosberg, F.R. (#12820), 15m, bottom of crater, BISH 49943.

***Chamaesyce prostrata* -- Prostrate spurge -- (Euphorbiaceae) -- Alien**

Not observed during this survey. First collected in 1979 by Strandtmann who noted, "on the ridge, NW ? side, not abundant". Could be looked for during routine monitoring.

12 Jun 1979, Strandtmann, R.W. (#s.n.), On the ridge, NW ? side, not abundant, BISH 439591.

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**

Occasional. Found near coast on south shore and on ridges on summit. First collected during this survey. This species could be increased by seed tossing and planting.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-20).

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**

Common. Found mixed in with other grasses over much of the islet. First collected in 1936 by Fosberg. Collected again in 1937 by Egler, in 1964 by Lamoureux and by Long who noted, and in 1979 by Strandtmann. Collected during this survey. This species could be hand pulled or sprayed in areas being returned to natives.

18 Jan 1936, Fosberg, F.R. (#12819), BISH 118332
18 Jan 1936, Fosberg, F.R. (#12819), 3 m, USNM 02487689.
10 Jul 1937, F.E. Egler (#37-106), Occurring occasionally throughout the island, BISH 10691.
1 Mar 1964, Lamoureux, C.H. (#2584), BISH 456694.
2 May 1964, Long, C.R. (#1689a), Near beach, north side of island, USNM 02659960.
12 Jun 1979, Strandtmann, R.W. (# s.n.), Not really common, NW (?) side only, BISH 439567, 439572, 439577, 439579, 439580, 439581, 439582.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-26).

***Coccinia grandis* -- Ivy gourd -- (Cucurbitaceae) -- Alien**

Rare. One 20 m x 15 m patch on west wall of crater rim. First collected during this survey. The lone patch should be removed with herbicide. This pesky vine should be regularly looked for and removed on all the Oahu offshore islets.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-6).

***Cocos nucifera* -- Coconut -- (Arecaceae) -- Polynesian**

Rare. Two recently planted just south of the landing. Half dozen dead trunks in crater. First collected during this survey. They could be tolerated or removed.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-19).

***Cucurbita pepo* -- Pumpkin -- (Cucurbitaceae) -- Alien**
Not observed during this survey. First and only collection in 1937 by Egler.
10 Jul 1937, F.E. Egler (#37-103), Inside crater, on flat, BISH 47838.

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**
Occasional. A few patches near coast on west slope. First collected during this survey. Could be sprayed.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-23).

***Cyperus javanicus* -- Ahu awa -- (Cyperaceae) -- Indigenous**
Not observed during this survey. First collected in 1934 by Grant. Collected again in 1936 by Fosberg who noted, "crater floor". This species could be looked for during routine monitoring.
26 Aug 1934, Grant, M.L. (#7293), BISH 97089.
18 Jan 1936, Fosberg, F.R. (#12832), Crater floor, 15 m, USNM 03153328.

***Dactyloctenium aegyptium* -- Beach wire grass -- (Poaceae) -- Alien**
Occasional. Here and there in open sites, especially near the coast. First collected in 1964 by Lamoureux who noted, "upper rim, windward". This species could be hand pulled or sprayed in areas being returned to natives.
1 Mar 1964, Lamoureux, C.H. (#2579), Upper rim, windward, BISH 456638.

***Digitaria insularis* -- Sourgrass -- (Poaceae) -- Alien**
Rare. A few clumps on east ridge and slope. First collected in 1947 by St. John. Collected again in 1964 by Lamoureux, in 1964 by Long who noted "North slope of crater, in crater", and in 1979 by Strandtmann who noted "found only on the NW (?) side, abundant". This species could be hand pulled or sprayed.
25.iv.1947, St. John, H. (#22680), Filling the crater & covering the middle & upper outer slopes, BISH 21906.
29 Feb 1964, Lamoureux, C.H. (#2574), BISH 456659.
2 May 1964, Long, C.R. (#1688), North slope of crater, USNM 02659517.
2 May 1964, Long, C.R. (#1692), In crater, assoc with *Nicotiana*, BISH 120546, USNM 02659508.
12 Jun 1979, Strandtmann, R.W. (#s.n.), Abundant along the upper half of the NW (?) ridge, inner side, BISH 439574, 439575, 439576, 439578, 439583.

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**
Rare to occasional. Patches by trail near coast on northwest corner of islet. First collected during this survey. This species could be hand pulled or sprayed.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-3).

***Emilia fosbergii* -- Pualele -- (Asteraceae) -- Alien**
Occasional. Found on ridges and other open areas. First collected during this survey. Can be hand pulled.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-5).

***Eragrostis amabilis* -- Lovegrass -- (Poaceae) -- Alien**
Not observed during this survey. First collected in 1936 by Fosberg.
18 Jan 1936, Fosberg, F.R. (#12818), BISH 118894.

***Eragrostis variabilis* -- Emoloa -- (Poaceae) -- Endemic**

Rare. A few clumps near summit. This species could be increased by tossing seed and planting. Still needs to be collected.

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**
Not observed during this survey. First and only collection (as *F. c.* subsp. *umbellato-capitata*) in 1937 by Egler who noted, "above boat landing".

10 Jul 1937, Egler, F.E. (#37-105), Above boat landing, BISH 10723.

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**
Rare. One patch on east slope. First collected in 1936 by Fosberg. No action recommended other than routine monitoring.

18 Jan 1936, Fosberg, F.R. (#12824), 30 m, BISH 43250.

***Heteropogon contortus* -- Pili -- (Poaceae) -- Questionably Indigenous**
Not observed during this survey. First collected in 1927 by Lee. Collected again in 1936 by Fosberg who noted, "abundant". This species could be increased through tossing seed, placing bales, and plantings.

