

**Botanical Survey of
Laysan Island
Hawaiian Islands National Wildlife Refuge**



Prepared for:
United States Fish and Wildlife Service

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2013

OVERVIEW

Laysan Island is a low sand atoll 800 miles WNW of Oahu, Hawaii. The island is about a mile wide and a mile and half long, encompassing over 1,000 acres. The west and north rims of the island reach 30 to 40 feet in height before sloping downwards towards a hypersaline lake / lagoon that sits in the middle of the island. Most of the island is covered with native bunch grass (*Eragrostis variabilis*). There are very few trees.

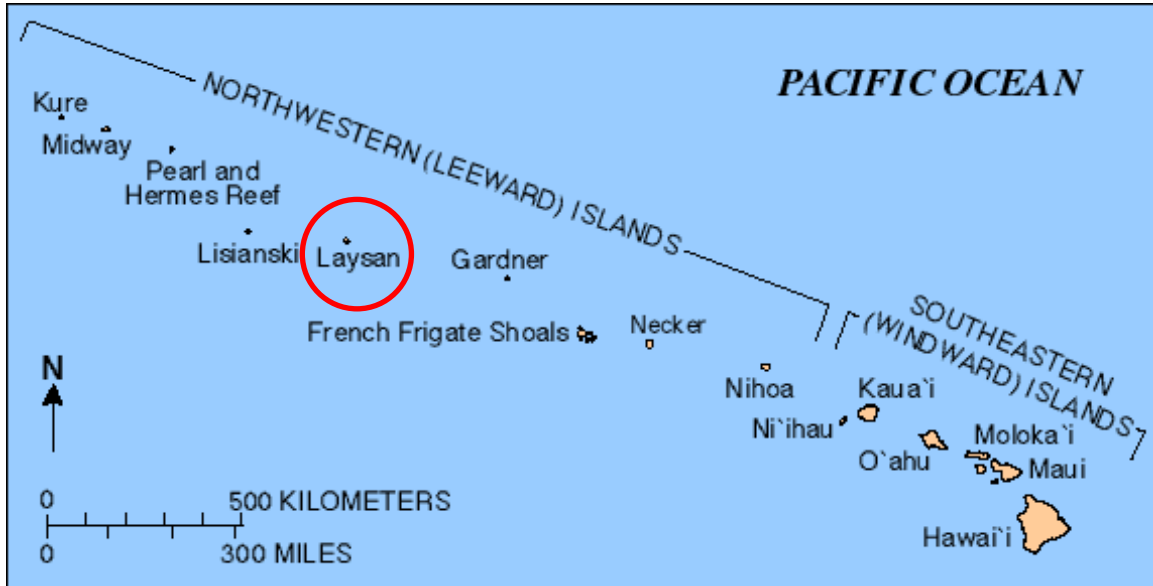
The island has in the past been mined for guano and denuded by rabbits. In 1909 Laysan was declared a refuge and today is managed by the United States Fish and Wildlife Service (FWS) who maintain a field camp on the island. However, recent budgetary constraints have led to the temporary closure of the Laysan Field Camp.

The main goal of this project was to secure camp to minimize injury to wildlife while the camp is temporarily shut down. A secondary goal was to provide an updated inventory of the plants on Laysan Island, with an emphasis on incipient non-native plants, and a historical context. A third goal was to study native *Hyposmocoma* moths, by looking for new species, increasing life history knowledge of known species, and getting images of these rarely seen before native moths in their natural habitat.

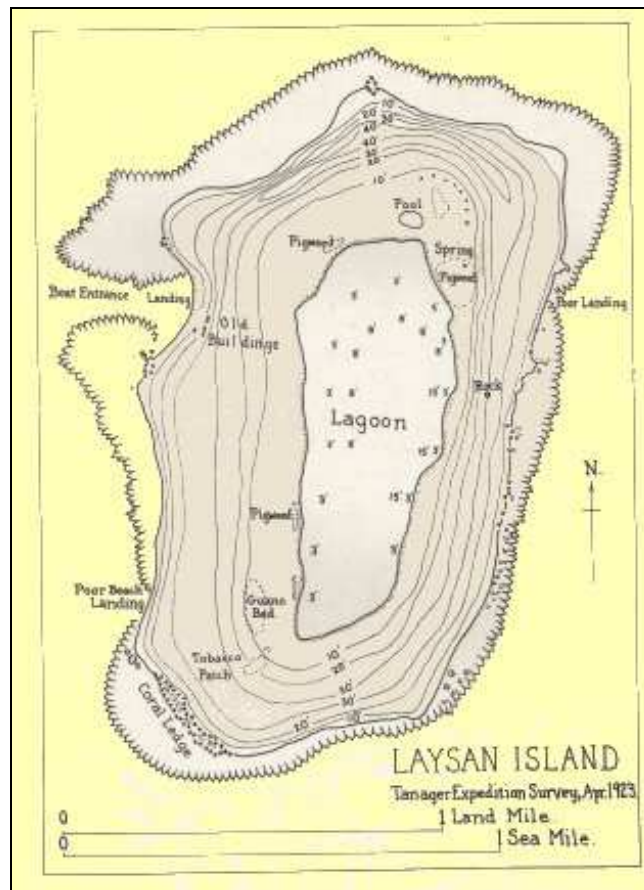


The low profile of Laysan Island as viewed from sea, September 2013.

LOCATION

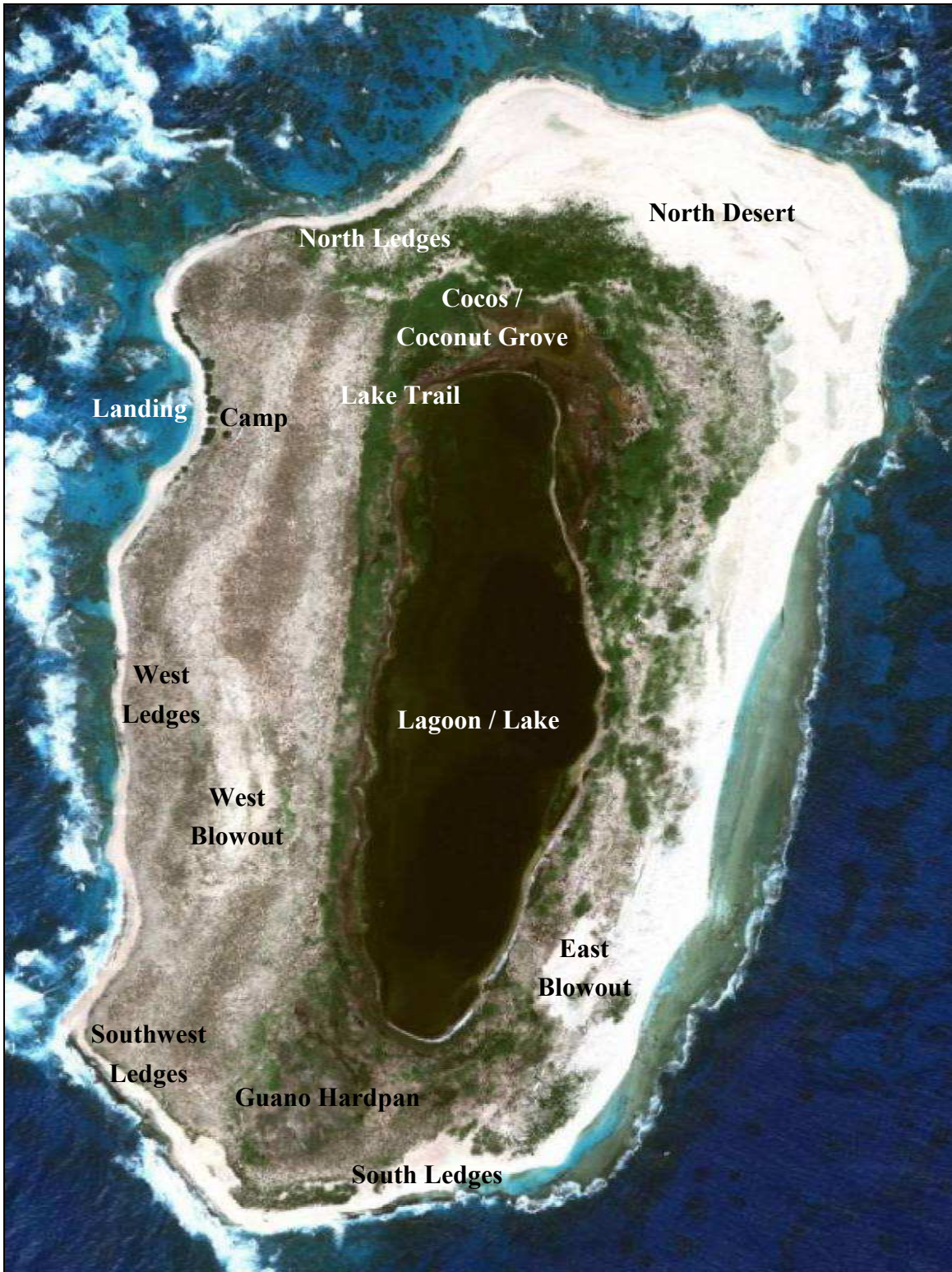


General location of Laysan Island, within the Northwestern Hawaiian Islands.



Major land features and elevation contours of Laysan Island are much the same today as they were in this map from the 1923 Tanager Expedition.

LOCATION NAMES



Laysan Island with names of main locations used in text.

METHODOLOGY

Two botanists, Forest Starr and Kim Starr, surveyed the refuge during September 10-18, 2013. A walk-through survey method was used, taking paths of least resistance through representative locations and habitat types. Extra emphasis was placed on areas with high diversity and potential for new introductions. Care was taken to avoid heavily burrowed areas, active nesting sites, and monk seals.

Though we were on-island for over a week, our dedicated survey time was limited. Much of the plant observations were incidental, made while helping clean up and secure camp for an extended shutdown.

Photographs were taken of many of the plant species on the island, to help provide for identification of individual species and to capture a record of the vegetation.

We supplemented our personal on-island sightings with information from previous surveys of Laysan, FWS Trip Reports, GPS data, and interviews with staff from recent and past Laysan Field Camps.



Taking notes on vegetation along the Lake margin at Laysan Island.

RESULTS

Laysan is a dynamic and resilient island, and though there have been some changes, looks much the same as it did in our last visit in 1999. Major events or forces on the vegetation over the past decade include a flooding rain, tsunami, and plant control and outplanting.

Laysan continues to be dominated by the native bunch grass emoloa (*Eragrostis variabilis*), which is found over most of the island. Other common native plants on Laysan include naupaka (*Scaevola taccada*) and pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*), both of which appear to have increased in distribution in recent years.

