BOTANICAL SURVEY OF MIDWAY ATOLL

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Prepared for:
UNITED STATES FISH AND WILDLIFE SERVICE

2022

BOTANICAL SURVEY OF MIDWAY ATOLL

OBJECTIVES

In order to keep a pulse on the plants on Midway, botanical surveys are occasionally conducted. In addition, it was deemed important to have a pre- mouse eradication vegetation baseline, to help record vegetation changes. The goals of this survey, done June 13-July 1, 2022, were to:

- Update the current list of plant species known from Midway.
- Conduct random plot surveys at 186 locations across the atoll.
- Conduct corridor and focal surveys for incipient and new species.
- Provide summary of results for refuge staff and volunteers.

Surveying plants on Sand Island.

Surveying plants on Eastern Island.

OVERVIEW

Midway Atoll (Kauihelani, Pihemanu) is located in the North Pacific Ocean, near the northwestern tip of the Northwestern Hawaiian Island chain, and is under the jurisdiction of the United States Fish and Wildlife Service as the Midway Atoll National Wildlife Refuge, Battle of Midway National Memorial, and Papahānaumokuākea National Marine Monument.

Midway is home to spectacular wildlife, including numerous seabirds, monk seals, turtles, and other marine life; native Hawaiian coastal vegetation; and a rich commercial and military history, including the Pacific Cable Company, Pan American Airways, and the Battle of Midway.

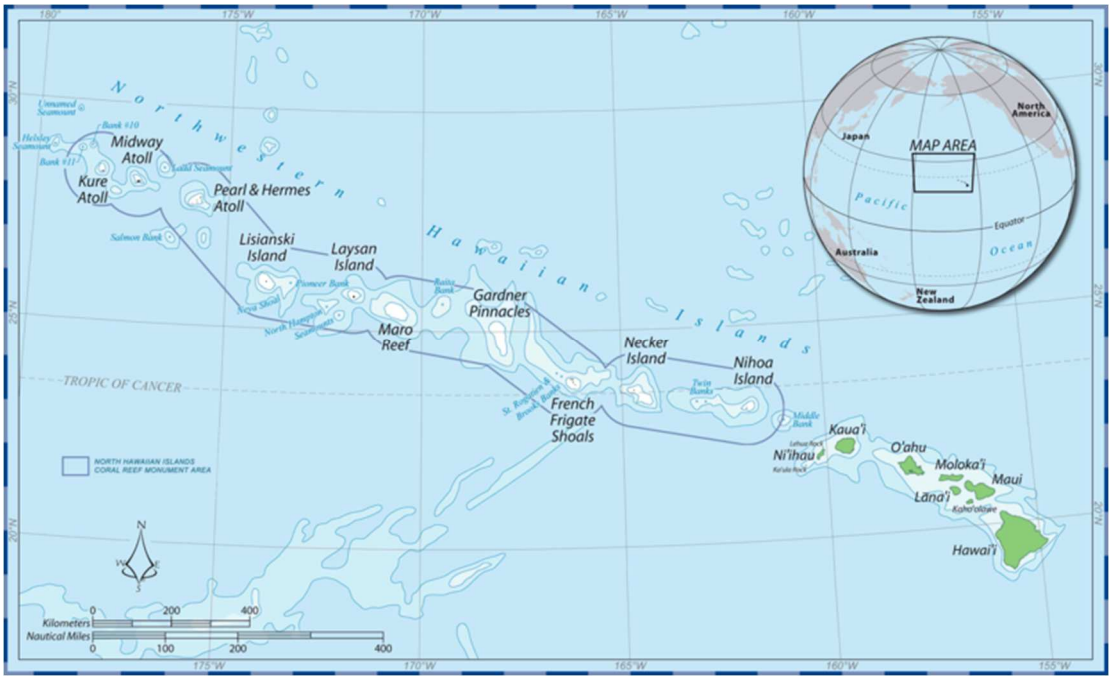
Midway is surrounded by a circular reef forming a shallow lagoon around two islands, Sand Island (1117 acres), and the now combined Eastern and Spit Island (~350 acres).

The islands consist mostly of sand and coral rubble, like other northwestern Hawaiian Islands. However, over the years, several tons of soil, rock, and other material have been added to make them more amenable to humans.

Additionally, unlike most other Northwestern Hawaiian Islands, Midway's vegetation has been greatly increased and diversified. Some plant species have been intentionally introduced, while others arrived as contaminants.

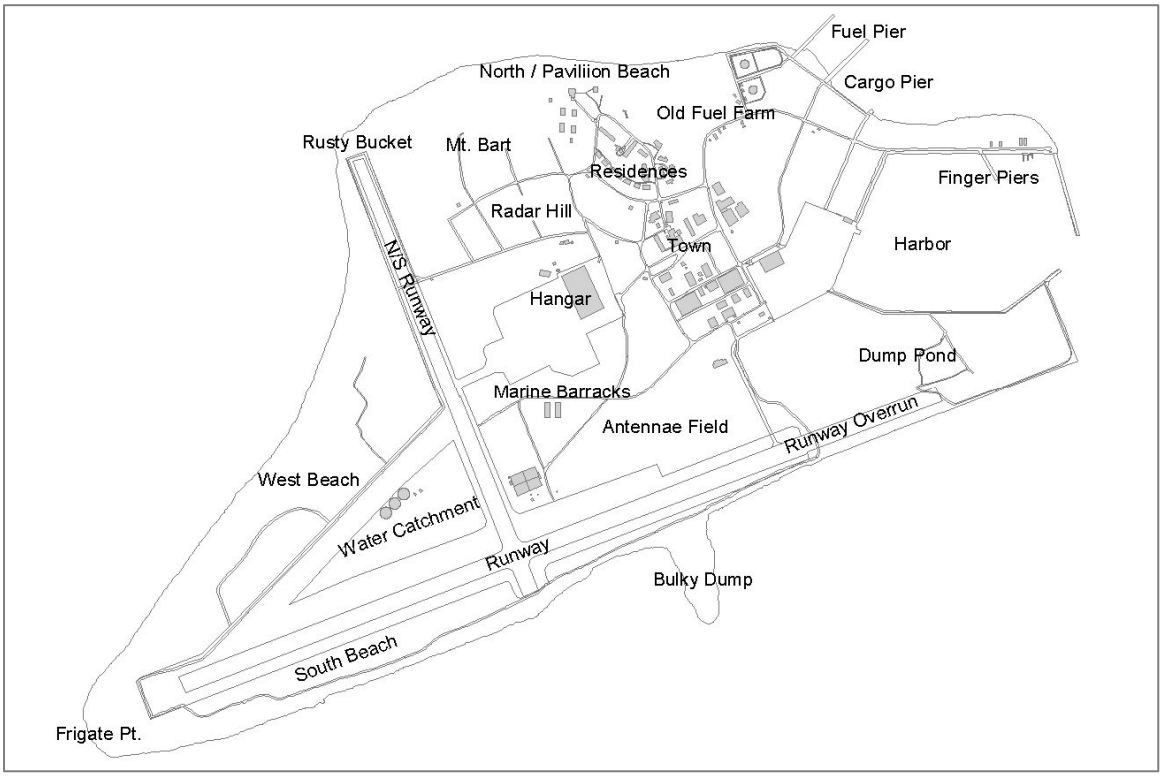
Some plant species have not caused any management issues, such as plumeria (*Plumeria* spp.) and hibiscus (*Hibiscus* spp.). While others, such as golden crown-beard (*Verbesina encelioides*) and ironwood (*Casuarina equisetifolia*), take vast resources to keep in check.

Battle Memorial surrounded by Laysan Albatrosses, Sand Island, Midway Atoll.

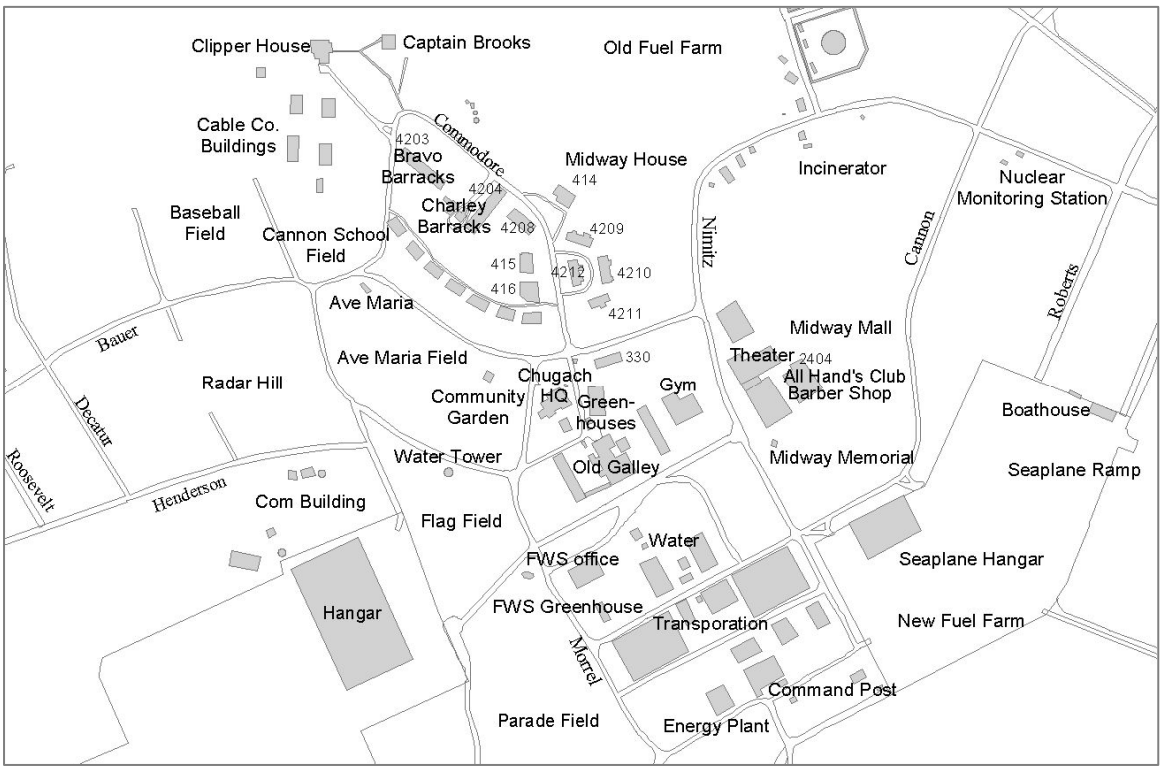


Map of Northwestern Hawaiian Islands.

Satellite image of Midway Atoll.



Map of Sand Island with location names.



Detail map of the Town area of Sand Island with location names.

METHODOLOGY

The main methods used were:

- **Random Plots** - Inventory of all plant species within 5 m radius circular plots at random locations within each cell of a 4 ha grid overlaying the refuge.

- **Focal Area & Corridor Surveys**- Surveys for incipient and watchlist species in areas where invasive species are likely to first occur (e.g., roads, piers, residential areas, gardens).

- **Incidental Observations** - Opportunistic observations between formal survey locations, sampling for a limited set of incipient and watchlist species, and anything new.

Laysan Albatrosses, one of the main wildlife resources guiding vegetation management on Midway.

RANDOM PLOTS

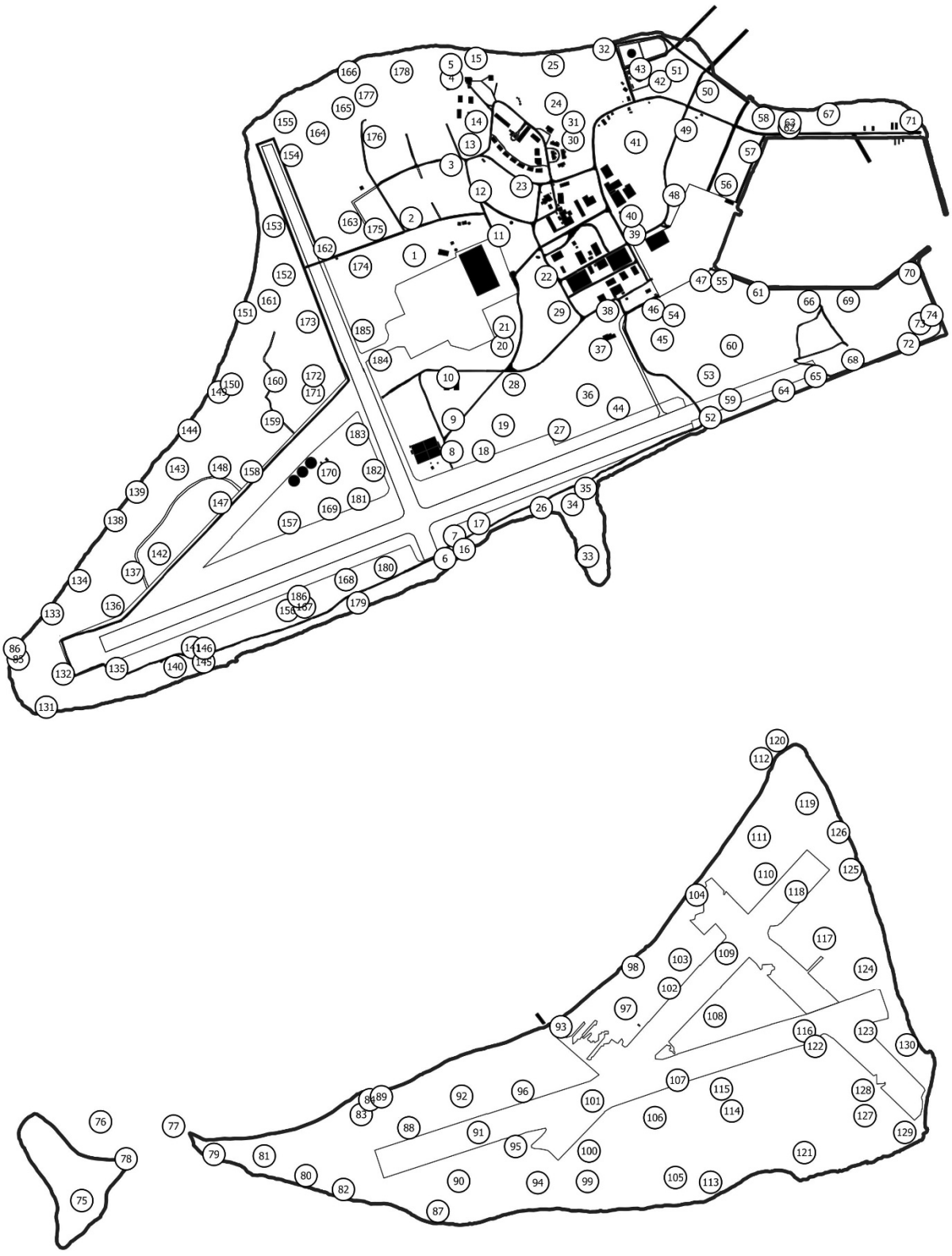
Random plot surveys involve compiling a list of all plant species within 5 m radius circular plots at random locations within each cell of a 4 ha grid overlaying the refuge. There are 186 plots across the atoll. The plots are not permanently marked. GPS navigation to the site is considered complete once the GPS indicates a distance to the plot center of 1-2 m.

2022 - All plant species within the plot were recorded, along with an estimated % cover in the plot for each species and bare ground or ocean. An image was also taken of each plot.

2017 - All plant species within the plot were recorded, the abundance of each was estimated with broad cover classes (few, moderate, dominant). All *Verbesina* plants were counted.