5 Jun 1927, Lee, H.A. (#316), 25 m, BISH 119309.
5 Jun 1927, Lee, H.A. (#316), 25 m, BISH 119362.
18 Jan 1936, Fosberg, F.R. (#12816), Abundant, 6m, BISH 119321.
18 Jan 1936, Fosberg, F.R. (#12816), Abundant, 6m, USNM 02487337.

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) --**
Occasional. Found near coast on sandy west shore. Closest plant to the ocean. First collected during this survey. Appears to be doing fine. No action recommended other than routine monitoring.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-18).

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**
Rare. One patch in rivulet just south of landing. First collected during this survey. This plant should be removed while it is still in limited distribution. It can be cut and sprayed with herbicide. Bagging the seeds will help minimize follow-up.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-17).

***Merremia aegyptia* -- Hairy morning glory -- (Convolvulaceae) -- Questionably Naturalized**
Occasional. A few vines, especially on west slope. First collected during this survey. This species seems to be attempting to make inroads on the offshore islets, but it is not yet well established. These hairy vines should be looked for during routine work and pulled when found.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-21).

***Nicotiana tabacum* -- Tobacco -- (Solanaceae) -- Alien**
Occasional. A few patches near south coast. Scattered in other open areas. In gulches in crater. First collected in 1936 by Fosberg. Collected again in 1964 by Lamoureux and by Long who noted, "central west area of crater, all growth stages present", "North slope outside crater above beach facing mainland". Collected in 1979 by Strandtmann. There isn't too much of this species, which could likely be removed through hand-pulling.

18 Jan 1936, Fosberg, F.R. (#12828), BISH 1002885.

29 Feb 1964, Lamoureux, C.H. (#2569), BISH 456664.
2 May 1964, Long, C.R. (#1686), North slope outside crater above beach facing mainland, BISH 51425.
2 May 1964, Long, C.R. (#1686), North slope outside crater above beach facing mainland, USNM 02659197.
2 May 1964, Long, C.R. (#1685), Central west area of crater, all growth stages present, BISH 51424.
2 May 1964, Long, C.R. (#1685), Central west area of crater, USNM 02659200.
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439585.
12 Jun 1979, Strandtmann, R.W. (#s.n.), Abundant in the crater and on the N. face of the S. side peak, BISH 439587.
12 Jun 1979, Strandtmann, R.W. (#s.n.), From near the top of the S. (?) peak, BISH 439594.

***Panicum torridum*--Konakona -- (Poaceae) -- Endemic**
Not observed during this survey. First collected in 1936 by Fosberg. Should be looked for during regular monitoring.
18 Jan 1936, Fosberg, F.R. (#12827), 60 m, BISH 119916.

***Passiflora suberosa* -- Huehue haole -- (Passifloraceae) -- Alien**
Occasional. A few patches in open areas on ridges and near the coast. First collected during this survey. Could be pulled when found.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-25).

***Pluchea carolinensis* -- Sourbush -- (Asteraceae) -- Alien**
Rare. A few plants in most westward gulch in crater. First collected in 1964 by Lamoureux who noted, "on outer SW slope". All plants on the islet could easily be removed. Most plants could be hand pulled, though some of the larger ones may require cutting and treatment with an herbicide.
29 Feb 1964, Lamoureux, C.H. (#2577), On outer SW slope, 30 m, BISH 456383.

***Pluchea indica* -- Indian fleabane -- (Asteraceae) -- Alien**
Rare. One plant on north slope. Observed during this survey. Too sheer to collect. This plant could be hand pulled if found in accessible areas.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Occasional. Here and there in open areas. First collected in 1930 by Neal. Collected again in 1936 by Fosberg who noted, "cinder slope, very abundant". Collected in 1979 by Strandtmann. This species could be hand pulled in areas being returned to natives.
16 Mar 1930, Neal, M.C. (#s.n.), BISH 63895.
18 Jan 1936, Fosberg, F.R. (#12817), Cinder slope, very abundant, BISH 63885.
29 Feb 1964, Lamoureux, C.H. (#2580), BISH 456644.
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439588.

***Prosopis pallida* -- Kiawe -- (Fabaceae) -- Alien**
Rare. One kiawe on last vegetated gulch on south side. First collected during this survey. This species should be cut down and treated with herbicide before it spreads.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-16).

***Reichardia picroides* -- Reichardia -- (Asteraceae) -- Alien**
Occasional. Found near coast on south shore and on ridges on summit. First collected during this survey. Can be hand pulled in areas being returned to natives.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-12).

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous.**

Occasional. Found near coast on west and east flanks. Observed during this survey. Still needs to be collected. Could be planted to compete with the buffel grass.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**
Occasional. Found near coast on south and east shores. First collected during this survey. No actions recommended other than routine monitoring.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-13).

***Setaria verticillata* -- Bristly foxtail -- (Poaceae) -- Alien**
Occasional. Scattered patches. First collected in 1936 by Fosberg. Collected again in 1954 by Richardson who noted "dense growth of grass, after rains". Collected in 1964 by Lamoureux, in 1964 by Long who noted "S inner side of crater", and in 1979 by Strandtmann. Could be hand pulled or sprayed in areas being returned to natives.
18 Jan 1936, Fosberg, F.R. (#12825), BISH 120410.
14 Mar 1954, Richardson, F. (#s.n.), Dense growth of grasses, after rains, BISH 10829.
29 Feb 1964, Lamoureux, C.H. (#2575), BISH 456658.
2 May 1964, Long, C.R. (#1691), S inner side of crater, USNM 02659153.
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439566.
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439571.
12 Jun 1979, Strandtmann, R.W. (#s.n.), BISH 439573.