The main vegetation types include Coastal Strand, Eragrostis Grassland, Naupaka Shrubland, Wetland Vegetation, and the Barren Lake. These vegetation types are generally found in concentric rings starting at the coast and ending at the central lagoon. Many of these habitat types intergrade, occur in pockets within other habitat types, and can be further divided into subtypes.

During the survey we came across 32 plant species, 23 were native and 9 were non-native. Of the 23 natives, 9, were endemic to the Hawaiian Islands, 13 were indigenous, and 1 was questionably indigenous.

Some of the native plants already on Laysan were propagated and planted, including aweoweo (*Chenopodium oahuense*) and Laysan Sedge (*Cyperus pennatifolius* var. *bryanii*). Additionally, a number of native species not known from Laysan in 1999 had been re-introduced from elsewhere in the Hawaiian Islands, including loulu (*Pritchardia remota*), maiapilo (*Capparis sandwichiana*), and iliahi aloe (*Santalum ellipticum*).

There are very few non-native plant species on Laysan, though they comprise some of the most conspicuous vegetation on the island. A significant amount of effort has gone into plant control and eradications on Laysan. The non-native species that remain on Laysan are either in the process of being eradicated, are too difficult to eradicate, seem unnecessary to eradicate, or provide some function that benefits wildlife.

A pollen core study involving a single core from the central lake was made on Laysan in 2004. Studies of this core provided insight into pre-human vegetation and environmental conditions, and helped inform management decisions. One finding is the physical environment and salinity of the lake has changed over the past few thousand years, from a fresh/brackish-water basin, to a hypersaline lake three times saltier than the ocean. The core also suggests a drier environment today, with more grass pollen present.

Though Laysan is a tough place to work, and presents many unique challenges, much progress has been made protecting and restoring the resources on this remote refuge, and Laysan remains the most native plant dominated sand island in the NWHI.

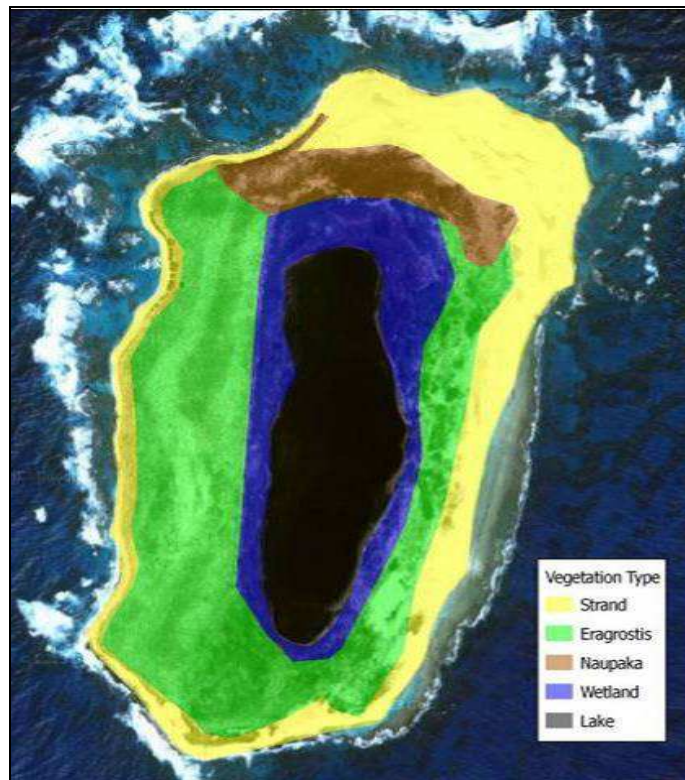
VEGETATION TYPES

The dominant vegetation on Laysan Island is mostly a function of distance to the shoreline and central lagoon. The vegetation types are generally found in a concentric ring pattern, starting at the coast and progressing in towards the lagoon.

Many of these broad habitat types intergrade, occur in pockets within other habitat types, and can be further divided into subtypes, such as the unique vegetation in the Guano Hardpan and Northern Desert and the vine-like vegetation just uphill of the wetland vegetation.

The main vegetation types evident at the time of our September 2013 survey were:

- Coastal Strand
- Eragrostis Grassland
- Naupaka Shrubland
- Wetland Vegetation
- Barren Lake



General vegetation types on Laysan Island, September 2013.

COASTAL STRAND

The coastal strand is found all along the seaward edge of the vegetation on Laysan, with the largest extent on the north and east sides of the island, where occasional large swells and strong winds create broad areas of almost barren strand like conditions. The strand zone is smaller and lusher on the south and west sides of Laysan.

Plants found in the coastal strand at Laysan include nama (*Nama sandwicensis*), beach morning-glory (*Ipomoea pes-caprae* subsp. *brasiliensis*), mauu akiaki (*Fimbristylis cymosa*), and naupaka (*Scaevola taccada*).

In the Northern Desert *Nama* is the dominant plant, and the cover is rather sparse. On the southern and western parts of Laysan *Ipomoea pes-caprae* is currently the dominant plant closest to the ocean and the vegetation is denser and lusher.

Other plants mostly in the coastal strand include the native grasses *Lepturus repens* and akiaki (*Sporobolus virginicus*), and the non-native tree heliotrope (*Tournefortia argentea*).



Pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*) is common over many of the beaches of Laysan.

ERAGROSTIS GRASSLAND

The bulk of the vegetation on Laysan is comprised of the native bunchgrass kawelu or emoloa (*Eragrostis variabilis*). This clumping grass is found virtually everywhere on the island, especially in the highest and driest locations. There is less bunchgrass near the coast and the lagoon. The western side of the island has larger expanses of grassland than the eastern side.

In many upland areas *Eragrostis* is the only vegetation. In others a mix of upland species can be found, such as alena (*Boerhavia repens*), beach morning glory (*Ipomoea pes-caprae*), nohu (*Tribulus cistoides*), and mauu akiaki (*Fimbristylis cymosa*).

Hairy horseweed (*Conyza bonariensis*) is prevalent in much of the *Eragrostis* grassland, especially on the western side of the island. As is tobacco (*Nicotiana tabacum*). In the northern part of the island, *Eragrostis* is mostly precluded by naupaka (*Scaevola taccada*).



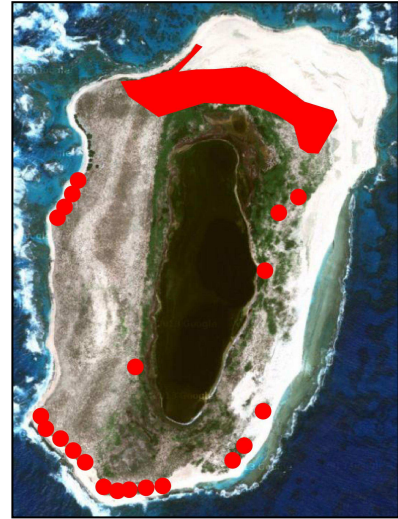
A sea of bunching emoloa grass (*Eragrostis variabilis*) covers most of Laysan.

NAUPAKA SHRUBLAND

This species appears to have increased in distribution in recent years, where it is currently present along the coast for much of island, and is dominant over much of the northern portion of the island.

Plants wax and wane in abundance on Laysan. Recent mapping and anecdotal insights suggest naupaka is currently increasing in cover on Laysan. There appeared to be much more naupaka on the margin of the Northern Desert compared to our 1999 visit.

The naupaka on Laysan is currently generally very low growing, usually less than 1 meter in height in most places, forming small, often inter-connected, clumps. Tangles of this shrub, though challenging to traverse, have proven to be preferred habitat for the Nihoa Millerbird on Laysan, which was up to 122 birds as of September 2013.



Much of northern Laysan is now covered with a sea of naupaka (*Scaevola taccada*), and has become the preferred habitat for the recently introduced Nihoa Millerbird.

WETLAND VEGETATION

Near the inland lake / lagoon the *Eragrostis* grass becomes less prevalent and wetland vegetation dominates. The main species directly along the margins of the lagoon are makaloa (*Cyperus laevigatus*), akulikuli (*Sesuvium portulacastrum*), nena (*Heliotropium currasavicum*), and pohuehue (*Ipomoea pes-caprae*).

Less abundant, but still present, is the rare native sedge *Mariscus pennatiformis* subsp. *bryanii*.

Mixed in with these plants, and often also extending further inland, are a suite of native vines, notably alena (*Boerhavia repens*), nohu (*Tribulus cistoides*), anunu (*Sicyos* spp.), *Ipomoea pes-caprae*, and koali awa (*Ipomoea indica*).

Non-native plants found within this vine habitat include Indian Fleabane (*Pluchea indica*), Bermuda grass (*Cynodon dactylon*), and dropseed (*Sporobolus pyramidatus*).



Makaloa (*Cyperus laevigatus*) is a dominant plant around the lake / lagoon margin.

BARREN LAKE

The bulk of the center of Laysan is completely barren, and for much of the year is covered with a hypersaline lake that fluctuates in level with rainfall and surf events. The depth of the lake is no more than a few feet in most places, but reaches 20 feet or so in the deepest spots.

Some areas of higher sand and soil, especially along previous high water marks, support numerous seedlings of wetland plants that grow until the next floods.

These large flat barren areas with low water levels along the margin of the lake support a number of shorebirds that over-winter on Laysan.



Barren portion of central Lake. Occasional flooding creates conditions that apparently no plants are able to tolerate.

NATIVE PLANTS

Laysan continues to be dominated by the native bunch grass emoloa (*Eragrostis variabilis*), which is found over most of the island. Other common native plants on Laysan include naupaka (*Scaevola taccada*) and pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*), both of which appear to have increased in distribution in recent years.

Hinahina kahakai (*Nama sandwicensis*) is the most common native plant out in the Northern Desert, forming little clumps in a mostly barren environment. Occasional ihi (*Portulaca lutea*) are also scattered about the desert, and is also a co-dominant on the guano hardpan. Mauu akiaki sedge (*Fimbristylis cymosa*) can be found in patches along the coast, as can the native grass *Lepturus repens*.

Near the lake makaloa (*Cyperus laevigatus*) dominates, along with akulikuli (*Sesuvium portulacastrum*), and kipukai (*Heliotropium curassavicum*). Additionally, this and nearby areas hold a number of vining native plants including pohuehue, alena (*Boerhavia repens*), koali awa (*Ipomoea indica*), anunu (*Sicyos* spp.), and nohu (*Tribulus cistoides*).

The small shrub aweoweo (*Chenopodium oahuense*) is more common than in 1999, occurring on the lake margin and near camp. Glossy nightshade (*Solanum americanum*) was found in small numbers around the Guano Hardpan.

The rare Laysan Sedge (*Cyperus pennatiformis* var. *bryanii*) is still present on Laysan, along the lake margin and near camp.



Native beach morning glory vine or pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*) is common over much of Laysan.