Future - In the future, it may be fine to just record species present in each plot, with no estimate of cover. There are many reasons for a future slimmed downed approach. The main ones are that GPS technology is not accurate enough to allow returning to the same exact spot; plot markers will not stay in the same spot over long periods of time and may affect the birds; estimating % cover is highly error prone; complex data takes more time to process and is awkward to display; collecting less data is quicker; and the results gleaned from a simple species list at each plot has now proven to be adequate to capture large scale changes in the atoll vegetation over time.

White Tern chick in one of the random plots on Sand Island.



Plot locations and numbers.

Calibrating random plot methodology near Turtle Beach.

Monitoring a random plot on the southeast side of Spit Island.

FOCAL AREA & CORRIDOR SURVEYS

Focal area and corridor monitoring involves surveying for new invaders and existing high priority weed species along corridors (e.g., roads) and in certain, pre-defined areas (e.g., gardens, ports of entry, high traffic areas, etc.) where new non-native species are most likely to appear.

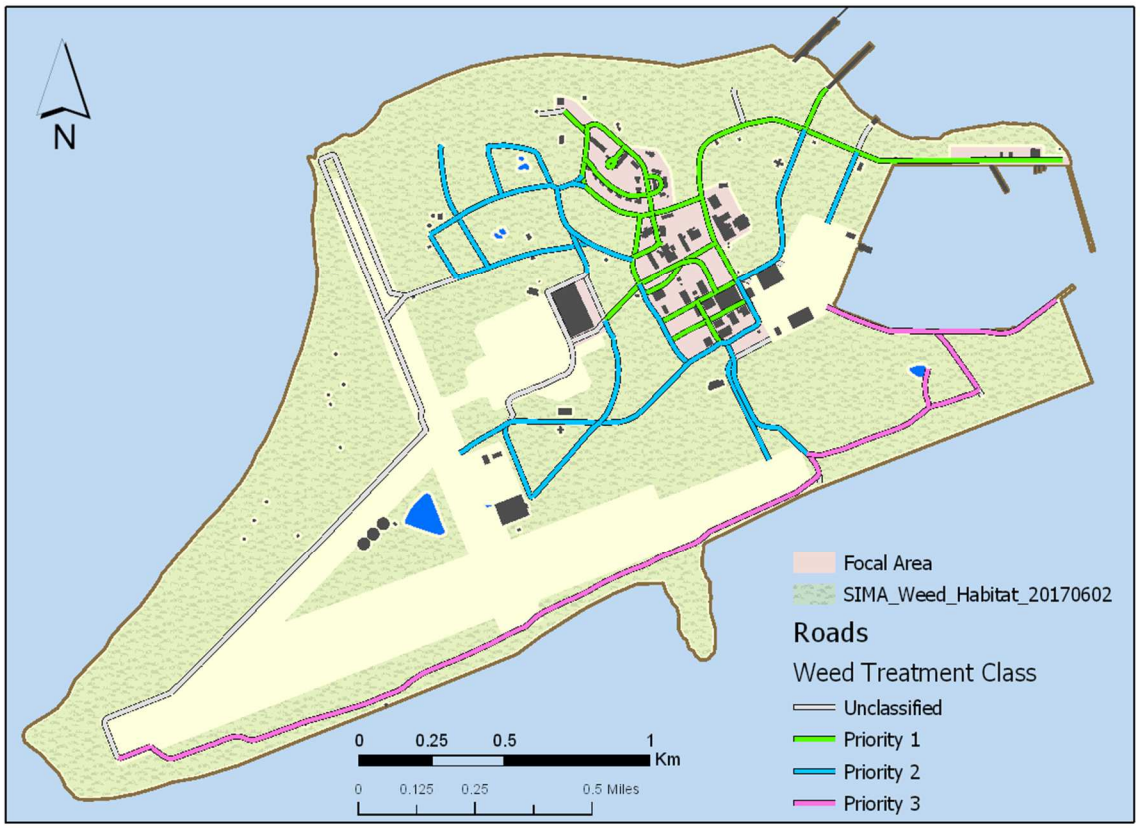
Focal Area Surveys

- New and target plant species are searched for, while also recording a running list of plant species on each island and their relative abundance.

- No specific routes are followed, rather a walk-through survey method is used, focusing on portions of the focal area with highest likelihood of new or target plant species.

Corridor Surveys

- Roads and nearby roadsides are surveyed, focusing on new and target plant species, while recording a running list of plant species on each island and their relative abundance.



Focal area and corridor survey locations.

Focal area survey of Community Garden.

Corridor survey in Town.

INCIDENTAL SURVEYS

Incidental surveys involve looking for a list of target species and any species new to the atoll when travelling from one survey site to the next.

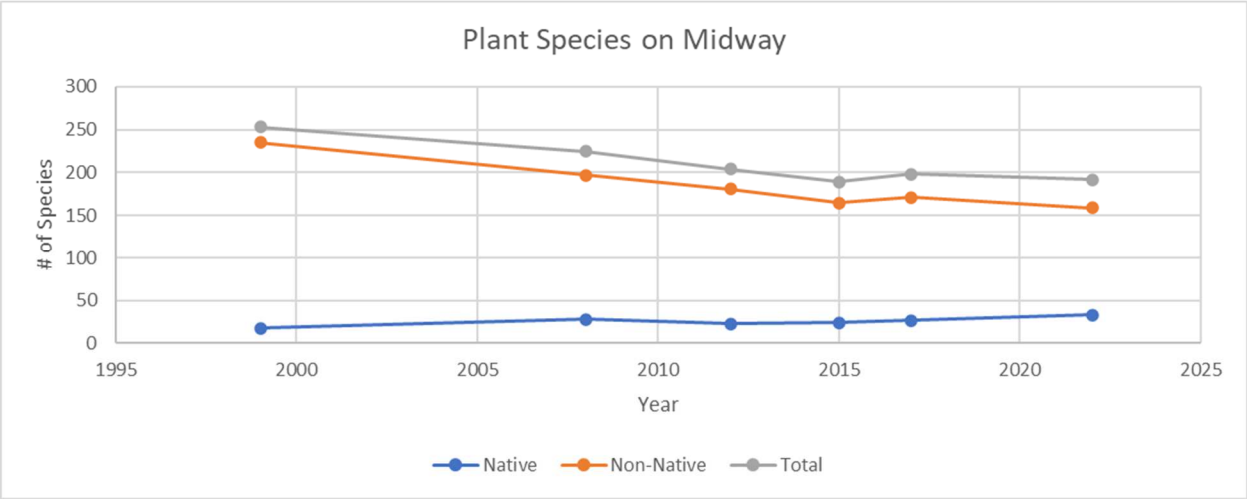
- GPS points are recorded for each incidental sighting with species name and any notes.
- GPS tracklogs are recorded during surveys, to show areas that were and were not surveyed.
- All species observed are used to update the Midway Plant List, by recording a running list of plant species on each island and their relative abundance.

Looking for plants at Base Camp on Eastern Island during incidental surveys between random plot locations.

RESULTS & DISCUSSION

Number of Plant Species Observed

Year	Native	Non-Native	Total
2022	33	159	192
2017	27	171	198
2015	24	165	189
2012	23	181	204
2008	28	197	225
1999	18	235	253



There were 192 plant taxa observed, 33 (17%) were native and 159 (83%) were non-native. One of the biggest changes since our last survey is the continued reduction of *Verbesina*, which we've watched over the decades go from a habitat type to an incipient species.

Also apparent are the removal of some of the ironwood groves and human structures, leading to more open habitat types. Many of these open areas have been revegetated with native plants. As a result of continued restoration efforts, a critical mass appears to have been reached for a few of the species, which are now able to propagate on their own, such as *Eragrostis variabilis*.

Before removal of rats on Midway, naupaka (*Scaevola sericea*) was deemed on the road to extinction on Midway. After removal of rats and competing non-native vegetation, it has taken off and continues to expand in range. This benefits some birds, but is to the detriment of others. Control of naupaka has increased, such as cutting trails for surveys and management, and opening even wider swaths for birds to get to the sea. Over time, it will likely increase further.

There were 16 new plant species recorded from the atoll this survey. Most were intentionally introduced, both native and non-native. The bulk of the new species were found in the Town area of Sand Island or in restoration sites.

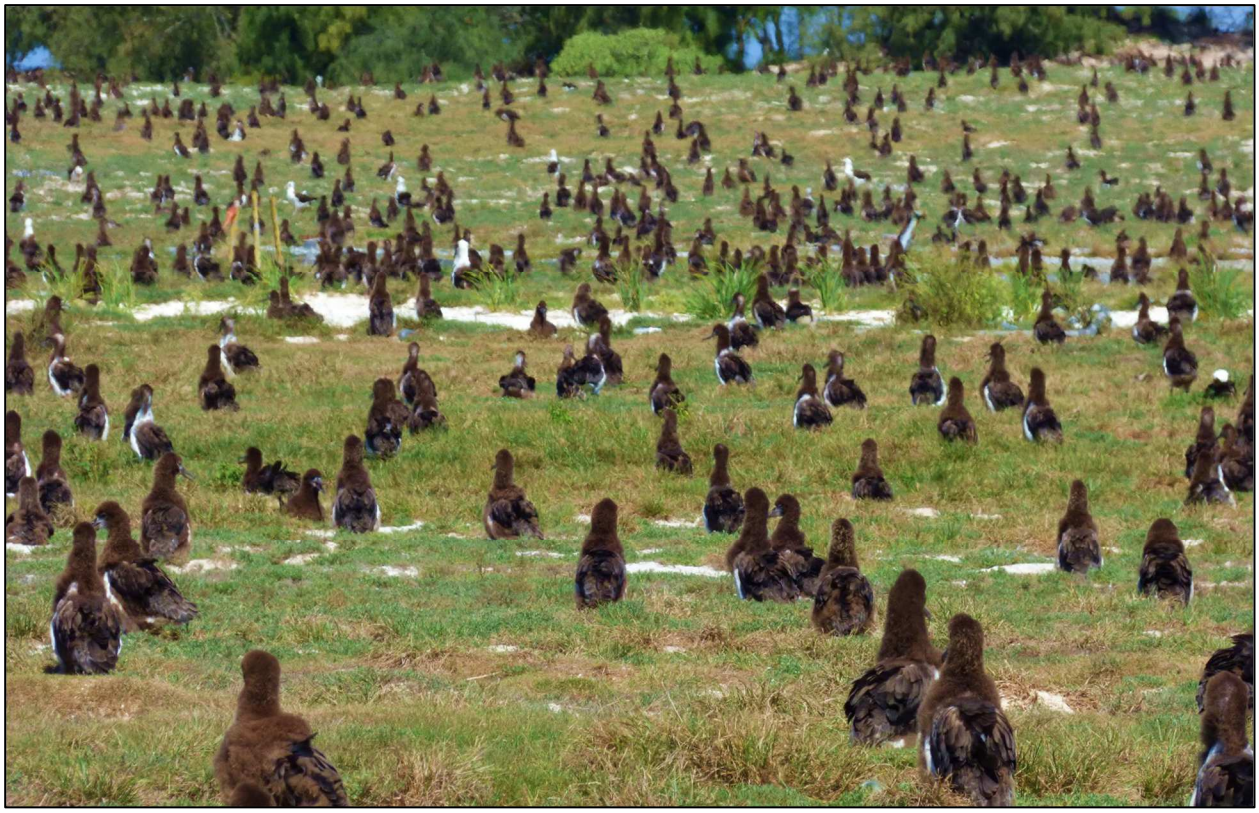
After years of control efforts, many invasive plant species are presumed to be eradicated, including ivy gourd (*Coccinia grandis*), Guinea grass (*Megathyrsus maximus*), Christmasberry (*Schinus terebinthifolius*), and African tulip (*Spathodea campanulata*).

Many more species remain at highly reduced levels and possibly could soon be eradicated, such as haole koa (*Leucaena*), castor bean (*Ricinus*), sour bush (*Pluchea*), and lantana (*Lantana*).

A series of collections were made to document the changing flora and get confirmation of identifications. Areas of focus this trip included newly introduced native and non-native plants, along with native and non-native grasses and sedges.

Questions of how best to manage each plant species on Midway will perpetually exist, the best answers changing as the vegetation, wildlife, people, and mandates on the atoll change. By understanding the habitat preferences of the different bird species on Midway and where folks would prefer those birds to be located, a vision for which plant species to promote where comes to light. Data being collected such as reproductive success in each vegetation type will help inform these decisions.

Though more could always be done, the vegetation management on Midway appears to have really hit its stride. It's amazing what has been accomplished out on this idyllic outpost.



Laysan Albatrosses thriving at Midway Atoll.

NEW PLANTS

16 "new" plant species were observed growing on Midway this survey. 3 of these presumably showed up on their own, being well known ocean dispersers. 6 were plants native to Hawai‘i introduced for restoration purposes. The remaining 7 were intentionally introduced edible plants.

Non-Human Assisted?
Canavalia cathartica (Maunaloa)
Calystegia soldanella (Sea bindweed)
Mucuna sp. (Sea bean)

Native - Intentionally Introduced
Achyranthes splendens (Achyranthes)
Euphorbia degeneri (‘Akoko)
Gossypium tomentosum (Ma‘o)
Melanthera integrifolia (Nehe)
Myoporum sandwicense/stellatum? (Naio)
Sesbania tomentosa (‘Ōhai)

Non-Native - Intentionally Introduced
Averrhoa bilimbi (Bilimbi)
Fragaria chiloensis (Alpine strawberry)
Malus pumila (Apple)
Oroxylon indicum (Indian trumpet tree, Broken bones tree)
Prunus persica var. *persica* (Peach)
Rubus sp. (Blackberry)
Zingiber officinale (Ginger)

Oroxylon indicum **(Indian trumpet tree, Broken bones tree), one of the new introduced edible plants.**

COLLECTIONS

Numerous plant collections were made during the survey. The main areas of focus were plants newly recorded from Midway, along with a series of grasses and sedges to help confirm the identifications and document their current presence on Midway.

Vouchers will be deposited at Bishop Museum and any relevant new records will be published in Bishop Museum's Hawai‘i Biological Survey Occasional Papers.

Eastern Island
220624-01 *Sporobolus pyramidatus*
220624-02 *Cynodon dactylon*
220624-03 *Digitaria ciliaris*
220624-04 *Setaria verticillata*
220624-05 *Eleusine indica*
220624-06 *Dactyloctenium aegyptium*
220624-07 *Sporobolus pyramidatus*

Sand Island
220625-01 *Myoporum sandwicense*/*stellatum*?
220625-02 *Myoporum sandwicense*/*stellatum*?
220625-03 *Achyranthes splendens*
220625-04 *Euphorbia degeneri*
220625-05 *Achyranthes splendens*
220625-07 *Cyperus polystachyos*
220625-08 *Eustachys petraea*
220625-09 *Eragrostis amabilis*
220625-10 *Lepidium virginicum*
220625-11 *Sporobolus pyramidatus*
220625-12 *Fimbristylis cymosa*
220625-13 *Melanthera integrifolia*
220625-14 *Sida fallax*
220625-15 *Gossypium tomentosum*
220625-16 *Euphorbia degeneri*
220625-17 *Paspalum setaceum*
220625-18 *Paspalum urvillei*
220625-19 *Sporobolus indicus*
220625-20 *Bothriochloa pertusa*
220625-21 *Canavalia cathartica*
220625-22 *Calystegia soldanella?*

PLANT ERADICATIONS

After years of control efforts, many invasive plant species are no longer known from Midway, a goal most other islands could only dream of. Examples of the presumed eradications include ivy gourd (*Coccinia grandis*), Guinea grass (*Megathyrsus maximus*), Christmasberry (*Schinus terebinthifolius*), and New Zealand spinach (*Tetragonia tetragonioides*).