***Sida fallax* -- Ilima -- (Malvaceae) -- Indigenous**
Not observed during this survey. First collected in 1964 by Lamoureux who noted, "West edge of crater floor". This species could be re-introduced by seed or mass plantings. Once momentum was built up, it would likely compete with the buffel grass.
29 Feb 1964, Lamoureux, C.H. (#2578), West edge of crater floor, BISH 456641

***Solanum americanum* -- Popolo -- (Solanaceae) -- Questionably Indigenous**
Occasional. In crater floor with *Verbesina encelioides*, *Amaranthus spinosus*, and *Cenchrus ciliaris*. First collected during this survey. No actions recommended other than routine monitoring.
25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-4).

***Solanum lycopersicum* var. *cerasiforme* -- Tomato -- (Solanaceae) -- Alien**
Not observed during this survey. First collected in 1964 by Lamoureux. Collected again in 1964 by Long who noted "windward side, SE side of crater", and in 1979 by Strandtmann who noted "NW side, near top". Could be looked for during routine monitoring.
29 Feb 1964, Lamoureux, C.H. (#2572), BISH 456660.
2 May 1964, Long, C.R. (#1687), Windward side, SE side of crater, USNM 02659208.
12 Jun 1979, Strandtmann, R.W. (# s.n.), BISH 439596.
12 Jun 1979, Strandtmann, R.W. (# s.n.), BISH 439597.
12 Jun 1979, Strandtmann, R.W. (# s.n.), BISH 439598.
12 Jun 1979, Strandtmann, R.W. (# s.n.), NW side, near top, BISH 439584.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- Alien**
Common. Found on ridges and other open areas. First collected in 1937 by Egler who noted, "inside crater, on flat, only 1 plant collected". Also collected in 1964 by Lamoureux who noted, "SW crater rim, one plant only, a few others seen near top of peak". Collected in 1964 by Long who noted, "N side of crater floor". Collected in 1979

by Strandtmann who noted, "West side of Island". Can be hand pulled in areas being returned to natives. Will generally die back in summer time.

10 Jul 1937, Egler, F.E. (#37-104), inside crater, on flat, only 1 plant collected, BISH 642615.
29 Feb 1964, Lamoureux, C.H. (#2576), SW crater rim, one plant only, a few others seen near top of peak, BISH 456666.
2 May 1964, Long, C.R. (#1694), N side of crater floor, Dry stream bed, deep soil areas carved by water erosion, BISH 460797.
12 Jun 1979, Strandmann, R.W. (#s.n.), West side of Island, Rocky ledge near beach, Rare, BISH 439601.

***Stapelia gigantea*-- Zulu giant -- (Asclepiadaceae) -- Alien**
Rare to occasional. A few patches cascading down south wall of east slope. First collected during this survey. This species can be hand pulled, though the sheer cliffs it grows on present a challenge.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-11).

***Tephrosia purpurea* var. *purpurea* -- Fish poison -- (Fabaceae) -- Polynesian**
Not observed during this survey. First collected in 1934 by Grant. Collected again in 1936 by Fosberg, in 1947 by St. John, and in 1964 by Lamoureux who noted, "S side". This species could be looked for during regular monitoring.

26 Aug 1934, Grant, M.L. (#7291), BISH 122372.2
18 Jan 1936, Fosberg, F.R. (#12815), 4m, BISH 56167.
25 Apr 1947, St. John, H. (#22678), BISH 21905.
29 Feb 1964, Lamoureux, C.H. (#2567), S side, BISH 456657.

***Tetragonia tetragonioides* -- New Zealand spinach -- (Aizoaceae) -- Alien**
Rare. A couple plants found and pulled. First collected during this survey. This species should be looked for during routine work and hand pulled.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-14).

***Tribulus cistoides* -- Nohu -- (Zygophyllaceae) -- Indigenous**
Rare. A large dead patch near landing. A live patch on last ridge of vegetation on slope. The biocontrol beetle (*Microlarinus* sp.) exit hole damage was visible on the plants near the beach on the west slope. The beetles had not yet found the plants on the SE side of the islet. First collected during this survey. This species could be further promoted through seed tossing and plantings. This perennial plant will die back every year in the main Hawaiian islands due to an introduced biocontrol. However, it usually is able to set some seeds before being killed, and can therefore persist as an annual.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-9).

***Tridax procumbens* -- Coat buttons -- (Asteraceae) -- Alien**
Occasional. Found on ridges and other open areas. First collected during this survey. It could be hand pulled in areas being returned to natives.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-7).

***Verbesina encelioides* -- Golden crown-beard -- (Asteraceae) -- Alien**
Dominant. Completely covers the crater floor. A few patches on west flank. Scattered individuals on east flank. First collected during this survey. This species has taken hold on a couple of the northwestern Hawaiian Islands and has proven very difficult to control. It is too widespread on Manana to easily remove. It can be hand pulled and sprayed in and near areas being returned to natives.

25 Feb 2005, Starr, F., K. Starr, D. Smith, S. Plentovich, & E. Shiinoki (#050225-24).

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

Rare. A few plants in open areas. First collected in 1936 by Fosberg. This species could be spread by tossing seeds.

18 Jan 1936, Fosberg, F.R. (#12823), BISH 70270.

KAOHIKAIPU

Figure 80. Kaohikaipu islet.