RESTORATION / PLANTING

Since our last visit in 1999, a number of native plant species have been re-introduced to Laysan from stock elsewhere in the Hawaiian islands. Additionally, some of the rarer native plants already occurring on Laysan were propagated and planted.

Plants already on Laysan that were propagated and planted include aweoweo (*Chenopodium oahuense*), Laysan Sedge (*Cyperus pennatiformis* var. *bryanii*), and nohu (*Tribulus cistoides*). Of these the aweoweo and Laysan sedge seem to have benefited the most, both appearing to be more common than in our visit in 1999.

Native species not present on Laysan in 1999, that have since been re-introduced from stock elsewhere in Hawaii, include maiapilo (*Capparis sandwichiana*), anaunau (*Lepidium bidentatum* var. *o-waihiense*), nehe (*Melanthera integrifolia*), loulu (*Pritchardia remota*), iliahialoe (*Santalum ellipticum*), ilima (*Sida fallax*), popolo (*Solanum nelsonii*), and akiaki (*Sporobolus virginicus*).

The native loulu palm (*Pritchardia remota*) is emblematic of restoration efforts on Laysan. This palm was planted on Laysan, from Nihoa, was doing well, but was killed in the flooding rains of 2011. Many of the other re-introduced native species seemed to have similar tales of misfortune, including attacks by Laysan Finches, tsunami, and insects.

Despite valiant efforts, the establishment rate of plantings on Laysan appears relatively low, as nehe and popolo were dead as of September 2013, and the other re-introduced native plants were present only in very low numbers. However, perhaps these challenging conditions should be expected. From guano miners through DLNR foresters, anyone trying to establish plants on Laysan has quickly realized it is a tough task.

That said, there have been many native plant restoration successes over the past decade, with a number of recently planted species still hanging on, such as akiaki grass, maiapilo, anaunau, loulu, and iliahialoe. Additionally, aweoweo and Laysan sedge appear to have greatly benefited from propagation and planting.



Shade house used for plant propagation on Laysan.

NON-NATIVE PLANTS

Though there are very few non-native plant species on Laysan, they comprise some of the most conspicuous vegetation on the island.

As one approaches Laysan by boat the 100+ year old ironwood tree (*Casuarina equisetifolia*) is one of the first recognizable landmarks, standing tall in front of camp, adorned with birds. Also visible along the coast is a line of tree heliotrope (*Tournefortia argentea*) trees, similarly covered with birds.

A tall grove of a couple coconuts (*Cocos nucifera*) used to be a dominant feature of the north end of the lake. The 50+ year old grove perished in the flooding rains of February 2011, along with much of the lakeside vegetation. Also killed in the Feb. 2011 flood was the bulk of the Indian fleabane (*Pluchea indica*)

On much of the higher ground on Laysan, especially on the west side of the island, can be found hairy horseweed (*Conyza bonariensis*), and to a lesser extent tobacco (*Nicotiana tabacum*).

In many of the disturbed and hardpan sites is pigweed (*Portulaca oleracea*), which forms a hybrid swarm with the native ihi (*P. lutea*). Also in the hardpan area is dropseed (*Sporobolus pyramidatus*), which is co-dominant with the *Portulaca*.



The ironwood tree (*Casuarina equisetifolia*) is a prominent landmark on Laysan.

CONTROL / ERADICATIONS

A significant amount of effort has gone into plant control and eradications on Laysan. The non-native species that remain are either in the process of being eradicated, are too difficult to eradicate, seem unnecessary to eradicate, or provide some function that benefits wildlife.

Perhaps the best known control project on Laysan is sand bur (*Cenchrus echinatus*), which was declared eradicated in 2002, but was subsequently found again in two widely separated locations in 2009 and 2010. These areas have since been followed up on, and *Cenchrus* is once again not known from Laysan.

A couple non-native plant species sprung up after our 1999 visit and were subsequently eradicated before we arrived in 2013. Swinecress (*Coronopus didymus*) was found on Laysan in 2003 and has since been controlled beyond detectable levels. Cherry tomato (*Solanum lycopersicum* var. *cerasiforme*) was found near Camp and removed.

Island-wide Indian fleabane (*Pluchea indica*) control began in the mid-2000's, was greatly assisted by the flooding rains of February 2011, and could likely be completed in a few years with a dedicated effort.

Despite an intensive control program, dropseed (*Sporobolus pyramidatus*) has not seen a decrease in distribution, mostly due to prolific seed set in very short time intervals. This may be one of the non-native species that is easier to just live with, the Laysan Albatross seem to do fine with it in the Guano Hardpan, where it is most prevalent.

Portulaca is another where control may be more hassle and cost than it is worth. The non-native *P. oleracea* is widespread over much of Laysan, forms a hybrid swarm with the native *P. lutea*, and provides basically the same structure and function as *P. lutea*.

There are some non-native species on Laysan, most notably ironwood and *Tournefortia*, that could be readily eradicated, but for a number of reasons, such as benefit to wildlife, are not controlled.



Indian fleabane (*Pluchea indica*) that was hand-pulled during control work.

FLOODING RAIN & TSUNAMI

The Lake vegetation went through changes with a flooding rainfall event in February 2011, which killed a larger area around the Central Lake than normally occurs each winter. Killed were the 50 year old coconut grove (*Cocos nucifera*) on the north part of the lake, and a stand of planted loulu palms (*Pritchardia remota*) that were just about to fruit for the first time. Along with killing native plants, the flood killed large stands of the non-native Indian fleabane (*Pluchea indica*).

The Tsunami of March 2011 affected mostly the coastal areas of Laysan. The greatest impact still visible in 2013 was the tree heliotrope (*Tournefortia argentea*). Many of the trees fronting the camp were broken off by the water and pushed inland a bit. Additionally, some of the broken branches and seeds were spread over the northern and eastern coastal portions of Laysan, establishing satellite populations.



Dead trunks were all that remained of the coconut grove (*Cocos nucifera*) in September 2013, killed two years earlier by an extraordinarily large rain event.



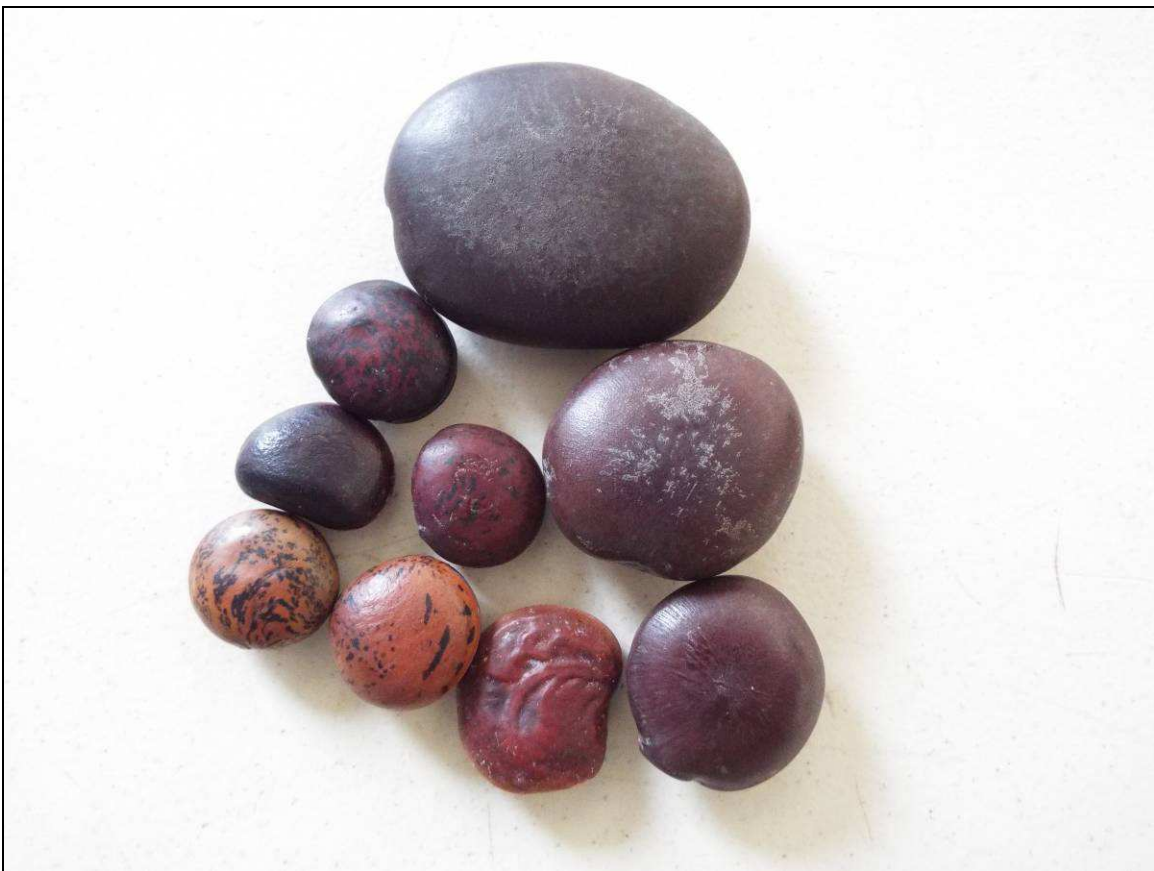
A Great Frigate sits in a Tree heliotrope (*Tournefortia argentea*) upended during the March 2011 tsunami (left). *Tournefortia* seedling in the Northern Desert (right).

FLOTSAM & OTHER SEEDS

Seeds of various sizes, colors, and shapes are often found on the beaches of Laysan and other Hawaiian Islands. These seeds are occasionally able to germinate, but don't appear to ever establish on Laysan.

Along with washing up along the shore, the seeds are also found well inland, likely the result of being picked off the surface of the ocean by a seabird and deposited on Laysan.

The seeds are predominantly in the legume family (Fabaceae), mostly in the genera *Caesalpinia*, *Canavalia*, *Dioclea*, *Entada*, and *Mucuna*. Other species found include kukui nuts (*Aleurites*), tropical almond (*Terminalia*), and walnuts (*Juglans*).



Assortment of Fabaceae seeds found on Laysan that arrived on the beaches through action of surf, or were picked up at sea by seabirds and deposited on Laysan.

POLLEN CORE

Paleoenvironmental investigations involving a single core from the central lake were made on Laysan in 2004. Studies of this core provided insight into pre-human vegetation and environmental conditions, and have helped inform management decisions.

One of the main conclusions is the physical environment and salinity of the lake has changed over the past few thousand years, from a fresh/brackish-water basin, to a hypersaline lake three times saltier than the ocean (Athens et al. 2004).