Some species have previously been declared eradicated on Midway and were re-introduced and then re-eradicated, such as ivy gourd (*Coccinia grandis*) and guava (*Psidium guajava*). Others reappeared from seed or were overlooked and have since been re-eradicated, like Christmasberry (*Schinus terebinthifolius*). Both were quickly dispatched when they reappeared.

A number of species have been significantly reduced in abundance, but still have a persistent seed bank requiring follow up, such as hairy abutilon (*Abutilon grandifolium*), spiny amaranth (*Amaranthus spinosus*), haole koa (*Leucaena leucocephala*), cheeseweed (*Malva parviflora*), and buffel grass (*Cenchrus ciliaris*).

Now that *Verbesina* has been significantly reduced, weed control efforts are further focusing on incipient species. To this end, a control team hikes across the entire atoll every month, dispatching incipient invasives. If continued, this should result in many more eradications.

Ivy gourd is an invasive edible vine that was eradicated in 1999, intentionally re-introduced some time before 2008, and then re-eradicated. This picture is from 2008, when we found ivy gourd to be well established in multiple locations. Ivy gourd was not observed in 2015, 2017, or 2022 and is presumed eradicated, again.

PLANTS NOT OBSERVED IN 2022

The following plants were not observed in 2022, but had been observed in the previous three surveys. Many of these species were common on Midway in the past, and probably still persist in low numbers and were overlooked, or still exist as a seed bank. But some may gone for good.

Many of the species are targets on the incipient invasive species list for the FWS weed control team. Our inability to find these once common species is a testament to their diligent work.

Abutilon grandifolium (Hairy abutilon)
Amaranthus spinosus (Spiny amaranth)
Andropogon glomeratus var. pumilus (Broomsedge)
Brassica juncea (Mustard)
Bromus catharticus (Prairie grass)
Cenchrus ciliaris (Buffel grass)
Chenopodium murale (Goosefoot)
Cyperus involucratus (Umbrella plant)
Leucaena leucocephala (Haole koa)
Malva parviflora (Cheeseweed)
Malvastrum coromandelianum spp. coromandelianum (False mallow)
Malvaviscus penduliflorus (Turk's cap)
Medicago lupulina (Black medic)
Mirabilis jalapa (Four o'clock)
Oxalis debilis var. corymbosa (Shamrock)
Pluchea carolinensis (Sour bush)

A veritable forest of haole koa (*Leucaena leucocephala*) on Midway in 2008. In 2022 we found none.

SPECIES TO WATCH

There are a few species that are invasive elsewhere, but are currently not invasive on Midway. Watching these will allow for the greatest number of control options if deemed necessary. Octopus tree (*Schefflera actinophylla*) seemingly has the potential to spread, given ample fruit and mynah birds to spread the seeds. It would be good to watch for seedlings of this species.

A few edible plants should be watched, including swamp cabbage (*Ipomoea aquatica*), bitter melon (*Momordica charantia*), turkeyberry (*Solanum torvum*), and mint (*Mentha* spp.). Preferably these species would not be grown on Midway. If they must be grown, they will be easiest to watch and contain in the Hydroponics Greenhouse.

Sea grape (*Coccoloba uvifera*) continues to expand in range. It wasn't that long ago folks said it didn't spread by seed, but today carpets of seedlings are readily observed. It probably won't be too long from now that folks will want sea grape controlled in places.

Natives can also be invasive. Control of naupaka (*Scaevola*), which is expanding in range, already occurs, to create corridors for humans and birds to access areas. As naupaka continues to expand, we anticipate an increase in control effort necessary to maintain these corridors and protect other resources. Things to watch include albatrosses and other bird species that don't do well in naupaka, native plants, duck seeps, and island infrastructure.

Kāwelu (*Eragrostis variabilis*) is starting to have a larger footprint on the islands. Folks tell us that anecdotally albatrosses have lower survivability in large stands of kāwelu than in Bermuda grass. Monitoring reproductive success of different birds in different vegetation types will help keep a wildlife conscious eye on kāwelu and other increasingly dominant native plants.

Beautiful and edible, swamp cabbage (*Ipomoea aquatica*), is a Federal Noxious Weed that has previously been released into and then removed from seeps on Sand Island. If folks are reluctant to eradicate this species from Midway, since it makes a tasty stir fry, then continue to contain it to the Hydroponics Greenhouse and watch for it in wetlands. Images from coastal wetland on Maui and Clipper House on Midway.

GARDENS

For as long as people have been living on Midway there have been gardens. The locations of gardens, types of plant species, and care given to the gardens fluctuates over time.

Though they are still less common than they used to be a couple decades ago, the gardens have expanded on Midway since our 2017 survey. This recent garden expansion has been not only around houses, but also to work areas such as the Transportation Building.

The plants, which are for humans not wildlife, are a mix of edibles and ornamentals. Some gardens are neatly kept and maintained, others are not. Along with innocuous plants such as *Hibiscus* and *Plumeria*, invasive species are also intentionally grown or persist in these gardens, including bitter melon (*Momordica charantia*), Chinese banyan (*Ficus microcarpa*), turkeyberry (*Solanum torvum*), and mint (*Mentha* spp.).

The Hydroponics Greenhouse stands out as the best edible garden, producing an array of beautiful produce of much higher quality and volume than all the other gardens combined. Though invasive species are grown in there, such as swamp cabbage (*Ipomoea aquatica*), the species is fully contained within the structure, minimizing potential for spread.

Plants in the contained FWS native plant nurseries also look exceptional, with nice potting media, fertilizer, and regular care.

Having a similar greenhouse(s) for personal gardens would be nice. Perhaps a new community/personal garden greenhouse could be built on the old Galley foundation slab after it is torn down later this year, or on Bravo, or other similar slabs. This would greatly increase the area available for gardening, with the least impact to the flora and fauna.

A bounty of produce growing in the Hydroponics Greenhouse.

Midway personal garden in 1999. Note also the mowed lawns.

Same garden in 2022 (23 years later). Over the decades, we have watched the people and plants on Midway change. But what remains constant is the human desire to grow plants.

Bountiful crops, such as cantaloupes and honeydew melons, thrive in the Hydroponics Greenhouse.

A new Community/Personal Garden Greenhouse, such as the Hydroponics or FWS greenhouses, would help provide much more room for gardening, with the least impact on the flora and fauna.

Folks managing Midway must balance the morale of workers far from their families, who yearn for flavors of their homeland, with the potential for invasive plant species to escape cultivation and cause irretractable changes to the refuge flora.

Some potential best management practices to limit spread of invasive species and intrusion on wildlife areas from personal gardens include:

- Plants in personal gardens should be grown in pots, preferably on concrete.
- Continue to gradually move as much food production and personal/community garden activity as possible to the Hydroponics or similar greenhouses.
- If invasive plant species must be grown, they should only be grown in the Hydroponics or other contained greenhouses.
- After a tenant moves out, all personal garden plants should be removed.
- Any new species should be vetted by FWS staff before introduction.
- Periodic surveys of gardens will help detect new and invasive species early.

Chatting about plants with a Thai worker who has been on Midway since 1994 (28 years).

RESTORATION

The restoration of native plants on Midway has increased in both effort and sophistication, with increasing acreage dominated by native plants since our last visit in 2017.

Some of the species that have done well include the native bunchgrass (*Eragrostis variabilis*), ʻāweoweo (*Chenopodium oahuense*), and the rare pōpolo (*Solanum nelsonii*). *Eragrostis* is now self-regenerating, creating abundant seedlings in many areas. In fact some folks are questioning whether it is doing too well, something many other restoration sites could only dream of.

Species that struggle include ilima (*Sida fallax*), maia pilo (*Capparis sandwichiana*), ʻakiʻaki grass (*Sporobolus virginicus*), and the dwarf bunchgrass (*Eragrostis paupera*). Perhaps it is just a matter of time before the optimal techniques and locations for these species come to light.

Along with more native plants being propagated and outplanted, seeds have also been scattered with promising results. Additionally seed collecting, processing, and storage has been taken to a new level with the Midway Seed Library that's packed with native seeds ready for restoration.

The use of coco coir, perlite, and fertilizer also appears to have been beneficial for propagation of native plants. Initial attempts at propagation used pure sand with no fertilizer.

As with the reduction in *Verbesina*, the increase in native plant restoration on Midway is impressive, showcasing what can be accomplished with focused efforts over time.

Native bunchgrass (*Eragrostis variabilis*) self-regenerating near Turtle Beach.

POTENTIAL NATIVE PLANT ADDITIONS

Many native Hawaiian plants have been introduced to Midway from other NWHI and the main Hawaiian Islands. Below is a list of even more native plants that are not currently present on Midway that could potentially be considered for addition to the Midway flora.

Bacopa monnieri (‘Ae‘ae)
Bidens mauiensis (Ko‘oko‘olau)
Cassytha filiformis (Kauna‘oa pehu)
Cordia subcordata (Kou)
Cressa truxillensis (Makihi)
Cuscuta sandwichiana (Kauna‘oa)
Cyperus pinnatiformis var. *bryanii* (Cyperus)
Heliotropium anomalum var. *argenteum* (Hinahina)
Ipomoea imperati (Hunakai)
Ipomoea tuboides (Hunakai)
Jacquemontia sandwicensis (Pā‘ū o Hi‘iaka)
Myoporum sandwicense (Creeping naio)
Nama sandwicensis (Hinahina kahakai)
Portulaca lutea (‘Ihi)
Portulaca molokiniensis (‘Ihi)
Portulaca villosa (‘Ihi)
Rauvolfia sandwicensis (Ha‘o)
Santalum ellipticum (‘Iliahi a lo‘e)
Scaevola coriacea (Dwarf naupaka)
Sicyos maximowiczii (Anunu)
Sicyos pachycarpus (Anunu)
Vigna marina (Nanea, beach pea)

Native creeping dwarf naupaka (*Scaevola coriacea*) growing on sand dune along roadside on Maui.

WHAT BIRDS DO YOU WANT WHERE? -- BUILD IT AND THEY WILL COME

We're often asked what management recommendations we have for areas. In wildlife dense sites like Midway, we find it useful to ask *"What birds do you want where?"*. Another way to look at it is *"Build it and they will come"*.

By understanding the habitat preferences of the different bird species on Midway, how many of each bird species folks would like, and where folks would prefer those birds to be located, a vision for which plant species to promote where comes to light.

For example, if one wants to have White Terns in an area, ironwoods suffice. However, if folks would prefer more Gray-backed Terns in an area, then taking the site down to gravel and small plants would be better. To dissuade albatrosses from using an area, naupaka can be planted. For excluding most birds, a paved surface seems to work.

It isn't as simple as painting by numbers, many plant species have habitat preferences of their own, such as naupaka and *Tournefortia* generally doing best along the coast. Additionally, bird species have cues beyond vegetation, such as Black-footed Albatrosses that usually nest close to the shore and have strong site fidelity.

All that said, the next time a question arises as to what to do with the vegetation in an area, it is useful to ask *"What birds do you want where?"*. *"Build it and they will come"*.

Laysan Albatrosses prefer soft sand and vegetation to hard runway. The military realized this and paved large areas to keep sites free of nesting albatrosses. As the abandoned runways become covered with sand and vegetation, the albatrosses are returning to the area.

WHAT WOULD YOU DO IF IT WAS NATIVE? -- STRUCTURE VS. COMPOSITION

Often we're asked what management actions to take for a particular non-native plant species, especially in regards to whether to control it or not. In these situations, we find it helpful to ask *"What would you do if it was native?"*. In many cases, the answer will be *"Enjoy it"*.

If the plant isn't causing harm, the fact that it is non-native shouldn't immediately result in control efforts. This is especially true in many wildlife-dense refuges where the vegetation is predominantly non-native, and in many cases is being readily utilized by wildlife.

Tree heliotrope (*Tournefortia*) is non-native, yet is promoted, as it provides good bird habitat. Bermuda grass (*Cynodon*) functions well for a number of bird species, and is also tolerated and occasionally promoted. These are pragmatic decisions, backed by science.

One tool that could help guide managers is a matrix of plant and bird species on Midway. Each plant species could be noted whether it is thought to have a positive, negative, or neutral effect on each of the bird species, regardless of whether the plant is native or not.

By taking into consideration how wildlife interacts with each plant species (structure), rather than purely the nativity of each species (composition), wildlife will reap the greatest benefits, and vegetation management will be the most effective.

Tree heliotrope (*Tournefortia*) is classified as non-native on Midway, yet provides good habitat / structure for numerous bird species.

VERBESINA

The increased management of golden crown-beard (*Verbesina encelioides*) at Midway has resulted in one of the greatest reductions in a non-native plant species we've ever witnessed. *Verbesina* went from a habitat type in 2008, to scattered hot spots in 2015, to very low numbers in 2017, and even fewer in 2022. *Verbesina* is still present as a seed bank on Midway, and will require continued vigilance to manage, but it's truly amazing what has been accomplished.

2008. Sea of *Verbesina* in field south of Seaplane Hangar, Sand Island.

2017. Virtually no *Verbesina*, the vegetation has become Bermuda grass and mixed native plants.

PLOT RESULTS

IMAGES

Images were taken of all 185 plots monitored in 2022, to help provide a visual record of the changes over time. Below are examples of some of the diversity of sites encountered.

ʻAkulikuli (*Sesuvium*) herbland.

Bermuda grass (*Cynodon*) grassland.

Naupaka (*Scaevola*) shrubland.

Ironwood (*Casuarina*) forest with bare ground understory.

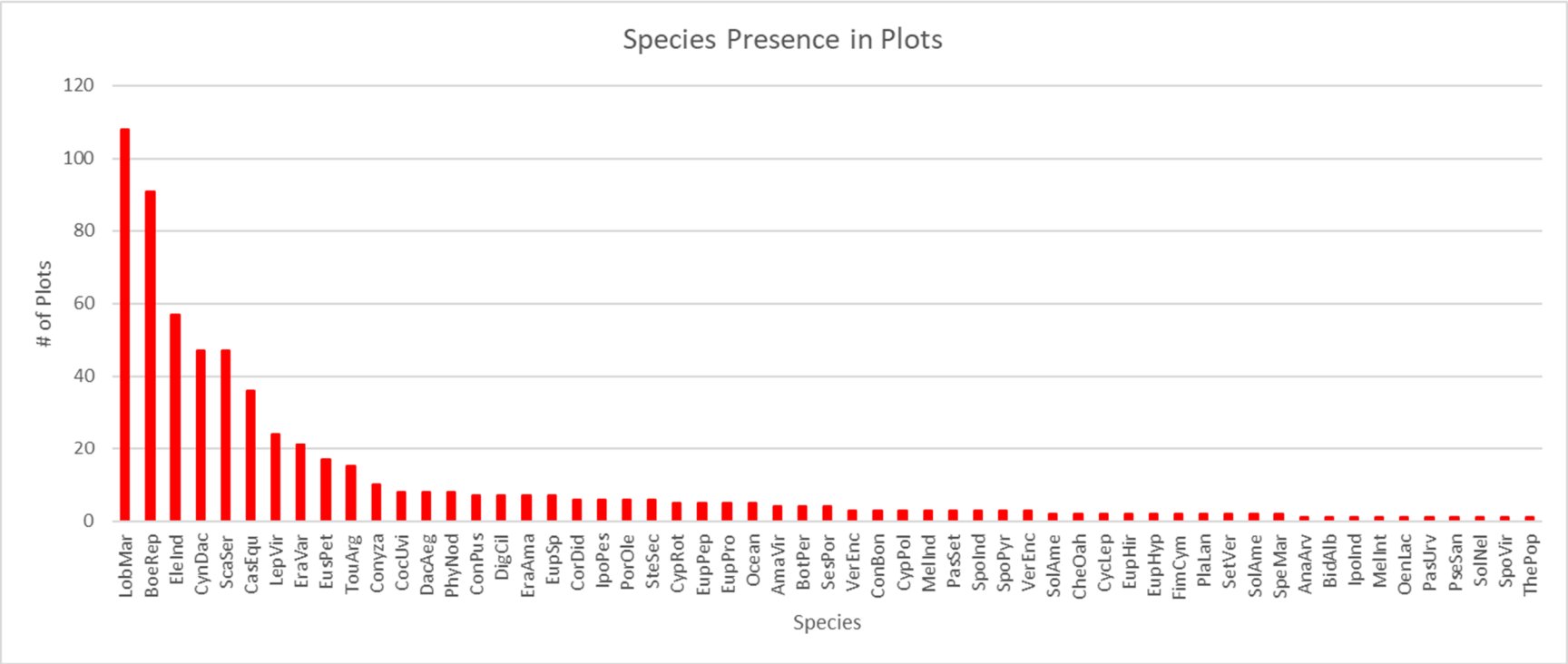
Alena (*Boerhavia*) and nohu (*Tribulus*) herbland.