Overview

Kaohikaipu (Turtle Island) is a small rocky islet approximately 11 acres in size that rises 40 ft. in elevation to the summit of a cinder cone (OIRC, 2005). Kaohikaipu is the southernmost islet of Oahu as well as the youngest (OIRC, 2005). The islet was surveyed on Feb. 24, 2005. We boated to the islet and swam to a rocky spot on the southwest part of the islet. We began in the morning and finished after lunch. The islet is made up of predominantly low growing native plant species over most of the islet, especially on the windward side, with some weedy sections near the landing on the western side. With some persistent weeding, the islet could be restored to a fairly pristine state.

Vegetation

There are numerous native plants including scattered pua kala (*Argemone glauca*), large patches of morning glory (*Ipomoea cairica*), nehe (*Lipochaeta integrifolia*), ilima (*Sida fallax*), and pau o hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*) existing on the islet, especially in high salt spray areas such as the northeast side of the islet. During our survey, we observed a total of 32 plant species. There were 15 (47%) native species and 17 (53%) were non-native. We collected 13 plants.

Threats

Non-native aggressive plants that are in low numbers could be removed before they became major nuisances, including *Achyranthes aspera*, sandbur (*Cenchrus echinatus*), golden crown-beard (*Verbesina encelioides*), and haole koa (*Leucaena leucocephala*).

Most of these were found in the weedier western portion of the islet. These incipient weeds could be included in a "have you seen these plants on Kaohikaipu" campaign which enlists workers and those visiting the islet to detect and report targeted plants.

Restoration

There are numerous native plants existing on the islet, especially in high salt spray areas such as the northeast side of the islet. Restoration could start in these areas and work inwards towards more weedier sections, such as the western area. Invasive plant species could be removed. The pigweed (*Portulaca oleracea*) could be removed and replaced with the native *Portulaca lutea*. Rare and interesting native plants such as ohai (*Sesbania tomentosa*), ihi (*Portulaca villosa*), and hinahina (*Heliotropium anomalum* var. *argenteum*), which were observed by earlier botanists on Kaohikaipu but are no longer found there, could be re-introduced. The endemic parasitic vine (*Cuscuta sandwichiana*) could be re-introduced. It could likely host on morning glory or ilima. Other native plants suitable to the area that are not present could be out-planted. Seeds of existing plants, such as emoloa (*Eragrostis variabilis*) and aweoweo (*Chenopodium oahuense*) could be spread. The nehe (*Lipochaeta integrifolia*) which is relatively abundant on this islet could be propagated and out-planted on other islets to ensure its survival.

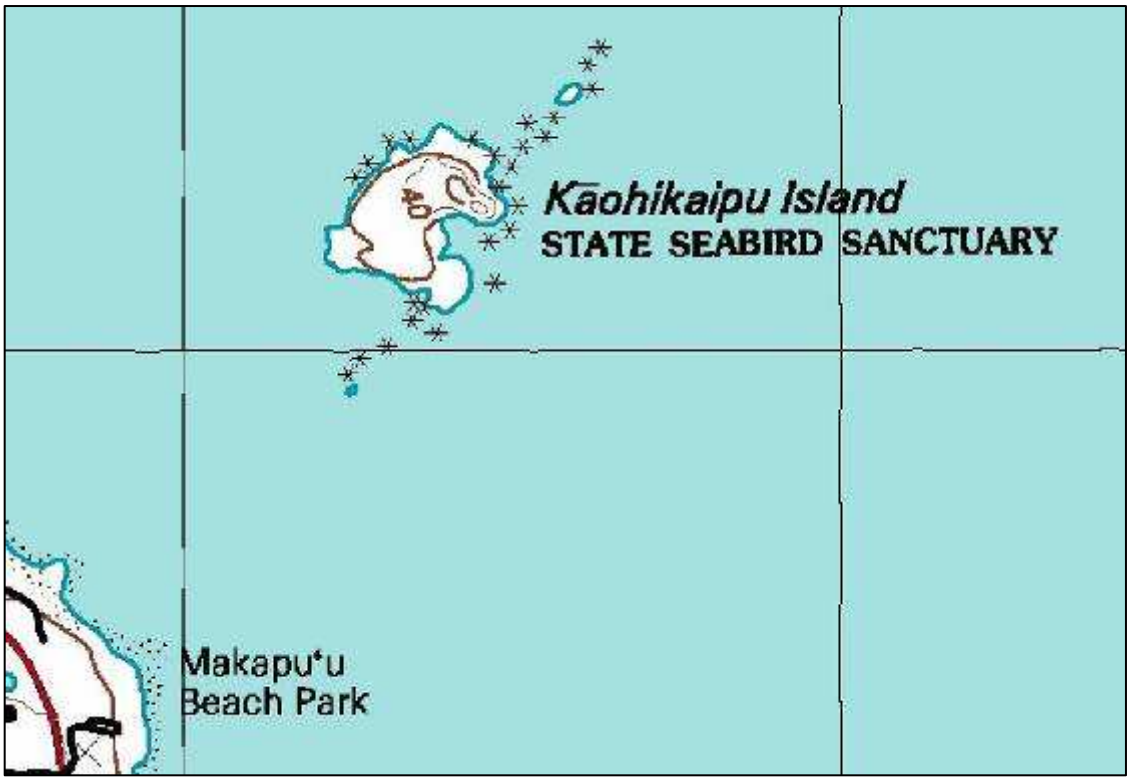

Figure 81. Kaohikaipu map.