Changes in plant abundance are also apparent. *Pritchardia* palms appear to have been a dominant component of the flora a few thousand years ago, but were apparently already in decline before humans arrived, at which point they disappeared altogether. It's surmised the decline of *Pritchardia* could have been the result of longer-term climatic drying (Athens et al. et al. 2004). Grasses also increased at the same time, further suggesting a drying climate trend. It also seems plausible that the increasing salinity of the central lake could lead to a decline in palms.

Four new plant taxa were identified for Laysan from the core, including prehistoric and possibly prehuman *Cocos*, *Hibiscus*, *Sida*, and *Ruppia*. In addition, there were three other new but unidentified pollen taxa (Athens et al. et al. 2004).



Lake margin, near where the pollen core was made in 2004. A few thousand years ago the lake was smaller and much less salty.

HYOSMOCOMA MOTHS

One of the goals of our September 2013 visit was to look for new species of *Hyposmocoma* moths and to gather information about and images of the two known species on Laysan. *Hyposmocoma* is a diverse genus of moths native to Hawaii found in a broad range of locations. The moths were a bit challenging to find at first, but once we figured out where they were, they seemed to be almost everywhere, substrate permitting.

Hyposmocoma laysanensis (Cone-shaped Moth)

Named after the island of Laysan, the cone-shaped *Hyposmocoma laysanensis* can be found mostly under coral rocks and guano on Laysan, where they perhaps eat the algae in the small spaces. This species was especially common in rock jumbles along the coast and in the piles of guano rocks further inland. They were also found under manmade debris that hadn't been moved in a while. The moths hide in crevices or under sections that don't get direct daylight. They seemed relatively abundant locally, usually by themselves or in small groups up to a half dozen.



Hyposmocoma ekemamao (Purse-shaped Moth)

Named for the purse shape (eke) and distant location (mamao), *Hyposmocoma ekemamao* appeared to be more associated with organic matter, such as decaying bunchgrass leaves, than the cones. They also seem to be found more inland, we did not find them on the bare rocks by the coast like the cones. If one turns over a guano rock on one of the guano piles, the cone cases are evident, as are the purse cases. It was the same with old wood boards. Even plastic boards and water jugs left on the ground long enough had these. When we searched in the litter near tussocks of grass or under the ironwood tree we found only purse cases, and very few. The easiest way to find purse cases was to turn over objects that had been lying on the ground for a while, such as stones, boards, or water jugs.



CHECKLIST OF PLANTS KNOWN FROM LAYSAN

Below is a checklist of all plants ever reported from Laysan. Some of these species were planted on Laysan but did not establish. Others have gone extinct on Laysan. This list does not include the pollen core data. Historical records were gathered mostly from the Atoll Research Bulletin for Laysan (Ely & Clapp 1973) and the Laysan Island Ecosystem Restoration Plan (Morin & Conant 1998). Plants observed during September 2013 are marked with relative abundance.

R = Rare. One to very few individuals found on the island.

O = Occasional. Scattered across island, but nowhere common.

C = Common. Regularly encountered on island, but nowhere dominant.

D = Dominant. One of the most abundant and aggressive species on the island.

2013	Species	Common name	Status
	<i>Achyranthes aspera</i>	Achyranthes	Non-native
	<i>Achyranthes atollensis</i>	Achyranthes	Native
	<i>Allium sp.</i>	Onion	Non-native
	<i>Amaranthus viridis</i>	Slender amaranth	Non-native
	<i>Atriplex suberecta</i>	Salt bush	Non-native
	<i>Barringtonia asiatica</i>	Barringtonia	Non-native
C	<i>Boerhavia repens</i>	Alena	Native
	<i>Calophyllum inophyllum</i>	Kamani	Non-native
	<i>Canavalia ensiformis</i>	Jack bean	Non-native
R	<i>Capparis sandwichiana</i>	Maiapilo	Native
R	<i>Casuarina equisetifolia</i>	Ironwood tree	Non-native
	<i>Cenchrus agrimonioides var. laysanensis</i>	Kamanomano	Native
	<i>Cenchrus echinatus</i>	Common sandbur	Non-native
O	<i>Chenopodium oahuense</i>	Aweoweo	Native
	<i>Coccoloba uvifera</i>	Sea grape	Non-native
R	<i>Cocos nucifera</i>	Coconut tree	Non-native
	<i>Conocarpus erectus</i>	Buttonwood	Non-native
	<i>Convolvulus sp.</i>	Bindweed	Non-native
C	<i>Conyza bonariensis</i>	Hairy horseweed	Non-native
	<i>Coronopus didymus</i>	swinecress	Non-native
	<i>Cordia subcordata</i>	Kou	Native
	<i>Cucurbita pepo</i>	Pumpkin	Non-native
	<i>Cynodon dactylon</i>	Bermuda grass	Non-native
C/D	<i>Cyperus laevigatus</i>	Makaloa	Native
O	<i>Cyperus pennatifolius var. bryanii</i>	Laysan sedge	Native
D	<i>Eragrostis variabilis</i>	Kawelu	Native
C	<i>Fimbristylis cymosa</i>	Mauu akiaki	Native
	<i>Haematoxylon campechianum</i>	Logwood tree	Non-native
C	<i>Heliotropium curassavicum</i>	Kipukai	Native
	<i>Hibiscus tiliaceus</i>	Hau	Non-native

2013	Species	Common name	Status
R	<i>Ipomoea indica</i>	Koali awa	Native
D	<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	Pohuehue	Native
R	<i>Lepidium bidentatum</i> var. <i>o-waihiense</i>	Anaunau	Native
R/O	<i>Lepturus repens</i> var. <i>subulatus</i>	Lepturus	Native
	<i>Leucaena leucocephala</i>	Koa haole	Non-native
	<i>Lipochaeta integrifolia</i>	Nehe	Native
	<i>Melinis minutiflora</i>	Molasses grass	Non-native
C/D	<i>Nama sandwicensis</i>	Hinahina kahakai	Native
	<i>Nicotiana glauca</i>	Tree tobacco	Non-native
O/C	<i>Nicotiana tabacum</i>	Tobacco	Non-native
	<i>Phoenix dactylifera</i>	Date palm	Non-native
	<i>Phyllostegia variabilis</i>	Phyllostegia	Native
O	<i>Pluchea indica</i>	Indian fleabane	Non-native
O	<i>Portulaca lutea</i>	Ihi	Native
O/C	<i>Portulaca oleracea</i>	Pigweed	Non-native
	<i>Pritchardia pacifica</i>	Fiji fan palm	Non-native
R	<i>Pritchardia remota</i>	Loulu	Native
	<i>Pritchardia sp.</i>	Loulu	Native
R	<i>Santalum ellipticum</i>	Iliahialoe	Native
D	<i>Scaevola taccada</i>	Naupaka kahakai	Native
C/D	<i>Sesuvium portulacastrum</i>	Akulikuli	Native
R	<i>Sicyos maximowiczii</i>	Puaokama	Native
R	<i>Sicyos pachycarpus</i>	Kupala	Native
	<i>Sicyos semitonsus</i>	Hybrid anunu	Native
R	<i>Solanum americanum</i>	Glossy nightshade	Native
	<i>Solanum nelsonii</i>	Popolo	Native
	<i>Solanum tuberosum</i>	Potato	Non-native
O/C	<i>Sporobolus pyramidatus</i>	Dropseed	Non-native
R	<i>Sporobolus virginicus</i>	Akiaki	Native
	<i>Terminalia catalpa</i>	False kamani	Non-native
	<i>Terminalia myriocarpa</i>	Jhalna	Non-native
	<i>Thespesia populnea</i>	Milo	Native
O	<i>Tournefortia argentea</i>	Tree heliotrope	Non-native
O	<i>Tribulus cistoides</i>	Nohu	Native
R	<i>Unknown Asteraceae</i>	Unknown	Non-native

ANNOTATED CHECKLIST OF PLANTS ON LAYSAN

The following annotated checklist includes information on select vascular plants known from Laysan Island, and includes historical information along with updated information from a botanical survey done by Forest Starr & Kim Starr September 10-18, 2013.

The checklist is listed in alphabetical order by species. Wagner et al. (1999) and Imada (2012) were used as the source for nomenclature, distribution, and status in Hawaii.

Included for each species is a bit of history (up to 1999) about the species, the current status (2000-present), notes on interactions with wildlife, a map of known distribution, and an image. When possible images from this survey are used, otherwise photos from the Plants of Hawaii website were used (Starr Environmental 2013).

Folks interviewed about Laysan flora and fauna include Cindy Rehkemper, Beth Flint, Stefan Kropidlowski, Michele Kuter, and Brianna Ordnung.

Much of the point data was from the Summer 2013 mapping project completed by Brianna Ordnung, Andrea Kristoff, Justin Yeh, Andy Bridges, and Ian Thomas.

Detailed FWS Trip Reports from 1997-2013 were reviewed. These were especially helpful for information about the source populations of new native plants introduced to Laysan, and insights on methodology and results of outplanting and control work.

Historical information was gathered mostly from the Atoll Research Bulletin for Laysan (Ely & Clapp 1973) and the Laysan Island Ecosystem Restoration Plan (Morin & Conant 1998). We also utilized our previous experiences, pictures, and report from our first visit to Laysan in 1999 (Starr & Martz 1999).

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

CURRENT

Found scattered over entire island, though rarely dominant. Common along coast, around camp, and a few locations south of the Central Lake. Quite variable in morphology.

HISTORY

Except for 1923, when only dead plants were seen, this plant has apparently always been a major constituent of the flora (Ely & Clapp 1973).

Laysan Finches eat the sticky seeds and also the root, which is somewhat tuberous and also sticky (Morin & Conant 1998).

In 1999 scattered over entire island. Nowhere did we observe alena as dominant. (Starr & Martz 1999).



Pink flowers and sticky seeds help distinguish alena (*Boerhavia*).

***Capparis sandwichiana* (maiapilo, puapilo) Brassicaceae Native (Endemic)**

CURRENT

Since 2000 maiapilo has been propagated and outplanted on Laysan. The Laysan stock is apparently from Oahu (Campbell Industrial Park).

In 2013, a few planted maiapilo were growing around camp, and another was present near the coast a bit further north.

The non-native Pink-spotted Hawkmoth or Sweet Potato Hornworm (*Agrius cingulata*) was observed visiting the flowers, and Laysan Finches were observed munching on flower buds.



HISTORY

First seen by Brooks in 1859. In 1896 Schauinsland reported man-high bushes, primarily on the west side of the island somewhat near the beach. In 1903 *Capparis* occurred in patches all over the higher elevations of the sand dunes.

Collections in 1959, 1961, and 1964 were all from the west side of the island, usually within or close to the bordering fringe of *Scaevola* south of the *Casuarina* tree. *Capparis* was present on Laysan up to 1969 (Ely & Clapp 1973, Morin & Conant 1998).



Laysan Finch taking bites from a flower bud of maiapilo (*Capparis sandwichiana*).