Sweet alyssum (*Lobularia*) herbland.

Mixed kawelu (*Eragrostis*) grassland, ʻāweoweo (*Chenopodium*) shrubs, and bare ground.

All sand plot on edge of ocean.

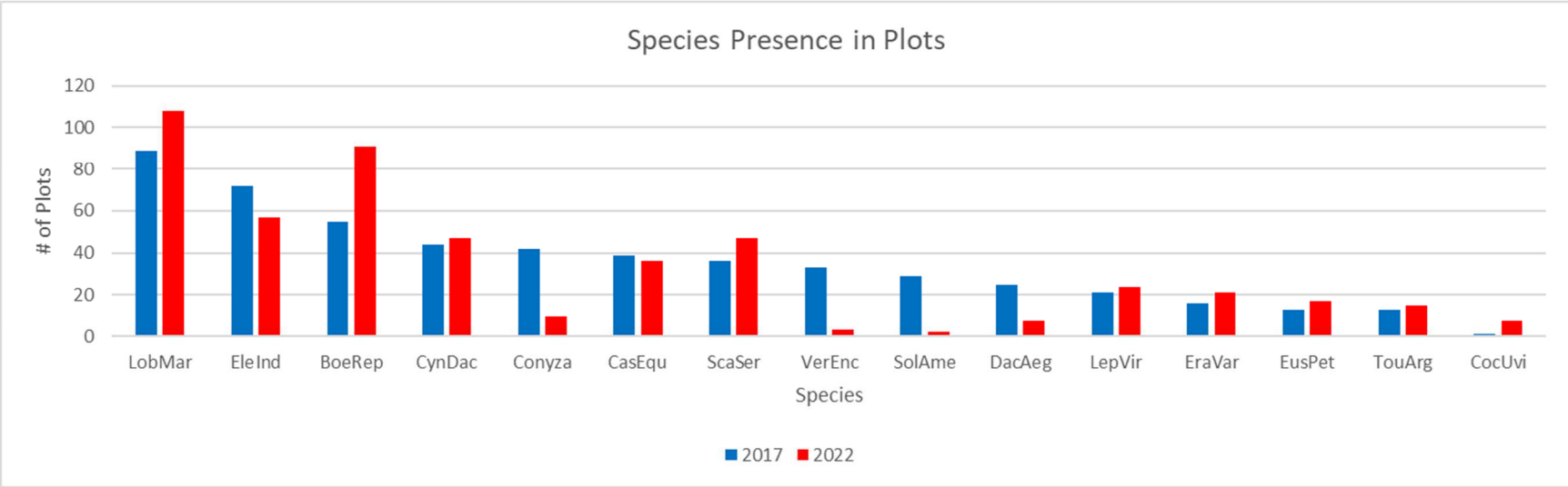
SPECIES ABUNDANCE - 2022



Dominant Species

There are about a dozen dominant species on Midway, with a long tail of less common species. The most abundant species in the plots in 2022 were sweet alyssum (*Lobularia maritima*), alena (*Boerhavia repens*), goose grass (*Eleusine indica*), Bermuda grass (*Cynodon dactylon)*, naupaka (*Scaevola sericea*), and ironwood (*Casuarina equisetifolia*).

SPECIES ABUNDANCE - 2017 VS 2022



Though the relative abundance remained similar for most species between 2017 and 2022, there were some significant changes. This chart highlights the some of the most abundant species in 2017 and how their abundance differed in 2022.

Increase in Abundance

Species that increased in abundance between 2017 and 2022 include sweet alyssum (*Lobularia*), alena (*Boerhavia*), naupaka (*Scaevola*), Bermuda grass (*Cynodon*), kāwelu (*Eragrostis*), and sea grape (*Coccoloba*)

Decrease in Abundance

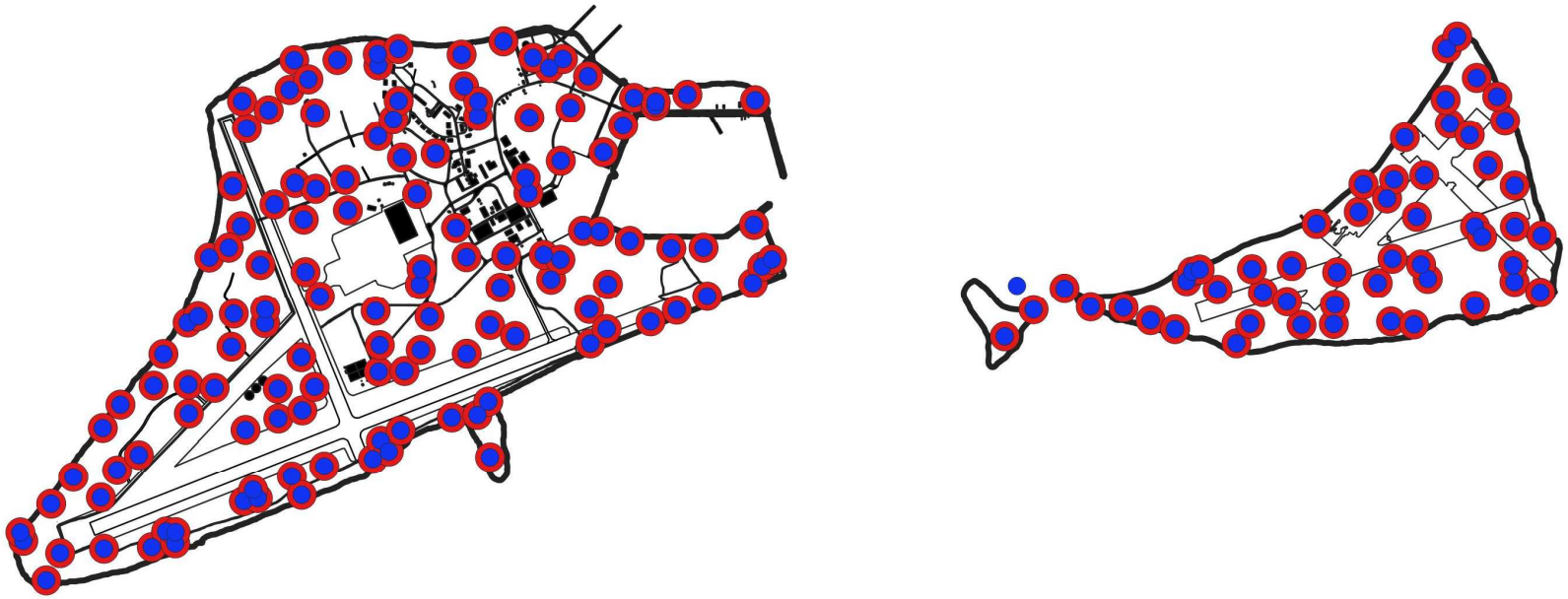
Species that decreased in abundance between 2017 and 2022 include goose grass (*Eleusine*), horseweed (*Conyza* spp.), glossy nightshade (*Solanum americanum*), beach wire grass (*Dactyloctenium*), and golden crown-beard (*Verbesina*).

PLOT MAPS

All the plots monitored in 2017 were repeated in 2022, with the exception of a single plot on Spit Island in the middle of a Sooty Tern colony that had young chicks, where it would have been too disruptive to the birds to monitor.

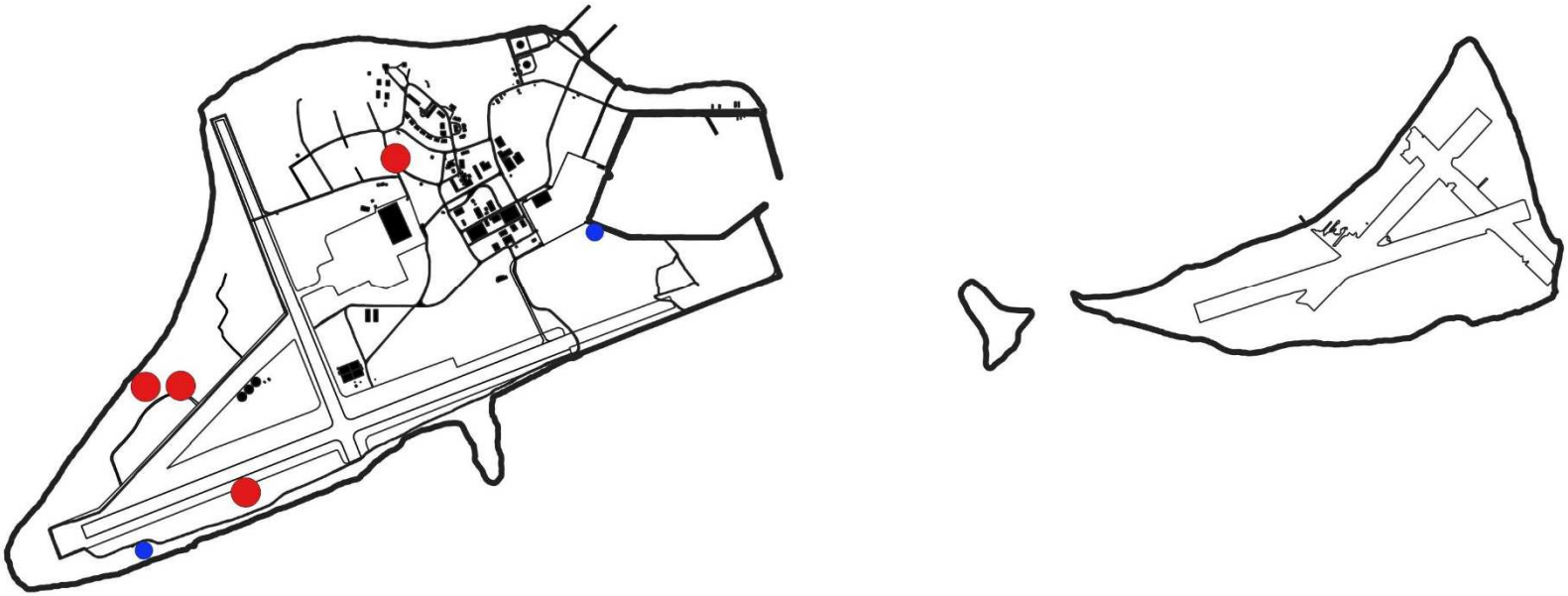
What follows are distribution maps for the most abundant species recorded in plots, along with a selection of other species highlighting changes, or lack thereof, between 2017 and 2022.

All Plots



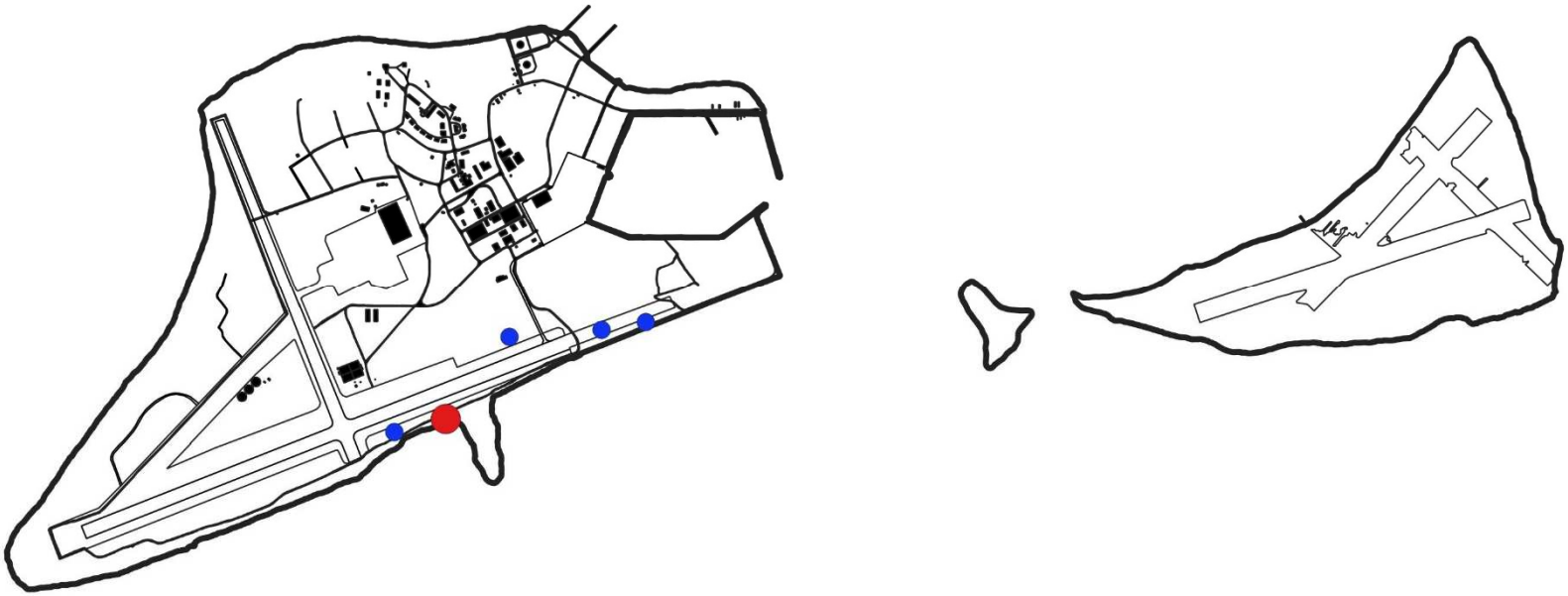
Red=2022, Blue=2017

Amaranthus viridis (Slender amaranth)