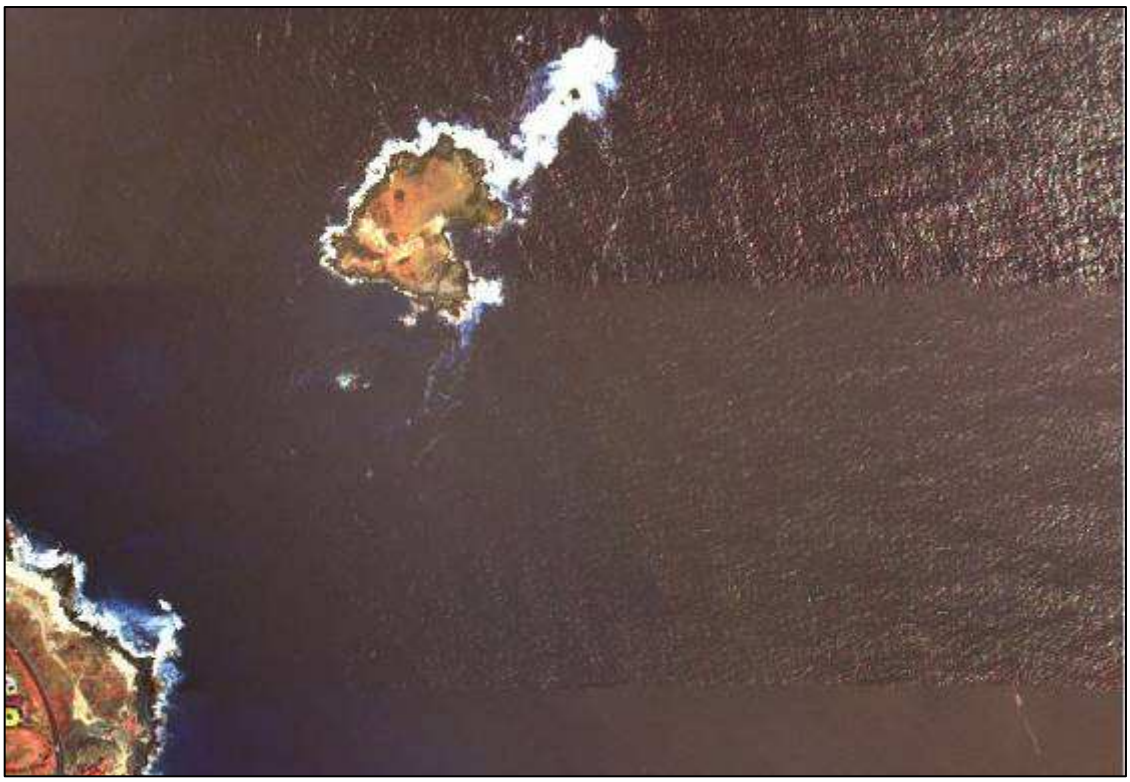

Figure 82. Kaohikaipu orthophoto.

Figure 83. Mixed herbland of native pau o hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*), nehe (*Melanthera integrifolia*), and koali ai (*Ipomoea cairica*).

Figure 84. View towards summit, mats of pau o hiiaka.

Figure 85. Scattered plants of Hawaiian poppy (*Argemone glauca*).

Figure 86. Patches of ilima (*Sida fallax*) near the summit and view west.

Annotated Plant List -- Kaohikaipu

***Achyranthes aspera* -- Achyranthes -- (Amaranthaceae) -- Alien**

Rare. A 3 x 3 m patch on the west side of islet. This small shrub has irritating prickles on the seeds and readily sticks to clothing and shoes. First collected during this survey. According to Dave Smith, the infestation was larger prior to control work. This species has become widespread on Manana and could continue to be the target of removal on Kaohikaipu. Hand pulling and spraying would likely work. There are massive amounts of seeds. Doing control work before seed set and bagging seed heads will help minimize follow-up required. Actions to help prevent spread of this species to other offshore islets should be encouraged.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-12).

***Argemone glauca* -- Pua kala -- (Papavaraceae) -- Endemic**

Occasional. Scattered plants, especially on north side and other exposed rocky areas. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. Reported in OIRC on-line species list. There is a disease or something that causes deformities in this species. It has been recorded from Haleakala on Maui, Mauna Kea on Hawaii, and we have now seen it here on Kaohikaipu on Oahu. The disease is similar to eriophyoid mite damage, but no mites have been found. Despite the deformation of a few plants, pua kala, appears to be doing fine, and no actions are recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14053), 10 m, Open slope, Leaves glaucous, flowers white, BISH 489579.

10 Aug 1967, Lamoureux, C.H. (#4079), BISH 490088.

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

Rare. One patch on southwest side. Observed in 1937 by Fosberg. Collected again in 1967 by Lamoureux who noted that there were others. Could be hand pulled.

13 Jun 1937, Fosberg, F.R. (#14063), 3 m, Rocks just above sea, Prostrate; fruiting bracts fleshy, red, BISH 46866.

10 Aug 1967, Lamoureux, C.H. (#4078), Others, BISH 489099.

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

Not observed during this survey. First collected in 1937 by Fosberg. This species has the potential to become invasive. It should be looked for during routine work and pulled if found.

13 Jun 1937, Fosberg, F.R. (#14048), Shade of basalt rocks, Flowers yellow, BISH 74106.

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

Occasional. Twining in vegetation here and there. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux, and again during this survey. This species appears to be doing fine. No actions are recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14054), 10 m, USNM 03142044.

10 Aug 1967, Lamoureux, C.H. (#4086), BISH 489080.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-4).

***Casuarina glauca* -- She oak -- (Casuarinaceae) -- Alien**

Dead. A couple trees observed on high point. They all appeared dead. Was not collected during this survey. First collected in 1967 by Lamoureux.