Casuarina equisetifolia (Ironwood) Casuarinaceae - Non-native

CURRENT

The ironwood tree / grove continues to persist on Laysan, in the same area it has stood for over 100 years.

Despite spreading on Midway, and having viable seed on Laysan, this ironwood has shown no signs of sexual reproduction. Perhaps one reason is that Laysan Finches apparently eagerly devour ironwood seedlings. The tree has also never reached great heights, likely a testament to the tough conditions on Laysan.

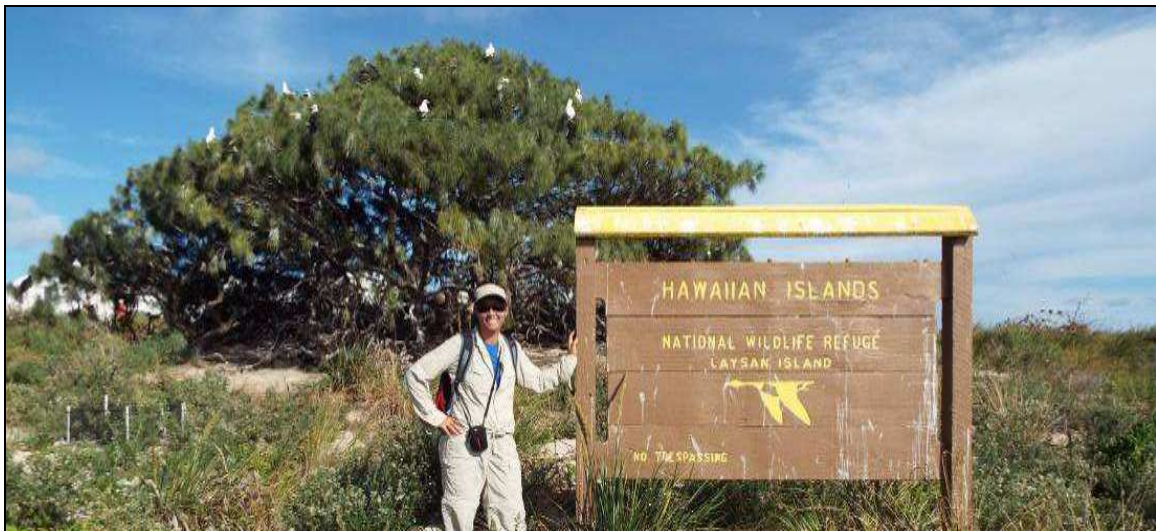
The tree was fruiting during our September 2013 visit. A number of bird species utilize this ironwood for roosting and nesting.



HISTORY

Ironwood was introduced to Laysan on at least three occasions. In 1905 Wilder planted a box of ironwood trees, one of which may have survived to be recorded by all subsequent surveys. In 1923 two pounds of ironwood seed were sown. In 1930 Wilder planted an unstated number of ironwoods around the old buildings and near the north side of the lagoon. In the 1960's there was one lone tree by camp, supporting the largest Black Noddy colony on the island (Ely & Clapp 1973).

In 1999 1 or 2 plants (unknown if rootsprout or seedling) at camp, both with female flowers and cones. Frigate birds roost in the trees but do not nest in them. Red-footed Boobies nest in the trees, as do Black Noddies and White Terns. (Starr & Martz 1999).



Ironwood in front of camp, where it has stood for over 100 years.

***Cenchrus echinatus* (Sand bur) Poaceae - Non-native**

CURRENT

None observed during our survey in September 2013.

However, this spiny-seeded grass, that had previously been declared eradicated from Laysan around 2002, was found and removed again on widely distant locations on the north part of the island in 2009 and 2010. No plants have been observed again since then.

Points on maps are of recent sand bur discoveries and subsequent removal programs on Laysan.



HISTORY

Presumed to have been introduced by military personnel in the 1960's. A few plants found near the camp on the northwest side of the island were destroyed, but this grass persisted and by 1984 it was still spreading. Although it provides food for Laysan Finches, it apparently inhibits regeneration of their primary nest substrate, *Eragrostis variabilis*. Through a control program this grass was believed to have been eradicated on Laysan by 1998 (Ely & Clapp 1973, Morin & Conant 1998).

In 1999 two sterile plants were observed, one at camp in a pot for a search image and one on the west coast near the beginning of the rock ledges (Starr & Martz 1999).



Sandbur (*Cenchrus echinatus*) on Midway Atoll, June 2008. Note spiny seeds.

Chenopodium oahuense (Aweoweo) Amaranthaceae Native (Endemic)

CURRENT

In 2013 this native shrub was found in many places of Laysan, especially around camp, and some of the margins of the lake. Planted on island and reproducing on its own, aweoweo was one of the only plants alive in the pots in the abandoned greenhouses, and had become much more common since our previous visit in 1999.



HISTORY

In 1896 Schauinsland reported this shrub was second in abundance only to *Eragrostis* and grew to 2 m and forming an almost impenetrable thicket (Athens et al. 2004). In 1903 Aweoweo was still common, but by 1911 was gone from the island. In the 1960's seeds were introduced from Nihoa and French Frigate Shoals. The Nihoa material apparently didn't establish, but the French Frigate Shoals material broadcast around the campsite on the northwest rim of the island did result in a few plants (Ely & Clapp 1973).

In 1983, 34 mature *Chenopodium* plants and 14 seedlings were seen by the ironwood tree. In 1994, two healthy patches were observed in the *Pluchea*-*Sesuvium* association at the southwest end of the lake, along with 5 plants southwest of the *Cocos* and 3 plants in the camp area, presumably near the ironwood tree (Morin & Conant 1998). In 1999, Two individuals were seen on the west side of the ironwood trees near camp. Other plants were seen on the south side of the lagoon near the guano hard pan. (Starr & Martz 1999).



Chenopodium growing in area previously dominated by *Pluchea*.

***Cocos nucifera* (Coconut) Arecaceae - Non-native**

CURRENT

In September 2013, the grove on the North part of the lake was dead, killed by a large rain and flood event in Feb. 2011. Wedge-tailed Shearwaters were utilizing the hollow fallen logs as burrows.

There was however, one lone coconut left on Laysan. Before the flood a coconut was apparently planted near a now abandoned greenhouse off the lake trail. This tree, which is about 2-3 meters tall looked healthy. No signs of *Hyposmocoma* flat purse cases or *Omiodes* larvae were found on the coconut leaves.



HISTORY

Pollen core studies are inconclusive but suggest that coconuts were present on Laysan long before historic coconuts were planted on the island beginning in 1902 (Athens et al. et al. 2004). Coconuts were planted on Laysan on several occasions but relatively few survived for very long. The current grove on the northwest corner of the lagoon was planted in 1959. A similar grove was also planted on the southeast portion of the lagoon and had live trees up through at least 1969 (Ely & Clapp 1973).

In the 1980s and 1990s, only the northwest grove continued to persist. White Terns, Tristram Storm-Petrels, and Wedge-tailed Shearwaters nest in the coconut rubble (mainly dead palm leaves) beneath the trees (Morin & Conant 1998).

In 1999 about 25 trees seen in clump at north end of lagoon. All the trees observed were rather large, with no regeneration noted. (Starr & Martz 1999).



This grove of coconuts (*Cocos nucifera*) was planted in 1959 and recently died during extended flooding after a large rainfall event in February 2011.



The lone coconut alive on Laysan as of September 2013 was this young tree south of the Lake Trail, near a recently dismantled greenhouse.

***Conyza bonariensis* (Hairy horseweed) Asteraceae - Non-native**

CURRENT

This annual is common over much of Laysan, usually in association with *Eragrostis* and disturbed sites. It is most abundant along the western portion of island. The plants were in flower and fruit during September 2013, and Laysan Finches were observed eating the seeds.

Conyza is occasionally controlled in high value sites on Laysan, but the seed bank, large distribution, quick time to flower, lack of demonstrable harm to wildlife, and heavily burrowed terrain has precluded eradication.

HISTORY

Probably introduced by military HIRAN operation of the early 1960's. First observed on Laysan in 1963 growing just south of the campsite on the northwest side of the island. All plants were uprooted, but despite efforts to control the plant it established (Ely & Clapp 1973).

By the 1990's *Conyza* was widespread on Laysan, but didn't form a dense cover. Laysan finches eat parts of this plant but it is not a primary food source. Most abundant in open vegetation such as *Eragrostis* grassland (Morin & Conant 1998). In 1999 hairy horseweed was found scattered over most of the island, especially the west side (Starr & Martz 1999).



Hairy horseweed (*Conyza bonariensis*) has many seeds, some of which become eaten by Laysan Finches.

***Cynodon dactylon* (Bermuda grass) Poaceae - Non-native**

CURRENT

Not seen in September 2013. Recent control efforts have greatly reduced the distribution of this grass. It was previously most abundant near the coconuts.

Points in map are from Summer 2013 mapping project.

HISTORY

Introduced from Honolulu by employees of the guano company. First collected on Laysan in 1903 and found scattered over the island by 1905. Not observed in 1923, but found in surveys since 1930. Most dense stands along northern perimeter on lagoon. (Ely & Clapp 1973).

In 1999 locally restricted to an area near camp, the south end of the lagoon, the coconut palms, and the north end of the island. (Starr & Martz 1999).



Bermuda Grass (*Cynodon dactylon*) growing at Kanaha Beach, Maui.

***Cyperus laevigatus* (Makaloa) Cyperaceae - Indigenous**

CURRENT

Continues to be a dominant component of the wetland vegetation at Laysan. Grows in a ring around the central lagoon with other wetland species, especially akulikuli (*Sesuvium portulacastrum*), nena (*Heliotropium curassavicum*), and pohuehue (*Ipomoea pes-caprae*).

In some areas more dominant than in others, ranging from scattered small plants to large mats. As with other wetland vegetation on Laysan, the specific locations shift over time due to flooding and other events, but stay in the general wetland area ringing the central lake.



HISTORY

Found to be growing in dense stands around the perimeter of the lagoon in 1896. In 1923, at the height of the rabbit destruction, this species was not found. From 1930 on makaloa has been observed during surveys, and by the 1960's had regained its former dominance. (Ely & Clapp 1973).

In 1999 large mats were found all around margin of lagoon. In places, the tussocks were over a meter tall. Finches eat seeds and ducks nest under it. Albatross nests were occasionally observed on top of these large tussocks. (Starr & Martz 1999).



Makaloa (*Cyperus laevigatus*) clumps on the margin of the Central Lagoon / Lake.

***Cyperus pennatiformis* var. *bryanii* (Sedge) Cyperaceae**
Native (Endemic)

CURRENT

Numerous around camp and around north part of lake near dead coconut trees, apparently the result of restoration. Plants in drier areas, such as around camp, were shorter and less lush, but appeared to be surviving. Seeding at the time of our visit. Laysan Finches ate the seeds of this sedge.