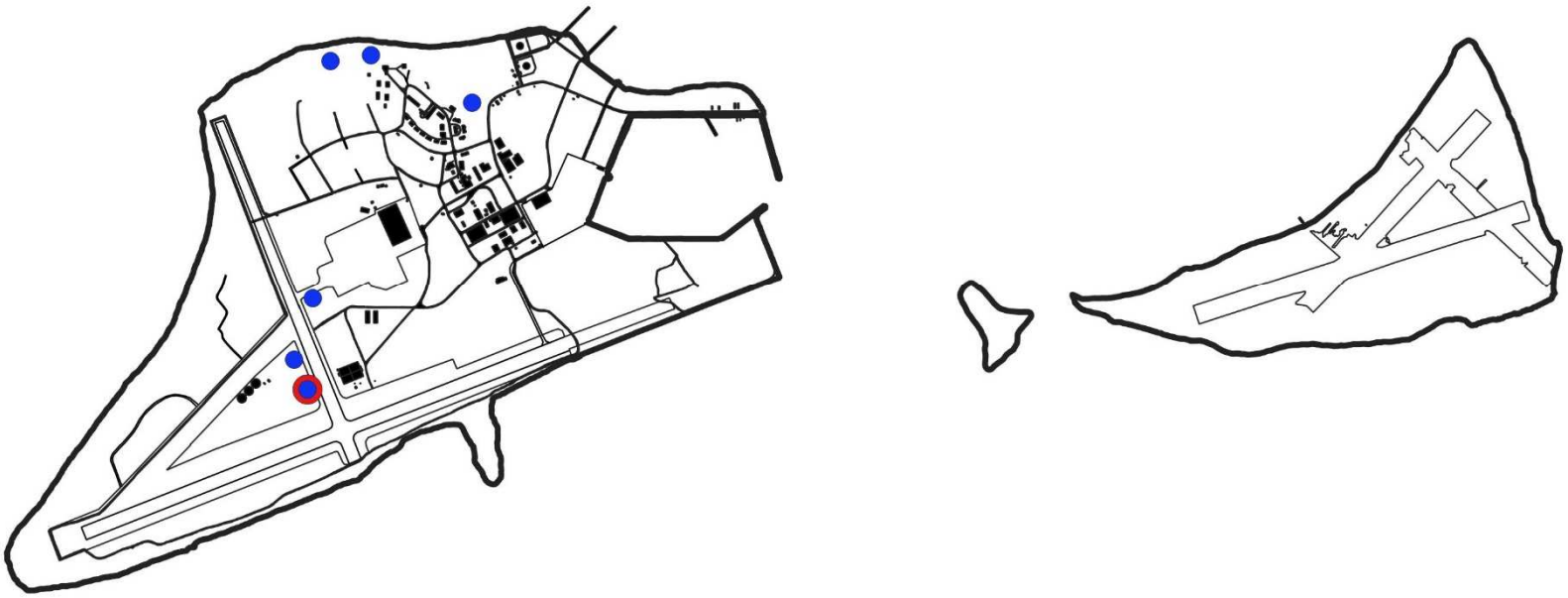
Red=2022, Blue=2017

Anagallis arvensis (Scarlet pimpernel)



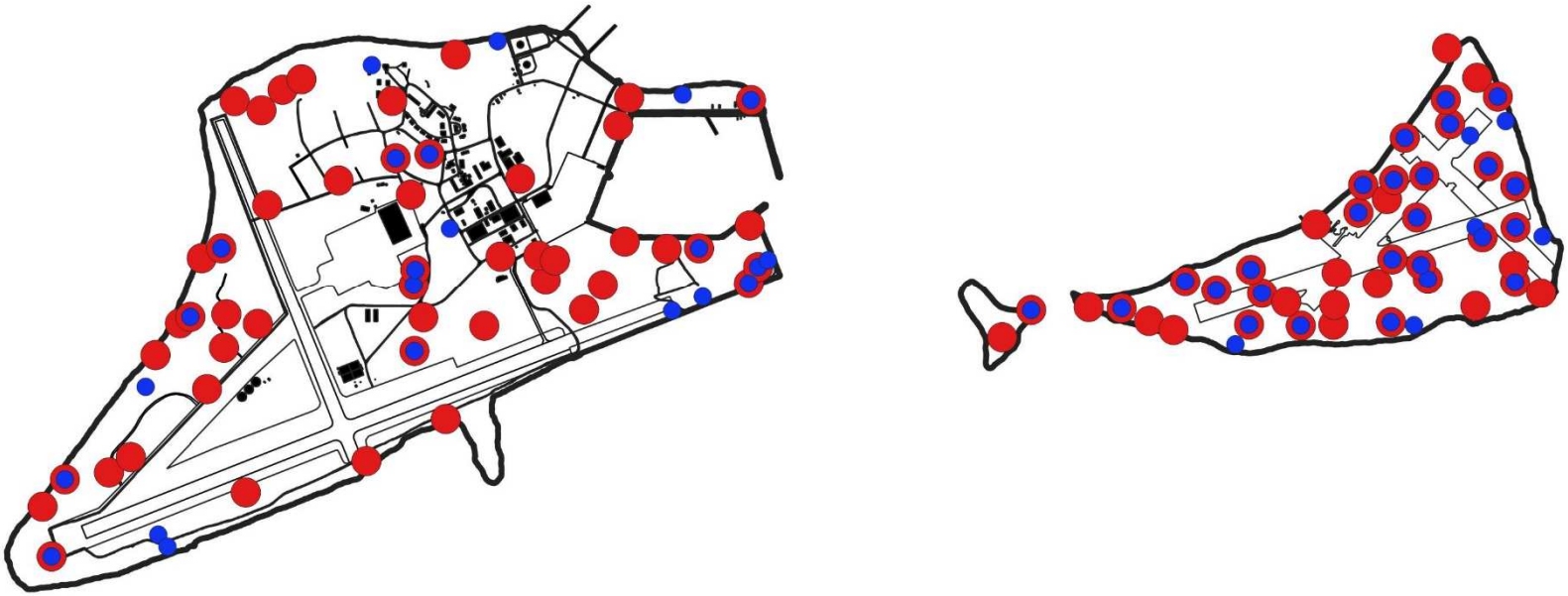
Red=2022, Blue=2017

Bidens alba (Spanish Needles)



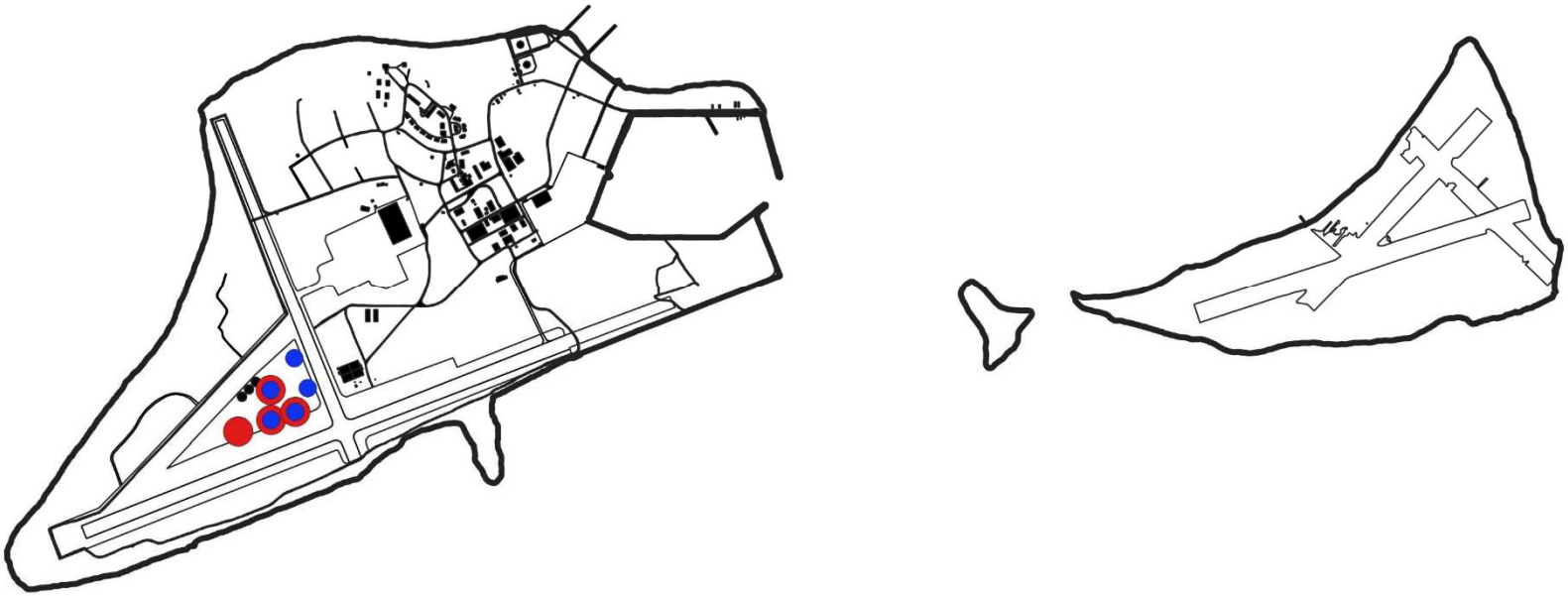
Red=2022, Blue=2017

Boerhavia repens (Alena)



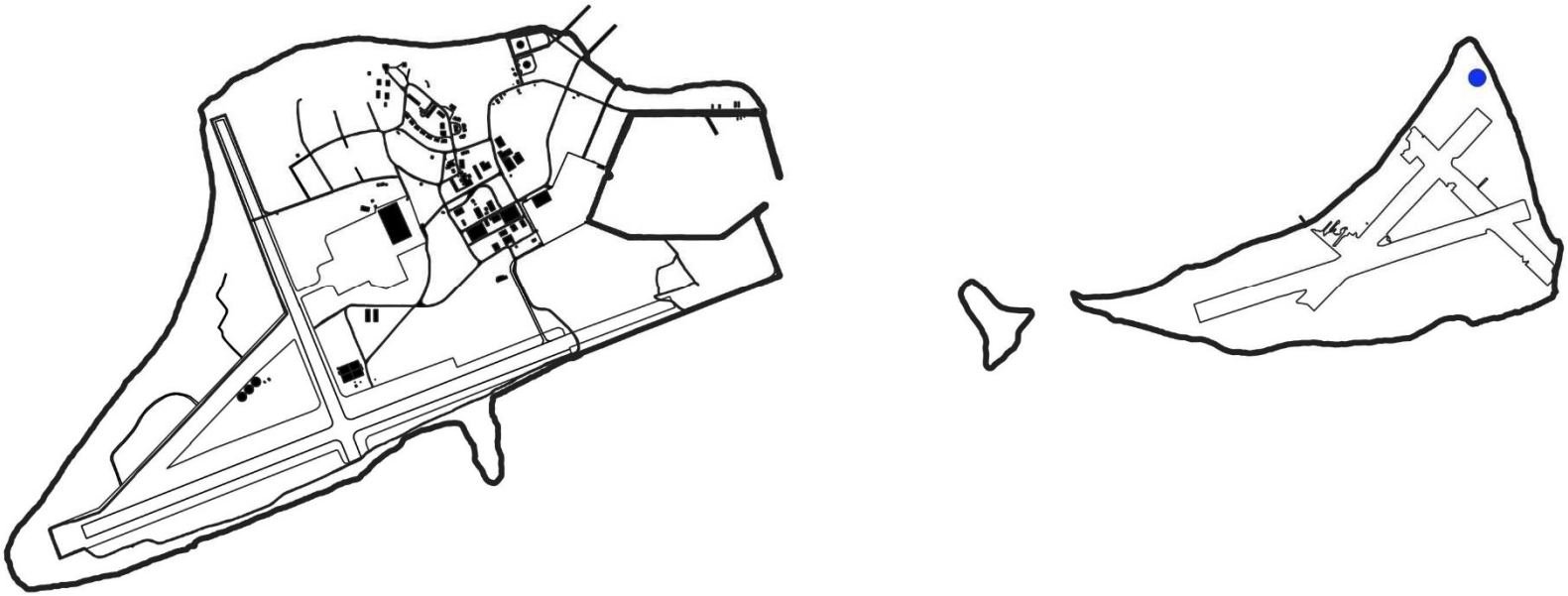
Red=2022, Blue=2017

Bothriochloa pertusa (Pitted beardgrass)



Red=2022, Blue=2017

Brassica nigra (Black mustard)

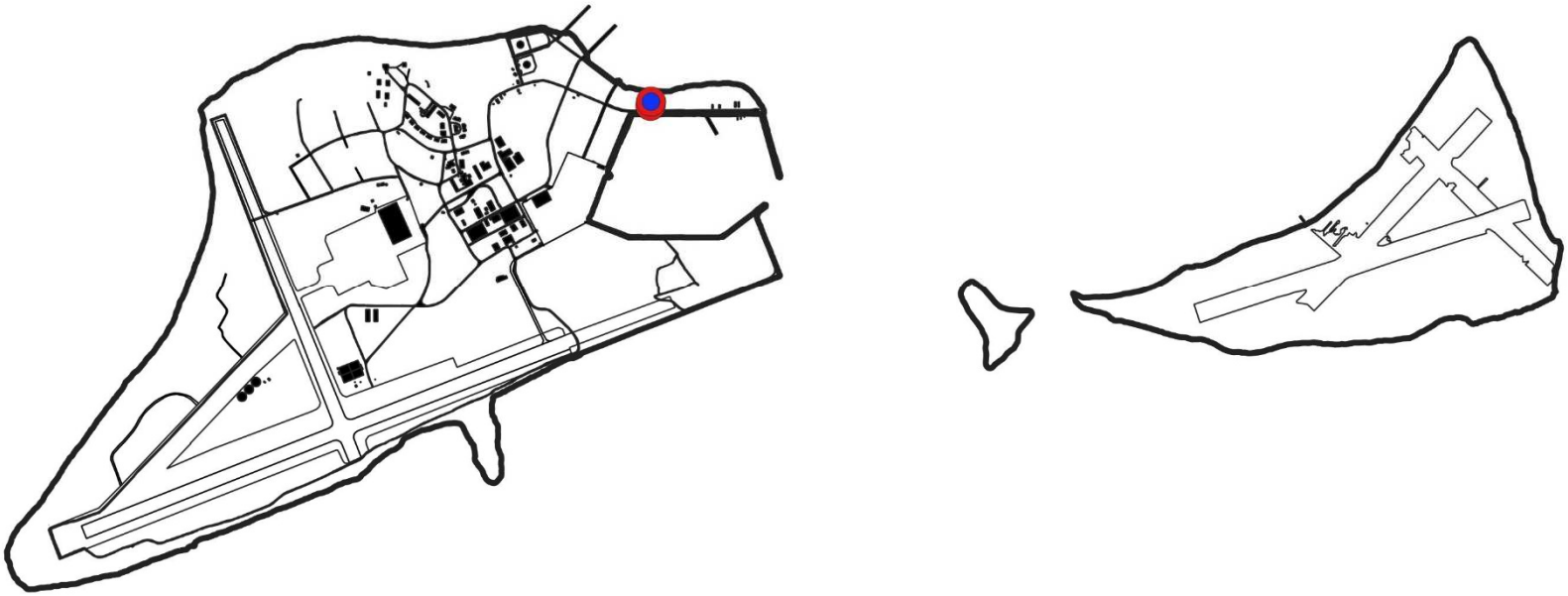


Red=2022, Blue=2017

Casuarina equisetifolia (Ironwood)