10 Aug 1967, Lamoureux, C.H. (#4068), Others, BISH 489100.

***Cenchrus ciliaris* -- Buffel grass -- (Poaceae) -- Alien**
Rare. One sterile plant may have been this. Observed during this survey. This species has the potential to become quite invasive. It should be looked for during routine work and pulled when found.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- Alien**
Occasional. A few patches on west end of islet. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. This hardy grass with spiny fruits can become quite aggressive. The infestation is still relatively limited and could be hand pulled or sprayed. Bagging seed heads will help minimize follow-up. This species should be looked for during routine work and removed when found.

13 Jun 1937, Fosberg, F.R. (#14046), 4 m, Broken basalt, BISH 118227.
10 Aug 1967, Lamoureux, C.H. (#4094), BISH 489083.

***Chenopodium oahuense* -- Aweoweo -- (Chenopodiaceae) -- Endemic**
Not observed during this survey. Reported in OIRC on-line species list. Could have died off. No actions recommended, though it could be re-introduced through seeds if desired.

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- Alien**
Common. Found in patches, especially on west end. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux, and during this survey. This species could be hand-pulled or sprayed.

13 Jun 1937, Fosberg, F.R. (#14066), 4 m, USNM 02487704.
10 Aug 1967, Lamoureux, C.H. (#4093), BISH 489084.
24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-7).

***Cuscuta sandwichiana* -- Kaunaoa -- (Cuscutaceae) -- Endemic**
Not observed during this survey. First collected in 1937 by Fosberg. Recently, several patches were observed (Feb. 2006) by Jaap Eijzenga on the west side of the islet hosting on pau o Hiiaka (*Jacquemontia ovalifolia* subsp. *sandwicensis*) and koali ai (*Ipomoea cairica*).

13 Jun 1937, Fosberg, F.R. (#14064), 3-10 m, Parasitic on other plants, mostly *Sida*. Stems yellow; flowers white, BISH 47249, USNM 02159891.
10 Aug 1967, Lamoureux, C.H. (#4074), BISH 489089.

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- Alien**
Not observed during this survey. First collected by Fosberg in 1937. Collected again in 1967 by Lamoureux. This species has the potential to become invasive. It should be looked for during routine work and hand-pulled or sprayed if found.

13 Jun 1937, Fosberg, F.R. (#14064), 5 m, Thin soil on basalt, BISH 47249.
13 Jun 1937, Fosberg, F.R. (#14047), 5 m, Thin soil on basalt, BISH 118447.
10 Aug 1967, Lamoureux, C.H. (#4098), BISH 489082.

***Dactyloctenium aegyptium* -- Beach wire grass -- (Poaceae) -- Alien**
Occasional. Here and there. First collected in 1937 by Fosberg. This species is not the most aggressive invader. It can be hand pulled or sprayed.

13 Jun 1937, Fosberg, F.R. (#14039), 3 m, Trampled soil in trail, BISH 118504.

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

Not observed during this survey. First collected in 1967 by Lamoureux. This species should be looked for during routine surveys and removed if found.

10 Aug 1967, Lamoureux, C.H. (#4096), BISH 489086.

***Eleusine indica* -- Wire grass -- (Poaceae) -- Alien**

Rare. A few plants in center of islet. First collected in 1967 by Lamoureux. Can be hand pulled or sprayed.

10 Aug 1967, Lamoureux, C.H. (#4097), BISH 489081.

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

Rare. A few plants in center of islet. First collected by Fosberg in 1937. Collected again in 1967 by Lamoureux. Not the most aggressive, usually popping up in open spots after rains. Can be hand-pulled.

13 Jun 1937, Fosberg, F.R. (#14055), Open rocky slopes, Flowers red, BISH 75075.

10 Aug 1967, Lamoureux, C.H. (#4091), BISH 489085.

***Fimbristylis cymosa* -- Button sedge -- (Cyperaceae) -- Indigenous**

Occasional. A few patches in open areas near coast. First collected in 1967 by Lamoureux as *F. cymosa* subsp. *umbellato-capitata*. Noted in OIRC on-line species list. Collected again during this survey. This species could be further promoted through scattering of seed, though will likely spread on its own as non-native plants around it are removed.

10 Aug 1967, Lamoureux, C.H. (#4070), BISH 489096.

10 Aug 1967, Lamoureux, C.H. (#4095), BISH 490085.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-8).

***Heliotropium anomalum* var. *argenteum* -- Hinahina -- (Boraginaceae) -- Endemic**

Not observed during this survey.

13 Jun 1937, Fosberg, F.R. (#14043), 3m, Thin coral sand on basalt, Flower of Kahoolawe (Used for tea), BISH 43167.

13 Jun 1937, Fosberg, F.R. (#14044), 3m, Thin coral sand on basalt, Prostrate sub-shrub; flowers white with orange center, very fragrant, BISH 43201.

***Heliotropium curassavicum* -- Heliotrope -- (Boraginaceae) -- Indigenous**

Rare. A few patches in exposed areas near coast. First collected in 1967 by Lamoureux. This species appears to be doing fine, no action recommended other than routine monitoring.

10 Aug 1967, Lamoureux, C.H. (#4090), BISH 489076.

***Hibiscus tiliaceus* -- Hau -- (Malvaceae) -- Questionably Indigenous**

Rare. 1 clump 20 m x 5 m on northwest part of islet. First collected during this survey. This shrubby thicket could be left, or could be removed. Left unchecked in the right habitat, hau can create dense impenetrable thickets. This patch of questionably native hau probably isn't providing much habitat for native birds, and is beginning to push aside other genuinely native plants.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-9).