HISTORY

Present in 1896, absent in 1923, observed during surveys since 1959. For much of the last century this sedge has been limited to a few bunches along the southwest corner of the lagoon.

In 1999 one clump with > 50 individuals of this extremely rare plant was seen restricted to the south end of the lagoon. Seed should be collected and propagated. It was almost ripe at the time of our survey in June. (Starr & Martz 1999).



Rare native sedge *Cyperus pennatiformis* var. *bryanii* with Laysan Finch stepping on and eating seedhead.

***Eragrostis variabilis* (Emoloa) Poaceae - Native (Endemic)**

CURRENT

The most widespread and dominant plant species on Laysan, covering virtually the entire island. Areas near the ocean shore, inland lake, and thick naupaka patches generally do not support as much of this clumping grass.

HISTORY

This bunchgrass, along with *Chenopodium*, was the most common plant on Laysan in 1896. In 1923 no live plants of this species were seen. Seeds and rhizomes from Kure Atoll and Pearl and Hermes Reef were subsequently planted on Laysan. In 1936 this species was still not very abundant, but by the 1960's had regained most of its former abundance. Important for seabirds for shade as well as stabilizing sand for nest burrows. (Ely & Clapp 1973, Morin & Conant 1998).

In 1999 emoloa was found over almost all of the island, where it was by far the most dominant plant species. Many bird species were observed nesting at the base of the plant and finches were eating seeds and apparently nesting in it also. Not found in extreme coastal areas and areas directly around lagoon margin. (Starr & Martz 1999).



A sea of the native clumping grass *Eragrostis variabilis* covers much of Laysan.

***Fimbristylis cymosa* (Mauu akiaki) Cyperaceae**
Native (Indigenous)

CURRENT

Along coast and trail to lake. Both forms or subspecies (*spathacea* and *umbellato-capitata*) were present, often on the same plant / clump. This sedge was observed germinating on the barren lake margin. And was most abundant along the coast, especially on the hardened vegetated crest just above the beach. Laysan finches were observed feeding on seeds.



HISTORY

First collected on Laysan in 1930. Surmised to possibly have been introduced during plantings in 1923, but no definitive evidence is available to support this. In 1960's this sedge was widely distributed over the drier portions of the island, being abundant at times on the slopes of the western interior. (Ely & Clapp 1973, Morin & Conant 1998)

In 1999 found to be scattered in coastal areas and along the lagoon margin. Both subspecies, *spathacea* and *umbellato-capitata*, were seen. As on Midway, the two subspecies seemed to intergrade (Starr & Martz 1999).



Clumps of the native sedge mauu akiaki (*Fimbristylis*) on the crest above the beach.

***Heliotropium curassavicum* (Nena) Boraginaceae**
Native (Indigenous)

CURRENT

Occasional around lake margin and near coast on north part of island. In some places around the lake this succulent low-growing herb forms large mats, usually in association with makaloa (*Cyperus*), akulikuli (*Sesuvium*), and pohuehue (*Ipomoea*). In the Northern Desert the plants are much smaller, less lush, and growing in association with hinahina kahakai (*Nama*).



HISTORY

In 1896 this herb was confined to the water-free part of the lagoon. This species disappeared during the rabbit era, but reappeared on its own by 1930 and has been recorded in every botanical survey since. In the 1960's it occurred both on the outer beach and in the inner band of vegetation surrounding the central lagoon. (Ely & Clapp 1973, Morin & Conant 1998).

The Laysan Finch feeds frequently in this association around the lake. Reported as Laysan Duck nesting site (Morin & Conant 1998). In 1999 found to be scattered in all areas of the island, especially near the lagoon (Starr & Martz 1999).



Nena (*Heliotropium*) growing in the relatively dry Northern Desert.

***Ipomoea indica* (Koali awa, Morning glory) Convolvulaceae**
Native - Indigenous

CURRENT

A couple vines, likely planted, were observed around Camp. The leaves were rather chlorotic. This species is a potential larval host plant and adult food plant for the non-native Pink-spotted Hawkmoth (*Agrius cingulata*).

HISTORY

In 1896 Schauinsland found this species dispersed over the island except in the vicinity of the lagoon. It was much less common than the related *Ipomoea pes-caprae*. Collected again in 1903, this species was not recorded from another botanical survey until 1959. The species has not been common since, apparently largely confined to low areas near the lagoon, and since the 1960's only reported from a lone patch on the southwest side of the island, halfway between the lagoon and the beach (Ely & Clapp 1973, Morin & Conant 1998).

Not observed in 1999, perhaps we did not walk through the area where it occurred.



Chlorotic koali awa (*Ipomoea indica*) sprawls on vegetation at camp.

***Ipomoea pes-caprae* subsp. *brasiliensis* (Beach morning-glory, Pohuehue) Convolvulaceae - Native (Indigenous)**

CURRENT

Pohuehue (*Ipomoea pes-caprae* subsp. *brasiliensis*) seems to have increased in distribution in recent years, to the point where it can be found over much of the island.

In September 2013 this quick growing vine was especially dominant near the coast and along the lake margins.

HISTORY

In 1896 this vine was found everywhere in higher places along the beach. In 1923 only two seeds were found, so a half pound of seeds of unknown origin was sown. By 1930 beach morning glory was well reestablished, particularly in sandy, more elevated areas, and extended on the southeast almost to the edge of the ocean. It has been recorded in every survey since, occurring on almost all areas of the island (Ely & Clapp 1973, Morin & Conant 1998).

Laysan Ducks forage under this vine, and Laysan Finches have been observed visiting its flowers (Morin & Conant 1998). In 1999 common along coastal areas where it formed dense mats with long tendrils. Also found inland near the lagoon, again forming large mats (Starr & Martz 1999).



Large stands of profusely flowering pohuehue drape the shoreline of the lake.

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

CURRENT

In September 2013 only a few scattered dried up plants that had gone to seed in and near camp were observed.

Outplanted with seeds from Pearl and Hermes in the early 2000's. Once established seeds were collected from plants on island. Reported to do well with direct seeding.

HISTORY

This species was collected on Laysan only by Schauinsland in 1896, who found a single stunted shrub 30 cm high on the east side of the island near the beach. Seeds from Kure Atoll were sown in two localities in December 1963, but did not establish (Ely & Clapp 1973).



Seedheads of anaunau (*Lepidium bidentatum*).

***Lepturus repens* (Lepturus) Poaceae - Native (Indigenous)**

CURRENT

Found mostly along the coast, especially near camp. Nowhere abundant. Plants were green and in flower and fruit in September 2013.

HISTORY

Considered common in 1896 by Shauinsland who found it growing near the beaches, particularly on the north side of the island. Collected again in 1903, but not seen in 1923. The Tanager Expedition attempted to plant material from Pearl & Hermes Reef, but it did not establish, as albatrosses pulled up much of the grass (Ely & Clapp 1973).

Not observed during botanical surveys again until 1988. It has been observed in subsequent surveys that found it to be very localized on the west side beach berm crest (Morin & Conant 1998). In 1999 scattered along coastal areas, especially western coast (Starr & Martz 1999).



Clump of *Lepturus repens* near camp.

***Nama sandwicensis* (Hinahina kahakai) Boraginaceae**
Native (Endemic)

CURRENT

A few clumps around camp. White flowers. Dominant over much of Northern Desert and Eastern Shore, where it is the closest plant to the ocean. Laysan Finches observed eating tender parts of it.

HISTORY

First recorded by Schauinsland in 1896 who found it distributed around the island on the higher parts of the beach, where it formed dome-shaped rosettes. Not found in 1923. Returned to former abundance by 1960's, where it was most abundant on the wide sandy beaches of the northern end of the island (Ely & Clapp 1973, Morin & Conant 1998). Laysan Ducks forage in association with this plant, probably due to the native *Agrotis* larvae that are abundant in the sand beneath (Morin & Conant 1998). In 1999 (Starr & Martz) found this herb scattered all over the island and especially abundant near the coast where it was often the closest plant to the high tide line forming large patchy stands.



Clump of hinahina kahakai (*Nama*) growing on coral chunk in North Desert.

Nicotiana tabacum (Tobacco) Solanaceae - Non-native

CURRENT

Common over much of the island, especially near camp, the cocos, and much of the western portion of the island. Scattered elsewhere, often in clumps or small patches. It was in flower during our visit in September 2013.

This species has had all the known individuals on the island pulled before, but readily resprouts from a seedbank. When dried, the tobacco is apparently smokeable. The Laysan Finches were observed eating the seed pods. Great Frigates and Red-footed Boobies roost and nest in the tobacco shrubs.



HISTORY

Introduced in the early 1900's, first collect by Bryan in 1911. Apparently the rabbits did not eat this plant, in 1923 a rather large patch was found near the southern end of the lagoon and spreading through the southern and southwestern portions of the island. In the 1960's scattered plants were found in many locations in the interior of the island and apparently most abundantly on the west side.

In 1999 adults and seedlings of tobacco were found scattered over the island, especially the west side. There was a large patch near the coconut grove at the north end of the lagoon. This large patch was pulled on June 4, 1999. (Starr & Martz 1999), but was still there in September 2013.



Tobacco (*Nicotiana tabacum*) in flower on Laysan.

***Pluchea indica* (Indian fleabane) Asteraceae - Non-native**

CURRENT

A massive rain event in 2011 lifted the central lake above normal flood levels and killed many plants on Laysan, including much of the large *Pluchea* that ringed the central lake. Control work has since further decreased the distribution of this shrub.

In 2013 we observed some live *Pluchea*, along with lots of recently dead *Pluchea*, in the areas around the lake where it was historically known. The largest area of live plants was in the southeastern portion of the island. The plants were all relatively small, except for scattered larger plants that had been left because of nesting birds during previous control efforts. The upper branches of *Pluchea* are utilized by Great Frigates and Red-footed Boobies for nesting. Burrowing birds occasionally nest below the roots.



The *Pluchea* distribution is well below recent levels. If control work is continued, it should only be a matter of time before *Pluchea* is no longer found on Laysan.

HISTORY

First recorded on Laysan in 1959, where it occurred in many areas around the lagoon, being largely absent from the western border and reaching its maximum development at the northwest and northeast corners of the lagoon (Ely & Clapp 1973).

In the 1980's and 1990's found as a broken ring of shrubs from the north lake shoreline along the east side down to the southwest. *Pluchea* is used by Great Frigates, Black Noddies, and Red-footed Boobies for nesting, and Laysan Ducks use it for some cover (Morin & Conant 1998). In 1999 found to be occasional on the far margins of the lagoon. Red-footed Boobies occasionally nest in it (Starr & Martz 1999).



Indian fleabane (*Pluchea*) along margin of central Lake.