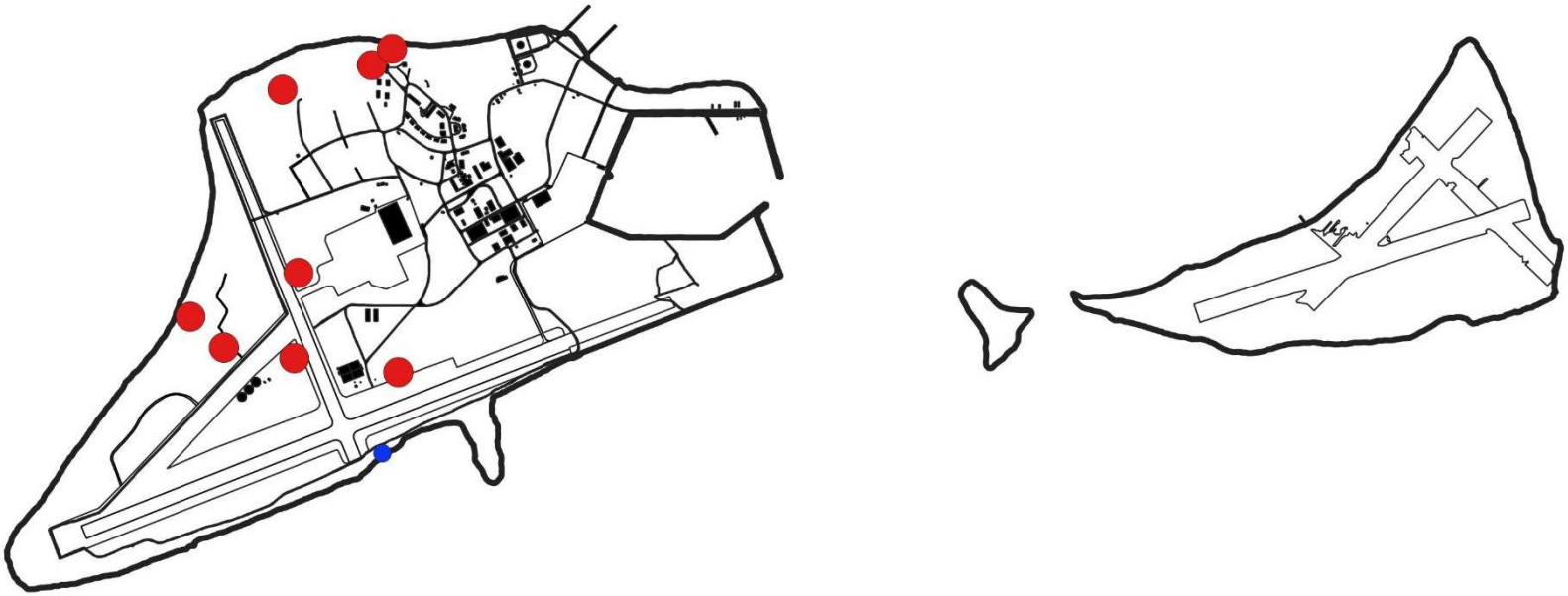
Red=2022, Blue=2017

Chenopodium oahuense (‘Āweoweo)



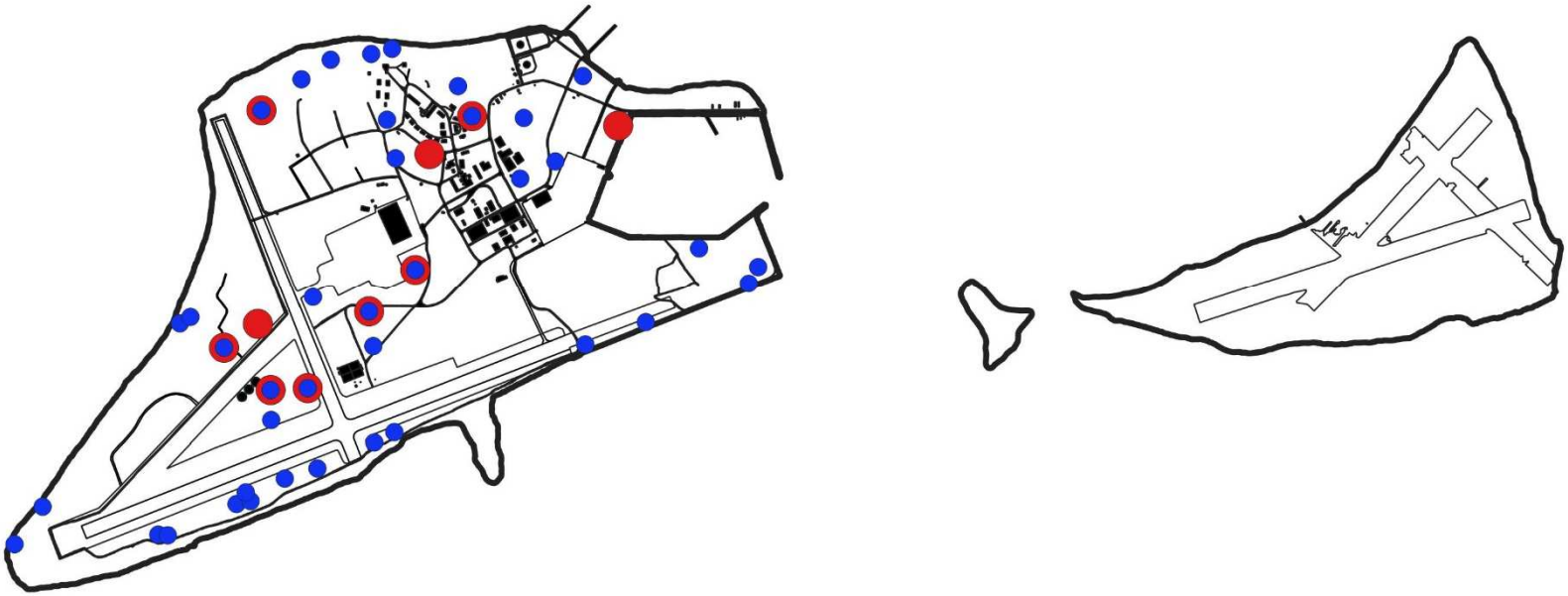
Red=2022, Blue=2017

Coccoloba uvifera (Sea grape)



Red=2022, Blue=2017

Conyza spp. (Horseweed)

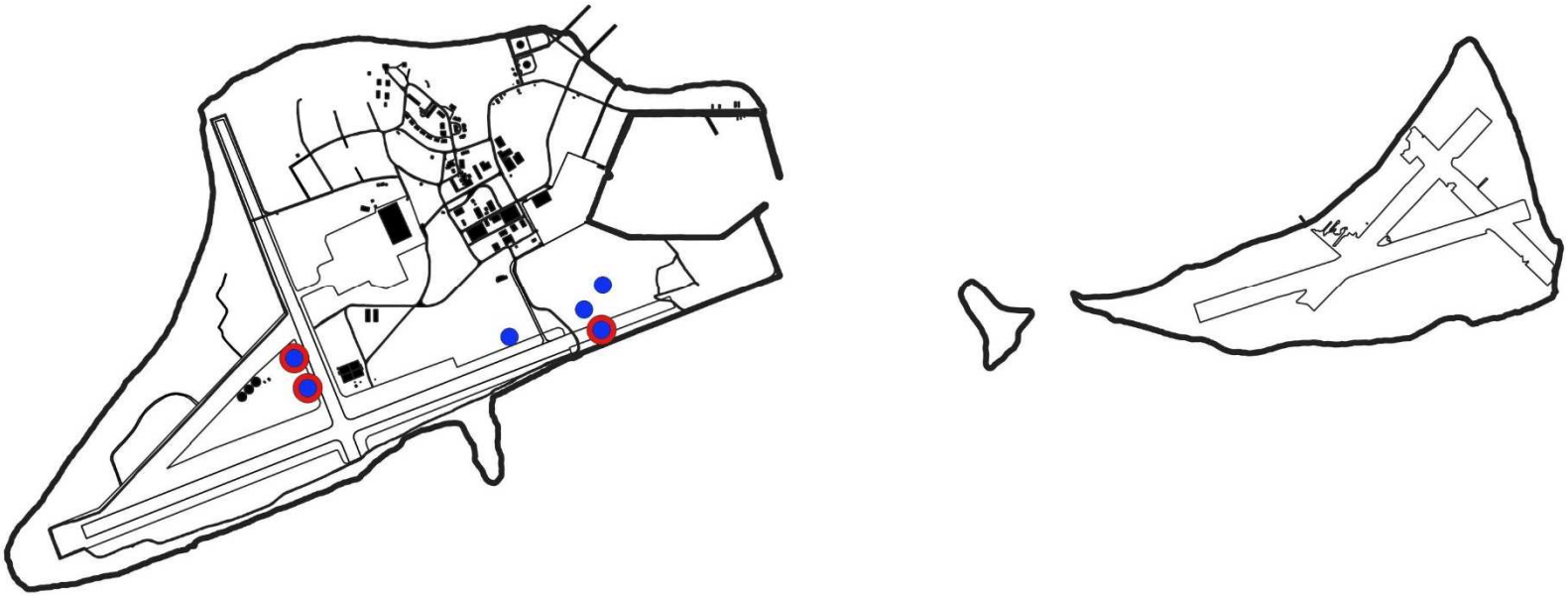


Red=2022, Blue=2017

Cynodon dactylon (Bermuda grass)

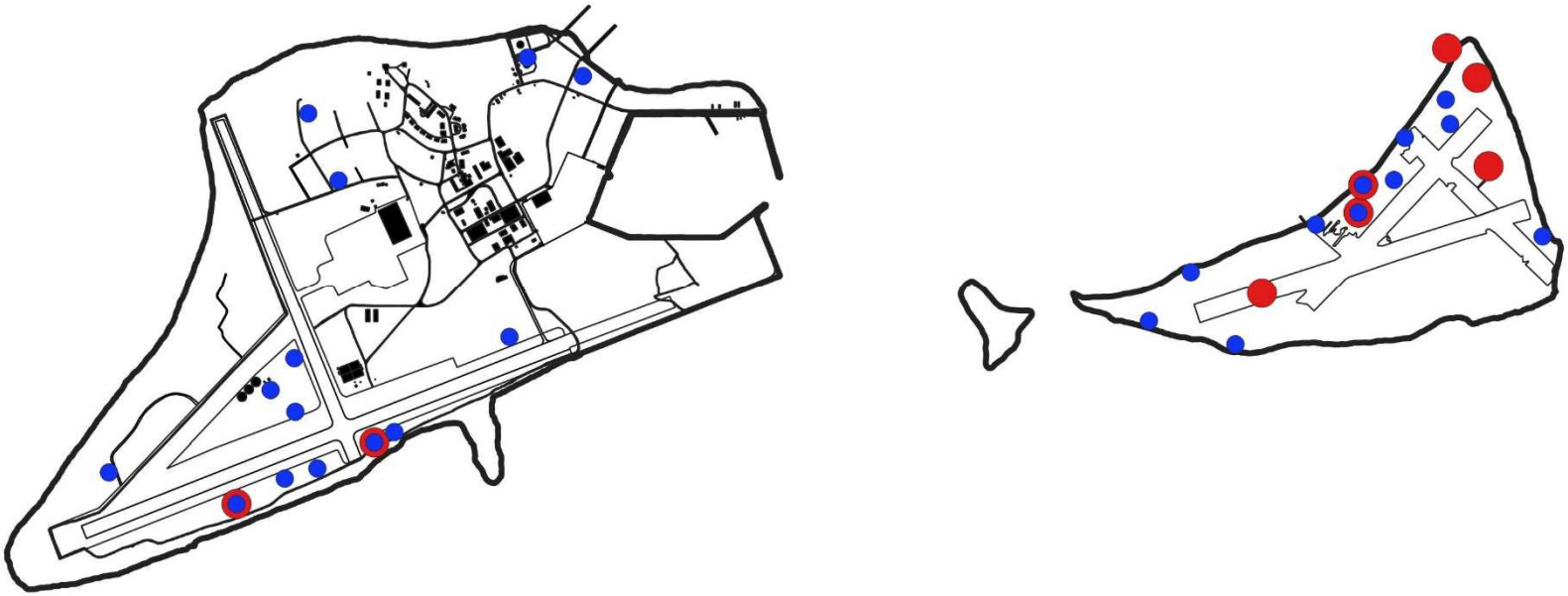
Red=2022, Blue=2017

Cyperus polystachyos (Cyperus)



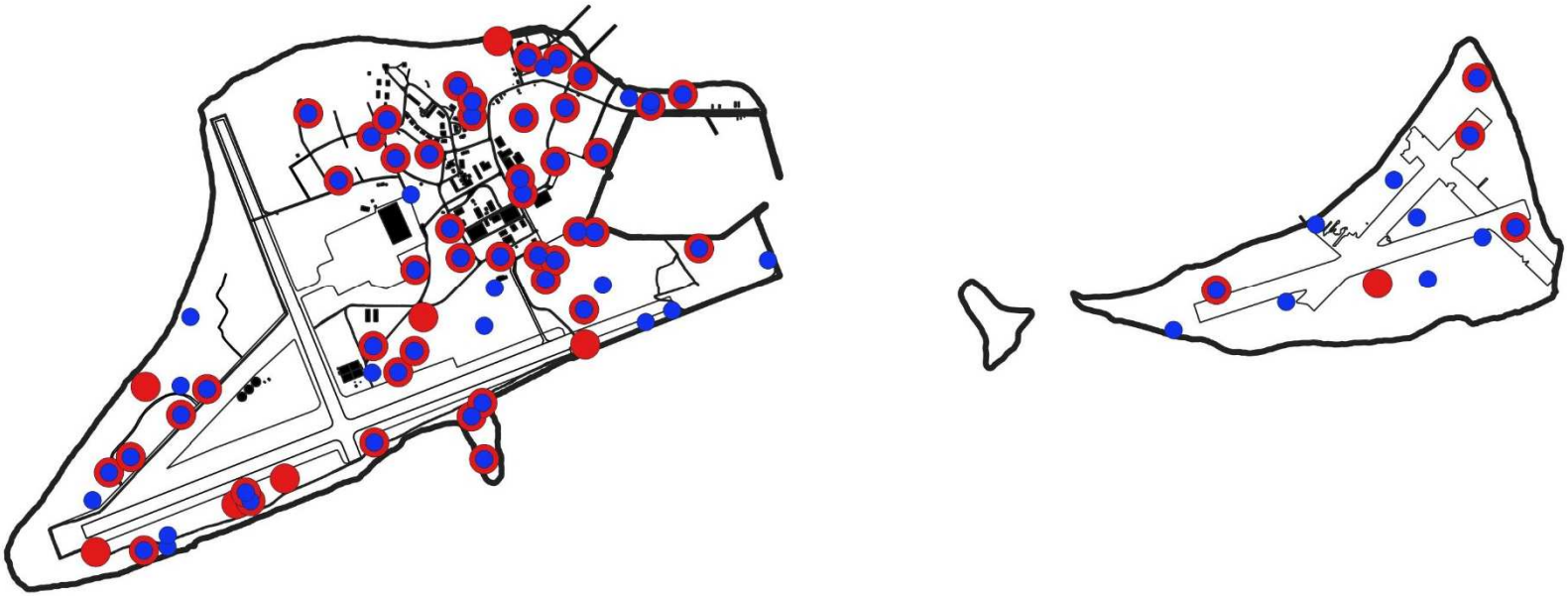
Red=2022, Blue=2017

Dactyloctenium aegyptium (Beach wire grass)