***Ipomoea cairica* -- Koali ai -- (Convolvulaceae) -- Questionably Indigenous**

Occasional to common. Forming mats on and near rocky ridge on west end of islet. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. This species appears to be doing fine, no actions recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14041), 5 m, Broken basalt rock, BISH 47536, USNM 02431420.
10 Aug 1967, Lamoureux, C.H. (#4048), BISH 489091.

***Ipomoea indica* -- Koali awa -- (Convolvulaceae) -- Indigenous**

Rare. One small sterile plant with cordate leaves, of what appeared to be *I. indica* found in rocky ridge on west end of islet. *I. indica* was first collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. Fertile material should be looked for to help confirm the identification.

13 Jun 1937, Fosberg, F.R. (#14040), 4 m, Broken basalt rock, Vine; flowers pink-lavender, BISH 47578, USNM 02431424.
10 Aug 1967, Lamoureux, C.H. (#4085), BISH 489075.

***Ipomoea pes-caprae* subsp. *brasiliensis* -- Pohuehue -- (Convolvulaceae) -- Indigenous**

Not observed during this survey. Reported in species list on website (OIRC, 2005). Could be propagated from other islets and out-planted. May also arrive again on it's own.

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

Dominant. Common over most of islet. Forming vast mats. Often the closest plant to the ocean. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. This species appears to be doing well, no actions recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14057), 3 m, Thin coral sand on basalt, Prostrate, leaves sometimes fleshy, flowers pale blue, BISH 47688.
10 Aug 1967, Lamoureux, C.H. (#4083), BISH 489090.

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

Not observed during this survey. First collected in 1937 by Fosberg. This species should be looked for during routine work, and pulled when found.

13 Jun 1937, Fosberg, F.R. (#14045), Broken basalt, Shrub 1m; flowers orange-yellow, turning deep pink, BISH 71968.

***Leucaena leucocephala* -- Haole koa -- (Fabaceae) -- Alien**

Rare. One plant on west side of islet in large boulder pile. The single small tree was cut, herbicide was applied, and the seeds were bagged. The plant had already gone to seed and follow-up will likely be needed. First collected during this survey. It should be looked for during routine work and removed when found.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-1).

***Lipochaeta* [syn. *Melanthera*] *integrifolia* -- Nehe -- (Asteraceae) -- Endemic**

Occasional to common. Several patches around islet. Forming mats. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. This species appears to be doing fine, no actions recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14051), 8 m, Broken basalt, Prostrate, leaves fleshy; flowers yellow, BISH 75728.
10 Aug 1967, Lamoureux, C.H. (#4076), BISH 489102.

***Lycium sandwicense* -- Ohelo kai -- (Solanaceae) -- Indigenous**
Rare. One small patch in center of islet. First collected during this survey. This species will likely spread on its own as non-natives around it are removed. No action recommended other than routine monitoring.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-5).

***Passiflora suberosa* -- Huehue haole -- (Passifloraceae) -- Alien**
Occasional. A couple patches on west end of islet. First collected during this survey. This species can be hand pulled or sprayed.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-10).

***Portulaca lutea* -- Ihi -- (Portulacaceae) -- Indigenous**
Not observed during this survey. First collected in 1937 by Fosberg. In 1937, Fosberg observed both *P. oleracea* and the native *P. lutea*. Today, no *P. lutea* remains. *P. oleracea* could be removed from the islet by hand pulling and replaced with *P. lutea*, which is still found in relative abundance on Popoia (Flat island). See *P. lutea* (Mokuauia Islet) for a description of this species.

13 Jun 1937, Fosberg, F.R. (#14042), 3 m, Thin sand over lava rock, Stem thick, fleshy, spreading; leaves fleshy; flower yellow 2 cm across; stamens many; style branches 6, BISH 681467.

***Portulaca oleracea* -- Pigweed -- (Portulacaceae) -- Alien**
Occasional. Here and there, especially in open areas. Observed in 1937 by Fosberg. Can be hand pulled when flowers are conspicuous and could eventually be replaced with native *P. lutea*.

13 Jun 1937, Fosberg, F.R. (#14061), Broken basalt, Stems prostrate, reddish, fleshy; leaves reddish, fleshy; flowers yellow, 0.5 cm across; stamens 4-6; petals emarginate, BISH 63881.
10 Aug 1967, Lamoureux, C.H. (#4073), Stems decumbent, red. Flowers 3-5 mm. in diameter, yellow, BISH 489093.
10 Aug 1967, Lamoureux, C.H. (#4074), Flowers as in #4073 (3-5 mm. in diameter, yellow), BISH 489092.

***Portulaca pilosa* -- Portulaca -- (Portulacaceae) -- Alien**
Occasional. Here and there, especially near coast. First collected during this survey. Can be hand pulled. Care should be taken when controlling this plant to make sure that it is not the similar looking rare native *P. villosa*. *P. pilosa* can be distinguished by having magenta colored flowers and seeds that are metallic blue black. The native *P. villosa* has white to pink flowers and seeds that are reddish black. *P. pilosa* could be replaced with the native *P. villosa*.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-11).

***Portulaca villosa* -- Ihi -- (Portulacaceae) -- Endemic**
Not observed during this survey. First collected in 1937 by Egler and Fosberg. Egler apparently collected his specimen from a plant at an elevation of 5m on coral rock with thin soil. He further noted that it was "infected with fungus, locally abundant" and described it as, "prostrate; leaves round in cross-section; flowers and fruit". Fosberg apparently collected his specimen at 10m in an area of thin soil and basalt. Fosberg gave the following description, "stem fleshy; leaves pale, almost terete, flowers pink, petals emarginate, stamens many; stigma 6 lobed". *P. villosa* was collected again in 1967 by

Lamoureaux. It has also been collected by Neal with no specified date. This species could be reintroduced through out-planting or seed sowing.