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

CURRENT

Found sparingly along the coast of the Northern Desert, and co-dominant with *Sporobolus pyramidatus* in the center of the Guano Hardpan on the south part of the island. In this hardpan area a hybrid swarm likely exists, with the most *P. lutea* like plants in the center of the hardpan and the most *P. oleracea* like plants on the margins of the hardpan.

P. lutea can be distinguished by a corky stem, flowers nearing the size of a thumbnail, and greater than 15 stamens. In contrast, *P. oleracea* does not have a corky stem base, has flowers the size of a pinky fingernail, and less than 15 stamens. Flowers were out in full by 10:30 am and peaked around noon.



HISTORY

In 1896 found in scattered localities in drier parts of the island. By 1923 only a small patch within a *Sesuvium* patch east of the lagoon remained. In the 1960's it was once more widely distributed over the island (Ely & Clapp 1973). Laysan Ducks have been reported to feed around the ihi. The Laysan Finch feeds on the apical buds, stems, seeds, leaves, and flowers, and pick the dark seeds from the sand (Morin & Conant 1998).

In 1999 purslane was found scattered throughout the island in *Eragrostis* and near the coast. The alien *P. oleracea* was seen, but flowers of most plants were not visible and are listed as *Portulaca* sp. As with other places where both *P. oleracea* and native *P. lutea* occur together, there is undoubtedly hybridization (*P. lutea* x *oleracea*) occurring. Management of *Portulaca* is clouded by this taxonomic quandary. Finches were seen eating seeds. (Starr & Martz 1999).



Ihi (*Portulaca lutea*) has large flowers with numerous stamens and corky bark.

***Portulaca oleracea* (Pigweed) Portulacaceae - Non-native**

CURRENT

Occasional to common around camp and over the entire island, forming small low growing mats. There are both *Portulaca oleracea* and *P. lutea* on Laysan, and hybrids swarms occur between the two. *Portulaca oleracea* is the more common of the two.

P. oleracea is distinguished from *P. lutea* by having smaller flowers, about the size of a pinky fingernail, with less stamens, generally <12, and no corky bark.

P. lutea has flowers the size of thumbnails, >15 stamens, and a corky bark on base of old stems. Hybrids between the two species will have intermediate characters.



HISTORY

First collected in 1959. Noted to be on the southwestern side of the island near the beach (Ely & Clapp 1973). Common in 1980's, noted to be seasonal, with seeds sprouting possibly in relation to rainfall. Reported to not provide adequate cover for ground-nesting seabirds and altering the stability of burrows for burrow-nesting seabirds. (Morin & Conant 1998).

In 1999 purslane was found scattered throughout the island in *Eragrostis* and near the coast. The alien *P. oleracea* was seen, but flowers of most plants were not visible and are listed as *Portulaca* sp. As with other places where both *P. oleracea* and native *P. lutea* occur together, there is undoubtedly hybridization (*P. lutea* x *oleracea*) occurring. Management of *Portulaca* is clouded by this taxonomic quandary. Finches were seen eating seeds. (Starr & Martz 1999).



Pigweed (*Portulaca oleracea*) has small flowers with few stamens and no corky bark.

***Pritchardia remota* (Loulu) Arecaceae - Native (Endemic)**

CURRENT

Pritchardia remota has been planted and sown on Laysan over the past decade, using seed stock from Nihoa Island.

Some of these plantings were doing well. However, just as the eight year old *Pritchardia* palm plantings around the Cocos were about to go to seed, the February 2011 flooding rain killed them and the coconuts.

During September 2013, some of the more recently planted palms near the Cocos were still alive, though still very young and less than 20 cm tall. The status of the plantings along the eastern shore of the lake is unknown.



We scattered a few hundred seeds of this palm around camp during our stay and planted 75 or so small loulu palm trees around the Cocos and on the ridge above it.

HISTORY

A small fan palm was first seen, but never collected or described, on Laysan in 1828. In 1859 at least five trees up to 15 ft. tall were present. But by 1896 Schauinsland found only numerous dead stumps and roots, some in the northern part of the island and others not far from the lagoon on the southeast part. Schauinsland estimated the original population numbered several hundred (Ely & Clapp 1973, Morin & Conant 1998).



Loulu palm (*Pritchardia remota*) seeds from Nihoa about to be scattered on Laysan.

***Santalum ellipticum* (Iliahi aloe) Santalaceae - Native (Endemic)**

CURRENT

During the 2013 survey a few small sandalwood trees were observed around camp. These had been planted from seed collected on Oahu (Makapuu). These small glaucous plants were in flower during September 2013. Laysan Finches were observed visiting the planted sandalwoods and feeding on their flower buds.

HISTORY

First collected on Laysan in 1896 by the shoreline, where it was most abundant on the northwest side and was the largest plant on the island, growing to as much as 2.5 m tall. It was also known along the southwest side of the island (Ely & Clapp 1973).

By 1923 the only remaining plants were found in a small patch along the southwestern side of the island. Some of the leafless stumps were trying to sprout but evidently did not long survive as none was found by subsequent observers (Ely & Clapp 1973, Morin & Conant 1998).



Laysan Finch eating flower buds of iliahi aloe (*Santalum ellipticum*).

***Scaevola taccada* (Naupaka kahakai) Goodeniaceae** **Native (Indigenous)**

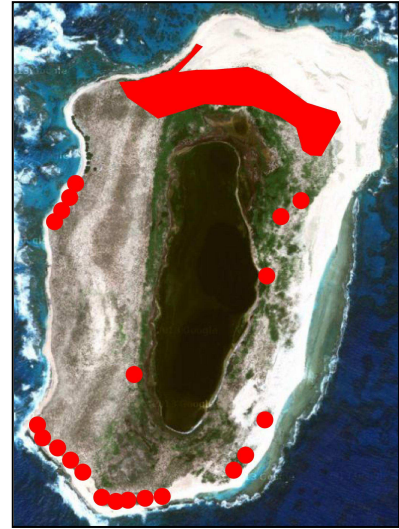
CURRENT

This species appears to have increased in distribution in recent years, where it is currently present along the coast for much of island, and is dominant over much of the northern portion of the island. Generally very low growing, usually less than 1 meter in height in most places, forming small, often interconnected, clumps. The preferred habitat for the Nihoa Millerbird.

HISTORY

In 1896 *Scaevola* was limited to the zone along the beach, abundant along the west beach, more stunted along the east side. By 1923, only three exceedingly poor patches were found. At this time seeds and plants of unknown origin were planted. By the 1960's this species has recovered its former abundance and may have become even more widespread than it was in 1896. At the time the species formed a well developed band around the outer perimeter of the island just inland from the beach. Scattered plants were also found inland on the west side of the island to within 50 yards of the lagoon. And it occurred in even greater abundance in the eastern interior, occasionally forming well developed stands near the lagoon edge. (Ely & Clapp 1973)

In 1999 naupaka was found along the coast, especially the northeast side of the island where it collects drifting sand in clumps 2m x 2m that are surrounded by *Ipomoea pes-caprae*. Seedlings were observed. (Starr & Martz 1999). Great Frigatebirds, Red-footed Boobies, and Black Noddies nest on top of naupaka. Red-tailed Tropicbirds, Christmas Shearwaters, and Laysan Ducks nest on the ground below naupaka. Laysan Finches eat its leaves and fleshy stems and fledglings often use the bush for cover. (Ely & Clapp 1973, Morin & Conant 1998).



Red-footed Boobies and Great Frigates utilize naupaka (*Scaevola*) for nesting.

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

CURRENT

Found along the margin of the lake, especially in areas of the lake that had recently become barren. Numerous seedlings and young plants were observed closest to the lake, with larger, more established, patches found in the higher areas further from the lake.

HISTORY

First collected in 1896 by Schauinsland who reported that individuals of this plant stood alone, only occurring in the low-lying salty soils in the vicinity of the lagoon where it grew profusely with *Heliotropium curassavicum* and *Cyperus laevigatus*. It was the only native species at all abundant in 1923, apparently the rabbits didn't eat it. In 1930 it covered large areas just above the high water mark of the lagoon. In the 1980's and 1990's akulikuli grew in the same places and in association with the same species as it had in 1896. (Ely & Clapp 1973, Morin & Conant 1998). In 1999 solid mats occurred around the margins of the lagoon (Starr & Martz 1999).



***Akulikuli (Sesuvium)* germinating amongst plastic pieces on margin of Lake.**

Sicyos maximowiczii (Anunu) Cucurbitaceae - Native (Endemic)

CURRENT

What appeared to be both species of *Sicyos* were observed on Laysan during September 2013, but only a few small patches were observed. Apparently the *Sicyos* on Laysan, as in many other areas, is seasonal and found in greater abundance during the moist months.

What appeared to be this plant, with fuzzier more succulent leaves, was found in a few spots around the northeast and east side of the lake often seen sprawling over makaloa (*Cyperus laevigatus*) or sometimes emoloa (*Eragrostis variabilis*). A few seedlings were observed. It was not in flower or fruit. Plants have been observed to flower and fruit in May at Kure Atoll (see photos below) so it perhaps also does the same at this time on Laysan as well.



HISTORY

First reported in 1896 to be not uncommon near the brackish pond of the southern guano field. It was not observed in 1923, but has been present from 1930 onward. In the 1980's it was seasonally common in the viney vegetation that rims the area above the lake flats that periodically flood, often in association with *Tribulus*, *Boerhavia*, and *Ipomoea*. Laysan Finches eat the fruits, flowers, and flower stalks of *S. maximowiczii*, and pick invertebrates from under its stems and leaves (Ely & Clapp 1973, Morin & Conant 1998).

In 1999 scattered over entire island. Crawling over vegetation. Two species, *S. maximowiczii* and *S. pachycarpus* were found. (Starr & Martz 1999).



Sicyos maximowiczii habit on Laysan (left), furry leaves and flowers (center), and large puffy fruit on Kure Atoll (right).

***Sicyos pachycarpus* (Anunu) Cucurbitaceae - Native (Endemic)**

CURRENT

What appeared to be both species of *Sicyos* were observed on Laysan during September 2013, but only a few small patches were observed. Apparently the *Sicyos* on Laysan, as in many other areas, is seasonal and found in greater abundance during the moist months.

A few patches of this more glabrous and chartaceous-leaved *Sicyos* were observed along the northeast and south parts of the lake margins often observed sprawling on makaloa (*Cyperus laevigatus*) and other wetland plants. These plants were in full flower and young fruit.



HISTORY

In 1896 occurring singularly on the margin of the lagoon, climbing on the *Cyperus*. Absent in 1923. Present after 1961. Present, but not common in 1980's.

In 1999 scattered over entire island. Crawling over vegetation. Two species, *S. maximowiczii* and *S. pachycarpus* were found. (Starr & Martz 1999).