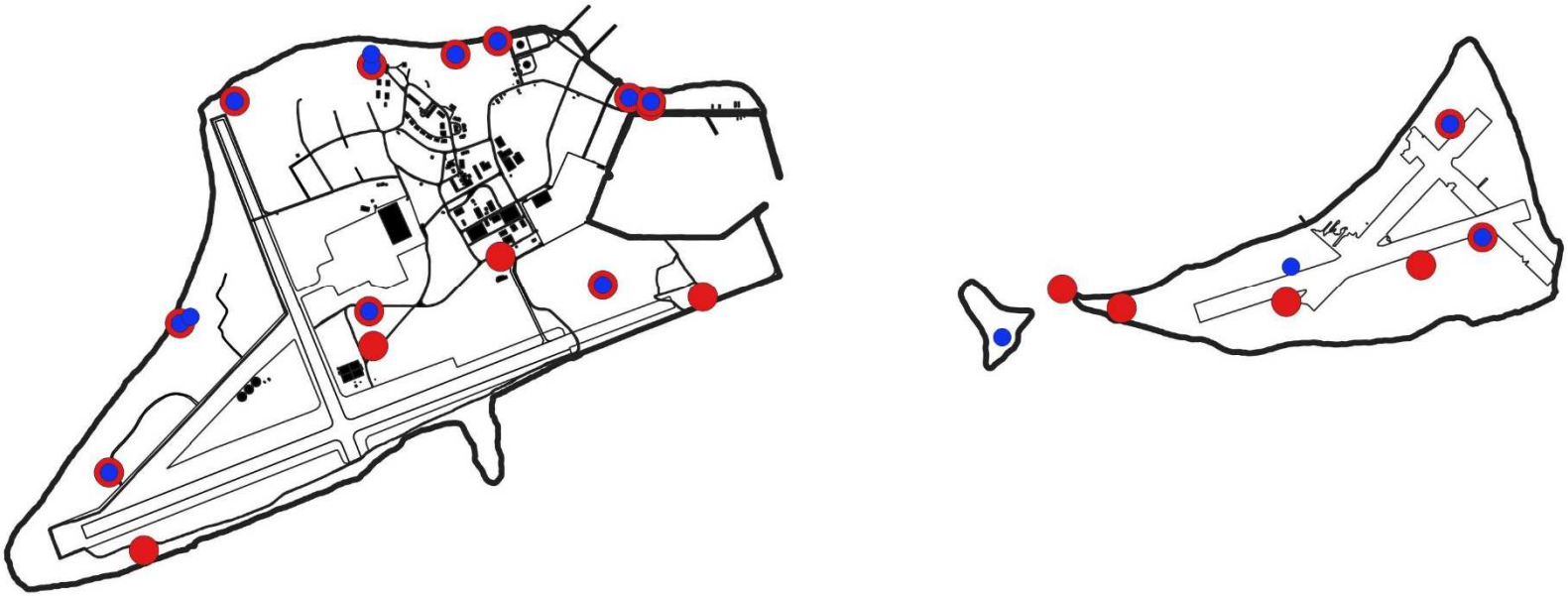
Red=2022, Blue=2017

Eleusine indica (Goosegrass)



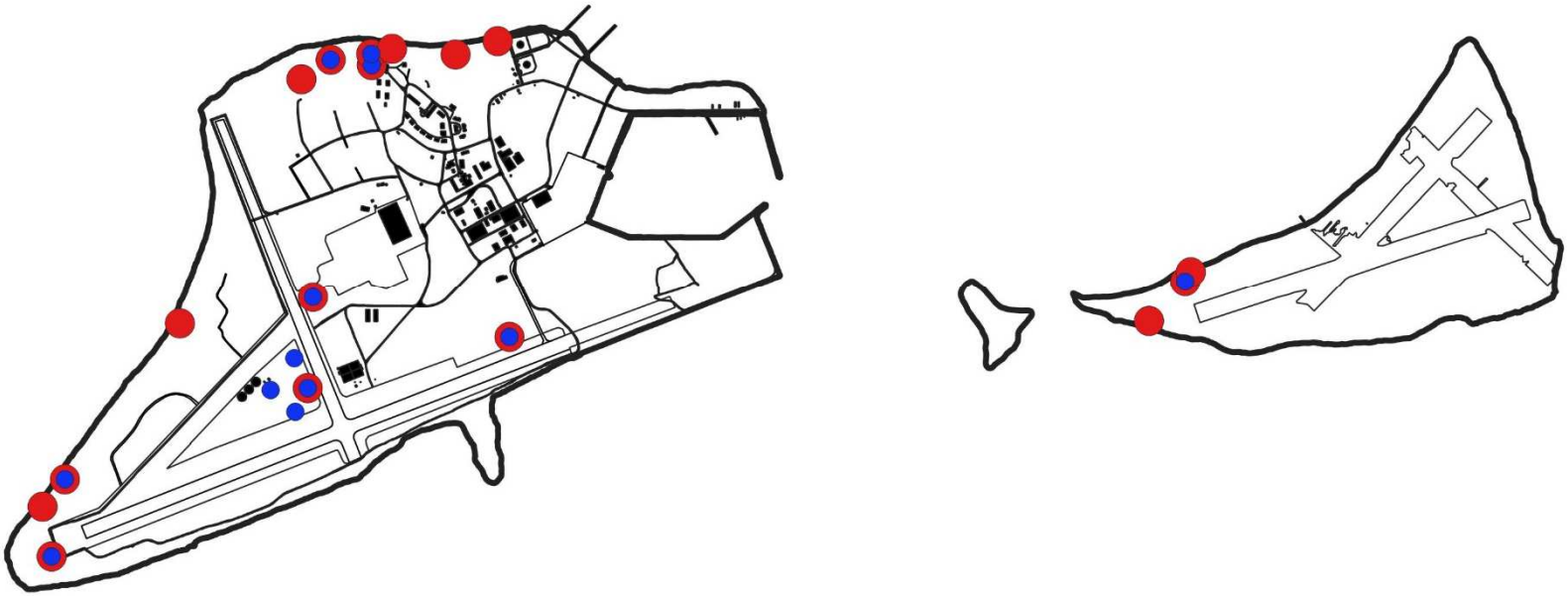
Red=2022, Blue=2017

Eragrostis variabilis (Kawelu)



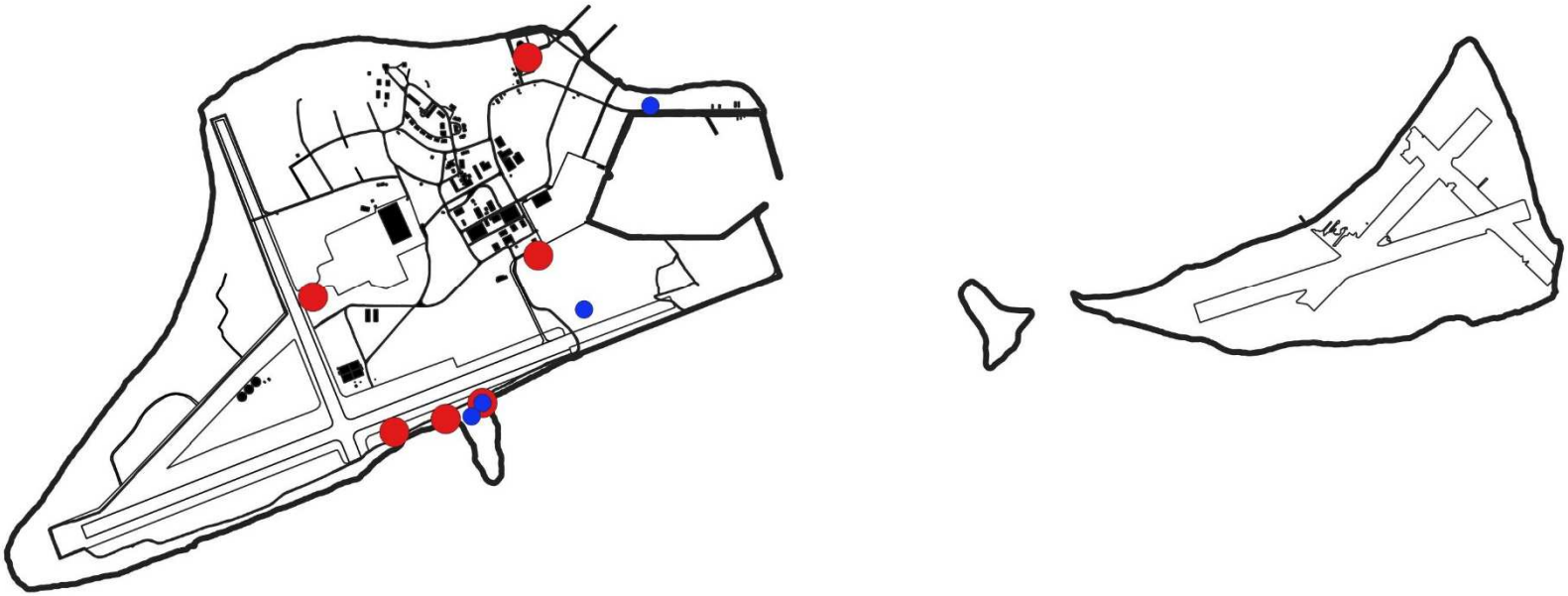
Red=2022, Blue=2017

Eustachys petraea (Eustachys)



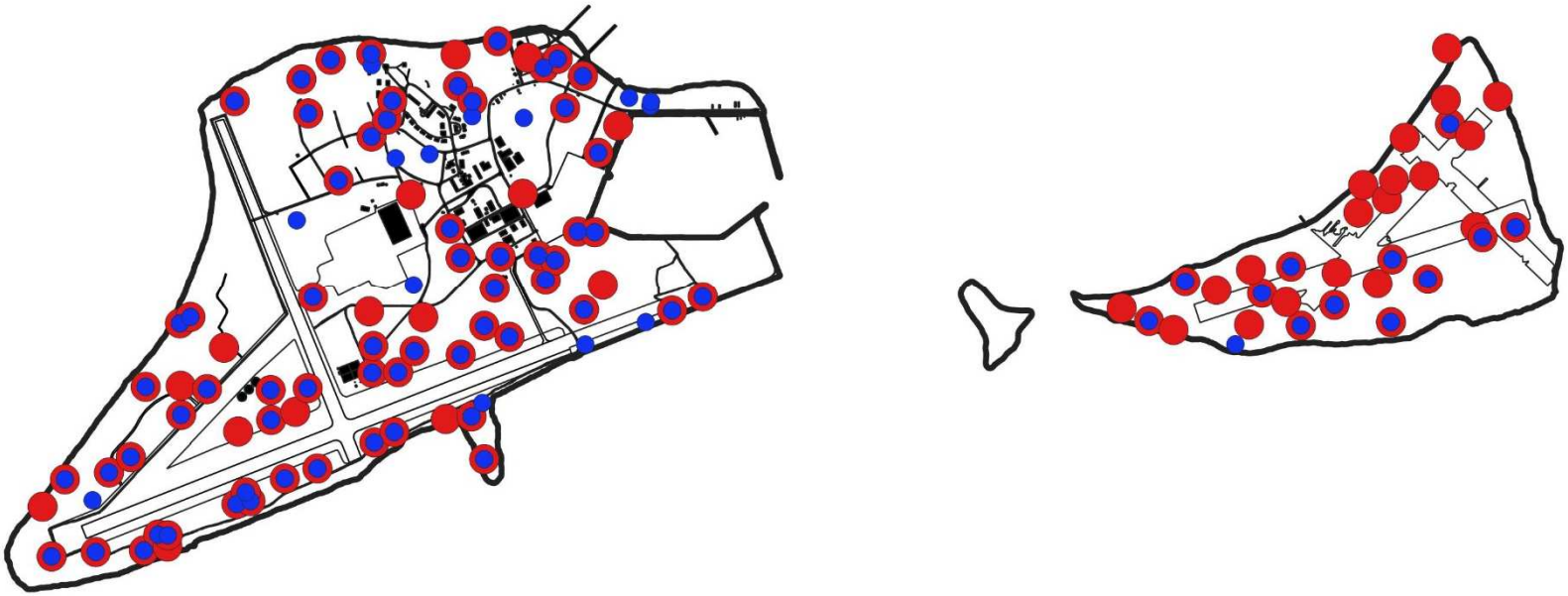
Red=2022, Blue=2017

Ipomoea pes-caprae (Beach morning glory)



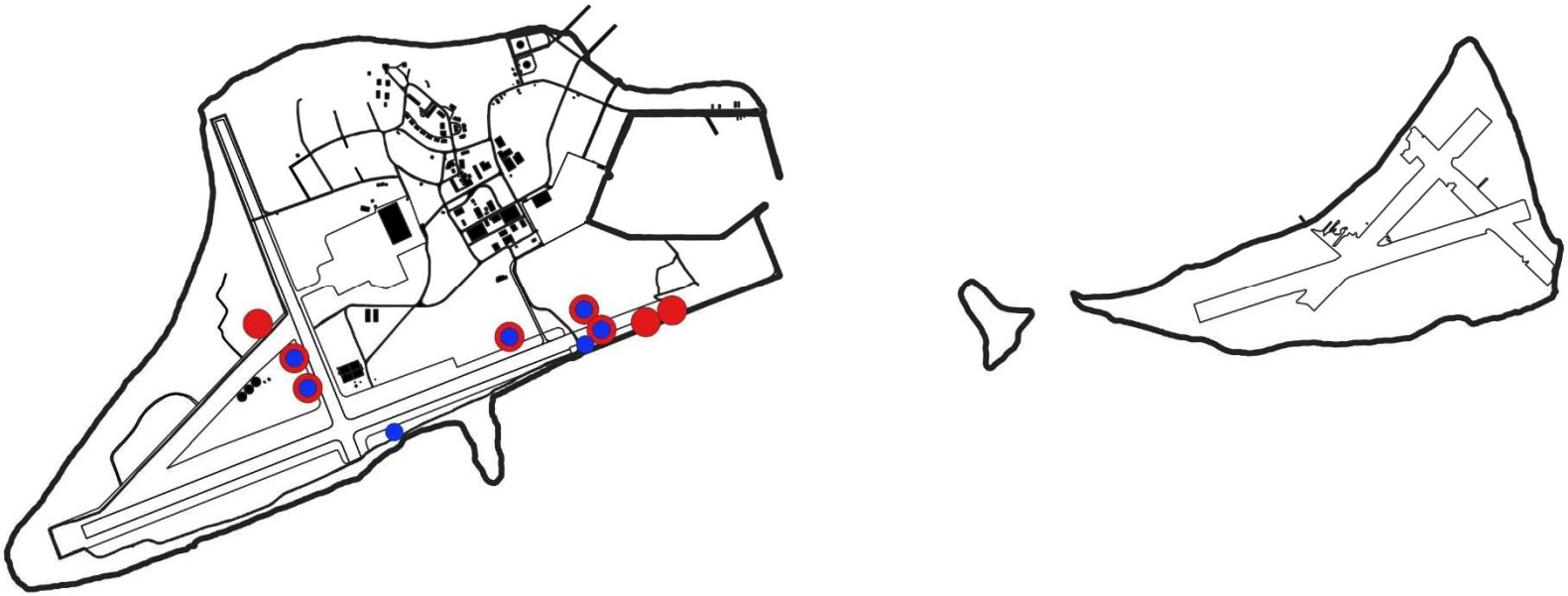
Red=2022, Blue=2017

Lobularia maritima (Sweet alyssum)