13 Jun 1937, Egler, F.E. (#37-78), 5m, BISH 63913, 6768.
13 Jun 1937, Fosberg, F.R. (#14070), 10 m, BISH 63918.
10 Aug 1967, Lamoureux, C.H., (#4067), BISH 489097.
None noted, M.C. Neal (#s.n.), BISH 63912.

***Reichardia picroides* -- Reichardia -- (Asteraceae) -- Alien**

Not observed during this survey. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. Grows on nearby Manana. Could be looked for during routine work and removed if found.

13 Jun 1937, Fosberg, F.R. (#14067), rocky flat, flowers yellow, BISH 121406.
10 Aug 1967, Lamoureux, C.H. (#4089), BISH 489077.

***Scaevola taccada* -- Naupaka -- (Goodeniaceae) -- Indigenous**

Occasional to common. Patches here and there, especially near coast. Reported in OIRC on-line species list. Still needs to be collected. This species appears to be doing fine, no action recommended other than routine monitoring.

***Sesbania tomentosa* -- Ohai -- (Fabaceae) -- Endemic**

Not observed during this survey. First collected in 1937 by Fosberg and Egler. Could be re-introduced from stock from the main island of Oahu.

13 Jun 1937, Fosberg, F.R. (#14052), 15 m, Broken basalt, Prostrate shrub, flowers orange red, BISH 55929, USNM 02159890.
13 Jun 1937, Egler, F.E. (#37-246), Locally frequent. Carpologica 610, On thin soil on volcanic rock, BISH 687256.

***Sesuvium portulacastrum* -- Akulikuli -- (Aizoaceae) -- Indigenous**

Occasional to common. Found near coast, especially in area exposed to surf spray. Creating large mats. Some areas close to salt spray have compact "jelly bean" form. Often the closest plant to the ocean. First collected in 1937 by Fosberg. Collected again in 1967 by Lamoureux. This species appears to be doing well, no further action recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14060), 2 m, Bare lava rock occasionally wet by salt spray, Prostrate; stems green; leaves fleshy; flowers white, BISH 643532, USNM 03308192.
10 Aug 1967, Lamoureux, C.H. (#4071), Stems red, flowers pink, BISH 489095.
10 Aug 1967, Lamoureux, C.H. (#4072), Stems red, flowers pink, BISH 489094.

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

Rare to occasional. A couple patches on west end of islet. First collected in 1967 by Lamoureux. This grass sticks to socks and animals. It could be hand pulled or sprayed.

10 Aug 1967, Lamoureux, C.H. (#4092), BISH 490084.

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

Dominant. Common over most of islet. Recorded in OIRC on-line species list (OIRC, 2005). First collected in 1937 by Fosberg. Collected again in 1937 by Lamoureux. No action recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14050), 10m, Broken basalt, prostrate shrub, flowers orange, BISH 57890.
10 Aug 1967, Lamoureux, C.H. (#4080), BISH 489087.

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

Occasional. Scattered plants here and there. First collected in 1937 by Fosberg. Some folks have treated this species as native, other as non-native. We are currently treating it as native. This species appears to be doing fine, and no actions are recommended other than routine monitoring.

13 Jun 1937, Fosberg, F.R. (#14058), Basalt rocks, Prostrate, ripe fruits black, BISH 70095.

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

Common. Found in patches around islet. First collected in 1967 by Lamoureux. Not the most aggressive species, usually taking advantage of open areas. It can be hand pulled when found.

10 Aug 1967, Lamoureux, C.H. (#4088), BISH 489078.

***Sporobolus pyramidatus* -- Dropseed -- (Poaceae) -- Alien**

Rare to occasional. A couple patches, the largest of which is 5 m x 5 m. First collected during this survey. Could be hand pulled or sprayed.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-2).

***Sporobolus virginicus* -- Akiaki -- (Poaceae) -- Indigenous**

Common. What appeared to be this grass was found over much of the islet. Should be collected when fertile to be sure of identification. First collected in 1937 by Fosberg who noted, "dominant plant, all sterile". Collected again in 1967 by Lamoureux, and during this survey. This species appears to be doing fine. No action recommended other than making collections of fertile material and regular monitoring.

13 Jun 1937, Fosberg, F.R. (#14068), 5m, thin soil over basalt rock, dominant plant; all sterile, BISH 530675.

10 Aug 1967, Lamoureux, C.H. (#4081), BISH 489088.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-13).

***Thespesia populnea* -- milo -- (Malvaceae) -- Questionably Indigenous**

Not observed during this survey. Reported by OIRC on-line species list as present. Milo may have died out or the patch of hau could have been mistakenly identified as milo.

***Tournefortia argentea* -- Beach heliotrope -- (Boraginaceae) -- Alien**

Rare. One large tree on west end of islet. First collected during this survey. It could be left or cut down. See discussion of this species on Mokuauia for more.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-6).

***Verbesina encelioides* -- Golden crown-beard -- (Asteraceae) -- Alien**

Occasional. A few patches on northeast part of islet. First collected during this survey. This species has the ability to become quite invasive. The infestation is still small and could be hand pulled or sprayed.

24 Feb 2005, Starr, F., K. Starr, D. Smith, & S. Plentovich (#050224-3).

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