***Sicyos pachycarpus* sprawling habit (left), female flowers center and fruit forming (center), and male and female flowers (right).**

***Sicyos semitonsis* (Anunu) Cucurbitaceae - Native (Endemic)**

CURRENT

The *Sicyos* we saw all appeared to fit within the two described species mentioned above. However, there were very few plants to compare with and none of the plants trending towards *S. mazimowiczii* had fertile material.

Very little is known about this species, the taxonomy is still uncertain, and no images exist of it in the wild. It would be very good to get images and specimens of this ephemeral vine known only from Laysan.

HISTORY

First collection made in 1964 by Long at the NW end of lagoon in herb community with *Ipomoea pes-caprae* (Wagner et al. 1999). Collected again in 1988 by Herbst noting location as "N end near edge of halophyte zone, ~100' E of coconut palm grove" (Bishop Museum 2013). Reported as having characteristics of both and is perhaps a hybrid of *S. maximowiczii* and *S. pachycarpus* (Wagner et al. 1999).



No image available.

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

CURRENT

During our visit in 2013, two small plants were observed next to where a greenhouse used to stand behind camp. The plants looked prostrate, but were very young.

Reintroduction of this species on Laysan began in the winter of 2005/2006 after it was found in pollen core studies (Athens et al. et al. 2004). Both cuttings and a little over 1,000 seeds were obtained from Nihoa's Middle Valley and propagated on Laysan. A few plants were outplanted at north camp (FWS Trip Reports).

HISTORY

This variable species is common on many other Hawaiian islands, but was previously unrecorded from Laysan, and has never been historically abundant on the low sand atolls of the NWHI.



One of two small plants of ilima (*Sida fallax*) observed on Laysan.

***Solanum americanum* (Glossy Nightshade) Solanaceae
Native (Indigenous?)**

CURRENT

In September 2013, this small shrub was found on margins of the Guano hardpan. It was apparently also known from near camp, but we didn't see any.

Over the past decade this species has at times, including currently, been called native and left to be, and at other times has been deemed non-native and controlled.

HISTORY

First collected on Laysan in 1930, it has remained limited in distribution. Reported most commonly near the camp on the northwest part of the island, it has also been collected from the southwest side of the lagoon and on the west slope of the interior. In 1999 found scattered along trail from lagoon to camp (Starr & Martz 1999).



Glossy Nightshade (*Solanum americanum*) along margin of Guano Hardpan.

***Solanum nelsonii* (Popolo) Solanaceae - Native (Endemic)**

CURRENT

No plants were alive in September 2013. Point on map is from Summer 2013 mapping.

Recently planted on Laysan in the mid 2000's using seeds, estimated at thousands, from Nihoa and Pearl and Hermes. Apparently crews struggled with keeping plants alive in shade houses and outplantings, listing problems with pests, diseases, and poor growth.

HISTORY

In 1896 Schauinsland found this species on small sand dunes in a few places near the north beach. They were still in the same spot in 1903, the last time they were seen (Ely & Clapp 1973).

In the 1960's seeds from Nihoa and Kure were planted in the northwest interior and north of the northern coconut trees. Subsequent observers found no evidence that any of these survived (Ely & Clapp 1973). No plants were observed in 1999.



Leaves and ripe fruit of popolo (*Solanum nelsonii*), Spit Island, Midway Atoll.

Sporobolus pyramidatus (Dropseed) Poaceae - Non-native

CURRENT

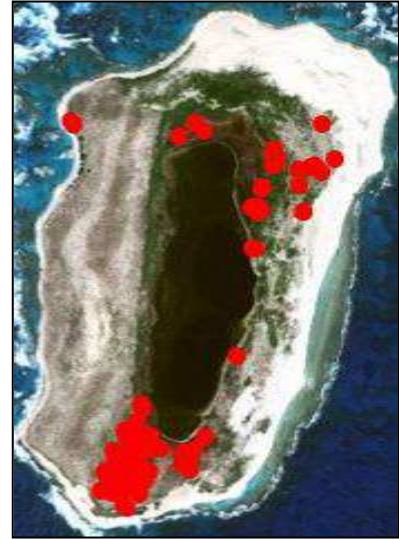
Co-dominant in Guano Hardpan with *Portulaca*, where they form a short-statured grassland / herbland. Also found scattered elsewhere around Laysan, mostly along the lake margin and in areas of harder soil.

Intensive eradication efforts against this grass seem to have had little impact on the distribution of this species. Laysan Albatross seem to nest in abundance without ill-effects in the *S. pyramidatus* dominated areas of the Guano Hardpan.

HISTORY

First found after 1992, when it was common on the southern hardpan area. (Morin & Conant 1998)

In 1999 patches of this grass were seen on the south side of the lake on and near the guano hard pan. Seemed to like compacted ground like on Tern Island. (Starr & Martz 1999).



Sea of dropseed (*Sporobolus pyramidatus*) in Guano Hardpan.

***Sporobolus virginicus* (Akiaki grass) Poaceae
Native (Indigenous)**

CURRENT

Recently planted on Laysan, using stem cuttings from James Campbell NWR on Oahu. In 2013 this grass persisted in a few of the plantings, especially along the coast and the margin of the Northern Desert. Most locations comprised small patches a couple meters across. Plants were in flower in September 2013.

HISTORY

In 1896 Schauinsland found this rhizomatous grass growing on high ground near the ocean shore, especially on the northern part of the island (Ely & Clapp 1973).

This grass had not been collected from Laysan since then.



Planted akiaki grass (*Sporobolus virginicus*) near camp.

***Tournefortia argentea* (Tree heliotrope) Boraginaceae**

Non-native

CURRENT

Currently called *Heliotropium foertherianum*, but known to most Laysan folks as *Tournefortia*. In 2013 this small tree was found predominantly along the coast by camp, where it has been the past few decades. However, in contrast to our 1999 survey, it was now also on the southeast part of Laysan.

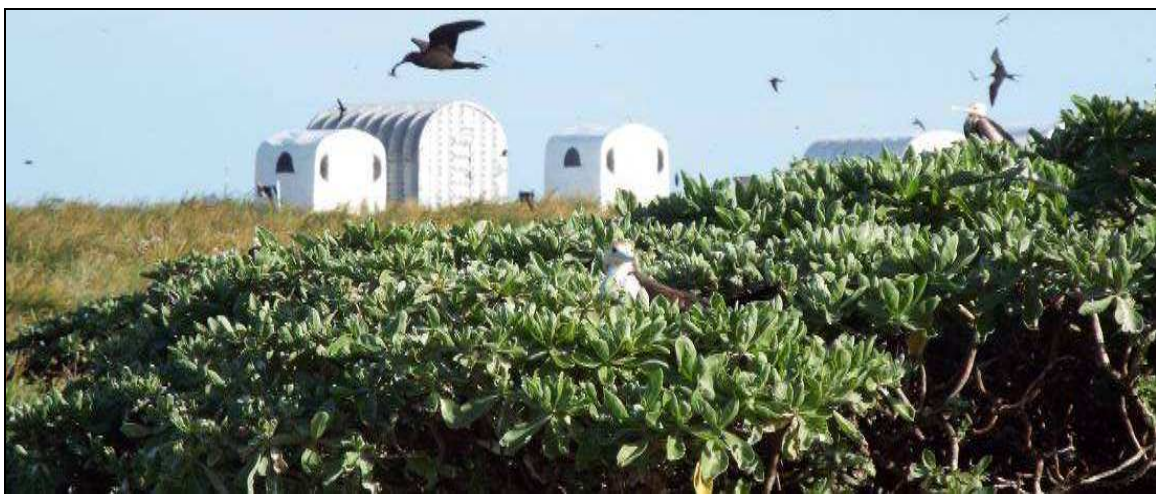
Apparently, much of the *Tournefortia* was damaged during a Tsunami in March 2011, which pushed many of the coastal *Tournefortia* inland a bit and scattered branches and seeds around the entire island. Some of these seeds took hold and now scattered small plants of *Tournefortia* are found on the southeast portion of Laysan.



While sitting, covered in flies, in the shade of a *Tournefortia* tree along the coast, we heard popping noises and looked up to see a Laysan Finch chomping down on the moist green *Tournefortia* fruit. Other birds known to utilize *Tournefortia* include Great Frigates, Red-footed Boobies, Black and Brown Noddies, and White Terns.

HISTORY

First found on Laysan in 1961 when a small tree was found growing at the top of the northwest beach between the *Nama* and *Scaevola* associations. In 1967 two trees south of the northwest landing were thriving and in bloom. (Ely & Clapp 1973). In the 1980's and 1990's tree heliotrope was most firmly established along the northwest vegetation line. In 1999 tree heliotrope was restricted to area right around beach camp (Starr & Martz 1999).



Tree heliotrope (*Tournefortia*) lines the coast near camp.

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

CURRENT

Scattered patches on / around the Guano Hardpan, the southeast coast and inland, and near Camp. Nowhere dominant.

HISTORY

In 1896 found throughout the island, particularly in drier areas. In 1923 only seeds and tiny seedlings could be found. By 1930 it was growing in many places on the island, and by the 1960's was once again found commonly throughout the island. (Ely & Clapp 1973).

Laysan Finches relish its seeds, leaves, flowers, prostrate runners, and seedlings. Laysan Ducks have been reported to forage under nohu. (Morin & Conant 1998). In 1999 found scattered over entire island. Nowhere observed as dominant. (Starr & Martz 1999)



Large yellow flowers and fuzzy leaves of nohu (*Tribulus*).

Unknown Asteraceae - Non-native

CURRENT

An unidentifiable plant, likely an Asteraceae that looked like a young *Emilia* or *Sonchus*, was found in a pot during the dismantling of a greenhouse near camp. The plant was immature, had no fertile parts, and only a few leaves.

The plant was pulled during the greenhouse clean up, but likely would not have lived much longer anyways, as it was very chlorotic and unhealthy looking. It is uncertain where the plant came from or how it got to Laysan.



HISTORY

We thought we had heard something mentioned about *Sonchus* on Laysan, but could find no previous records of an Asteraceae similar to this from Laysan.



Small unknown non-native Asteraceae pulled from pot during greenhouse dismantling, likely either *Sonchus* or *Emilia*.

ACKNOWLEDGEMENTS

Jason Hanley, USFWS Invasive Species Strike Team Leader for Hawaiian and Pacific Islands National Wildlife Refuges, was behind the vision and funding for this survey. Cindy Rehkemper, Chief Scientist for Hawaiian Islands NWR was the trip leader, provided logistical support, and shared insights about the flora and fauna of Laysan. Numerous other folks, who had previously spent time on Laysan, also provided insights into the status and changes of the vegetation on the island. The FWS Oahu staff provided additional logistical support. As did Captain Mario, Cook Ed Gordon, and the rest of the crew of the M/V Kahana, who got us safely to and from lovely Laysan Island.

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