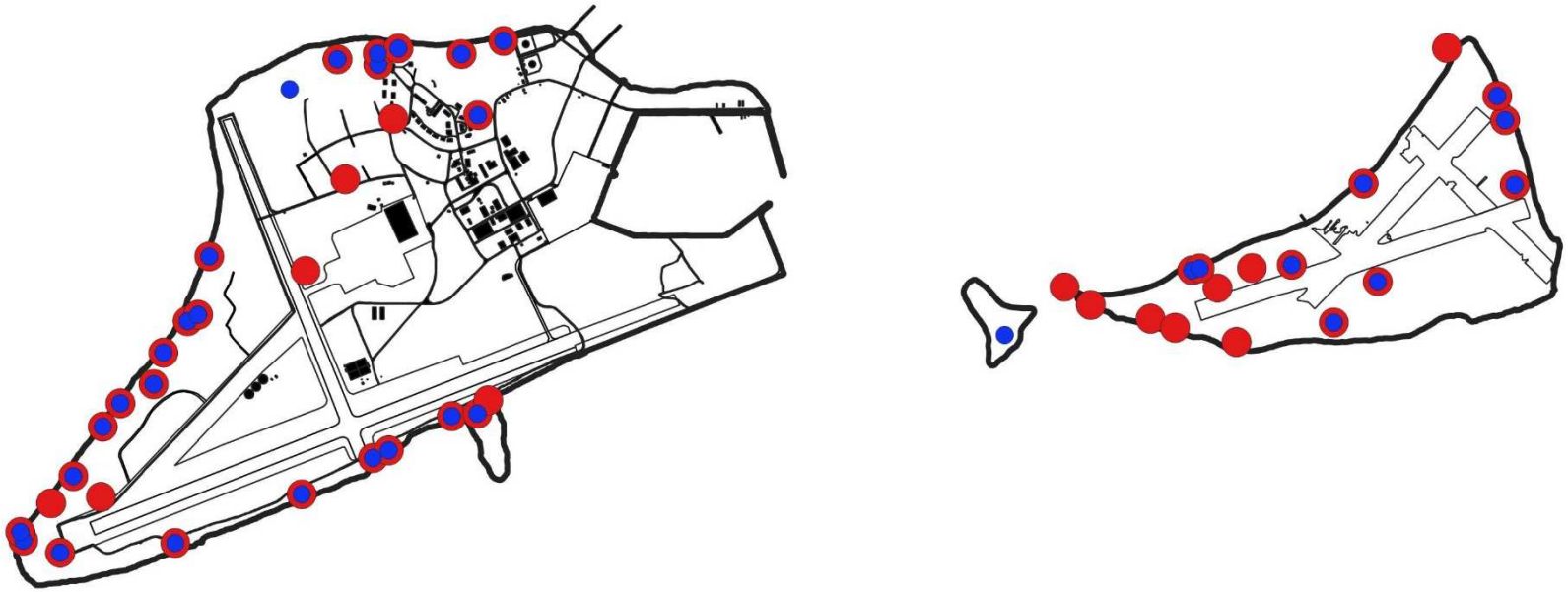
Red=2022, Blue=2017

Phyla nodiflora (Turkey tangle frog fruit)



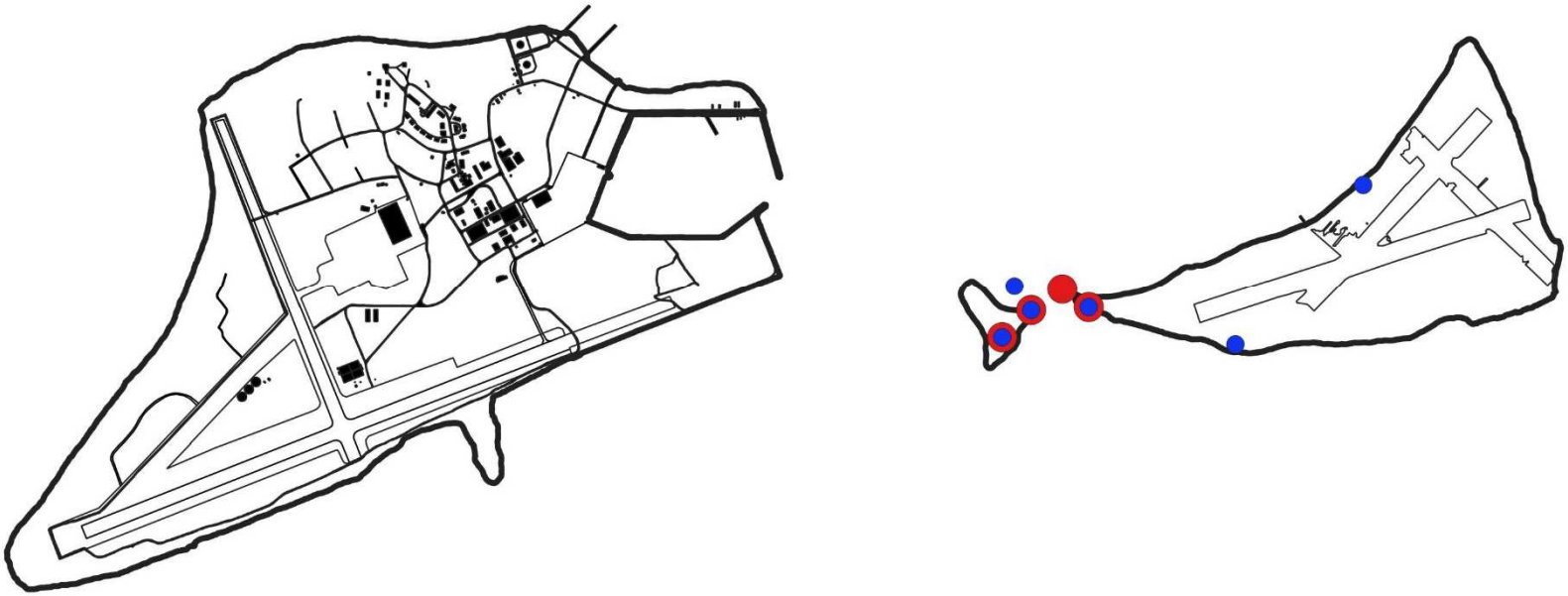
Red=2022, Blue=2017

Scaevola sericea (Naupaka)



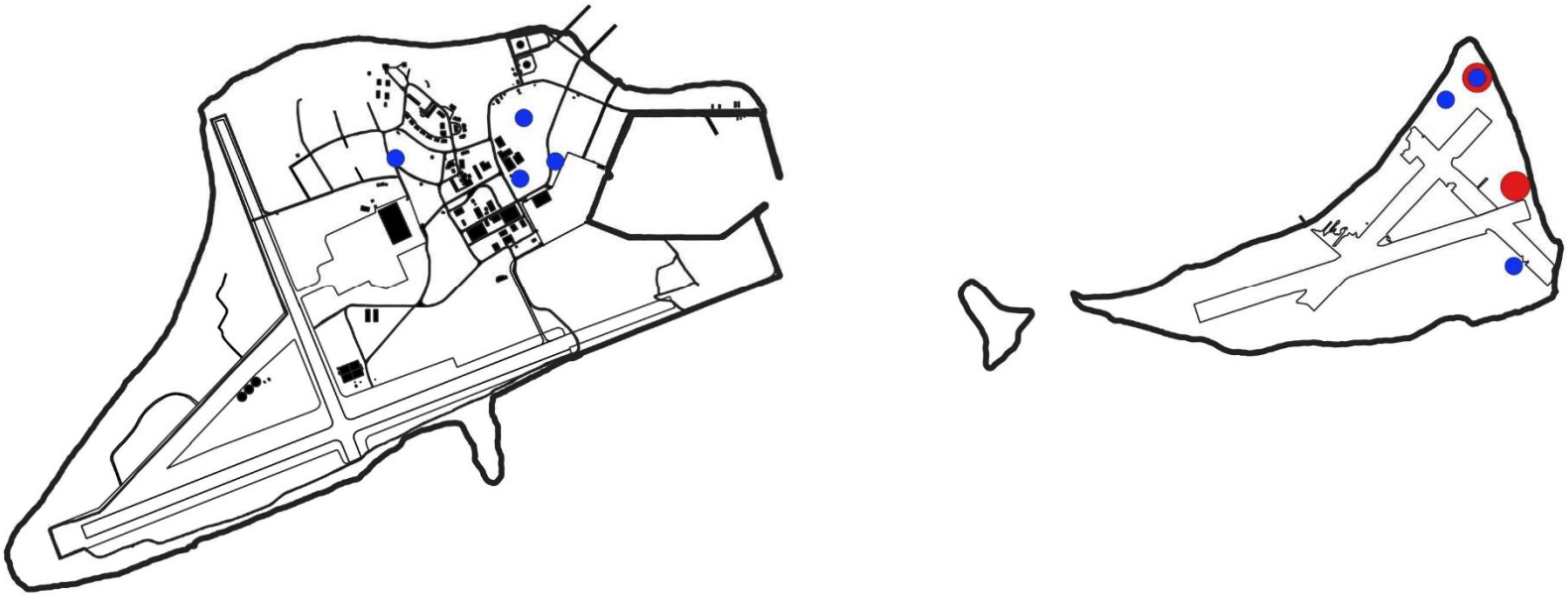
Red=2022, Blue=2017

Sesuvium portulacastrum (‘Akulikuli)



Red=2022, Blue=2017

Setaria verticillata (Bristly foxtail)

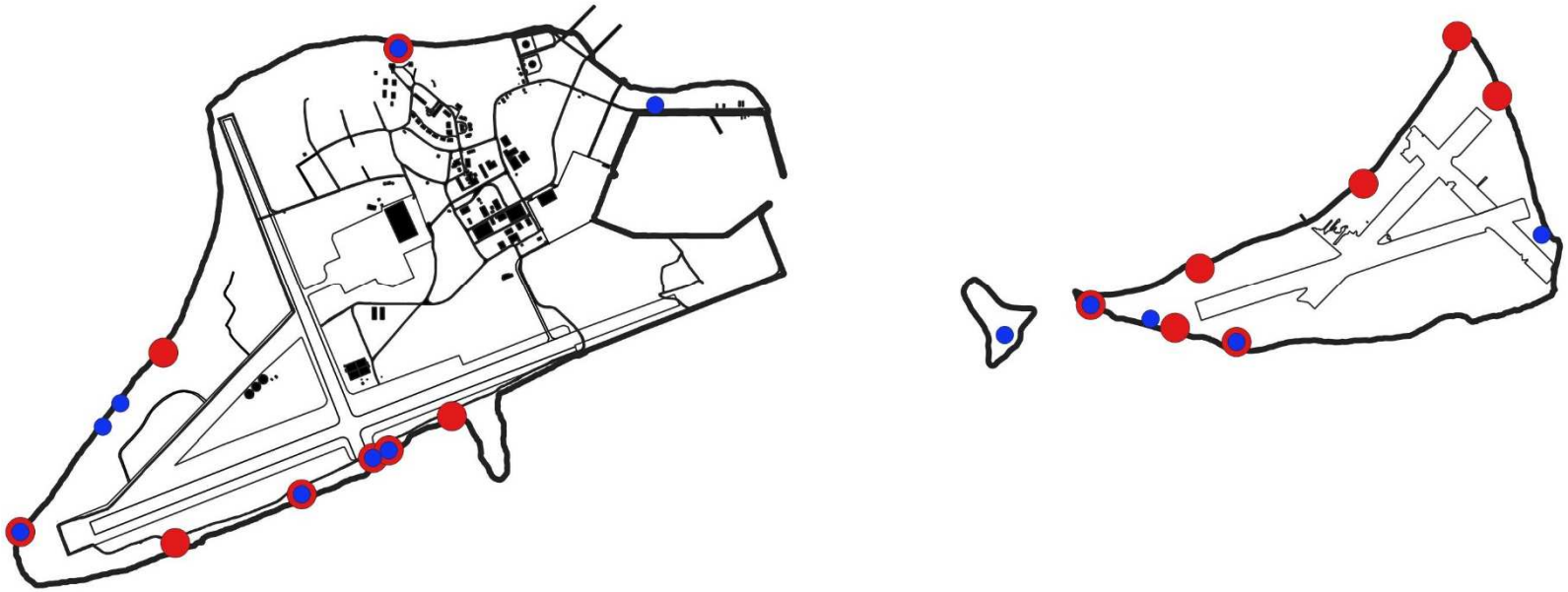


Red=2022, Blue=2017

Solanum americanum (Glossy nightshade)

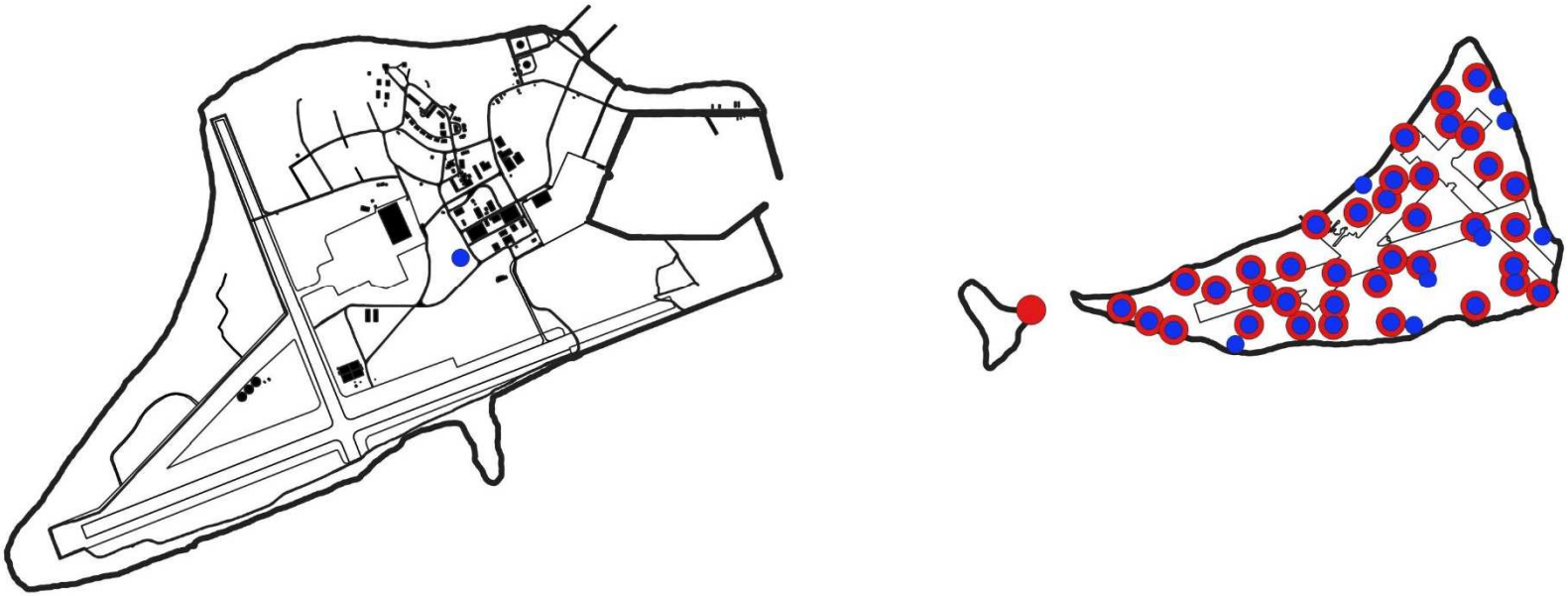
Red=2022, Blue=2017

Tournefortia argentea (Tree Heliotrope)



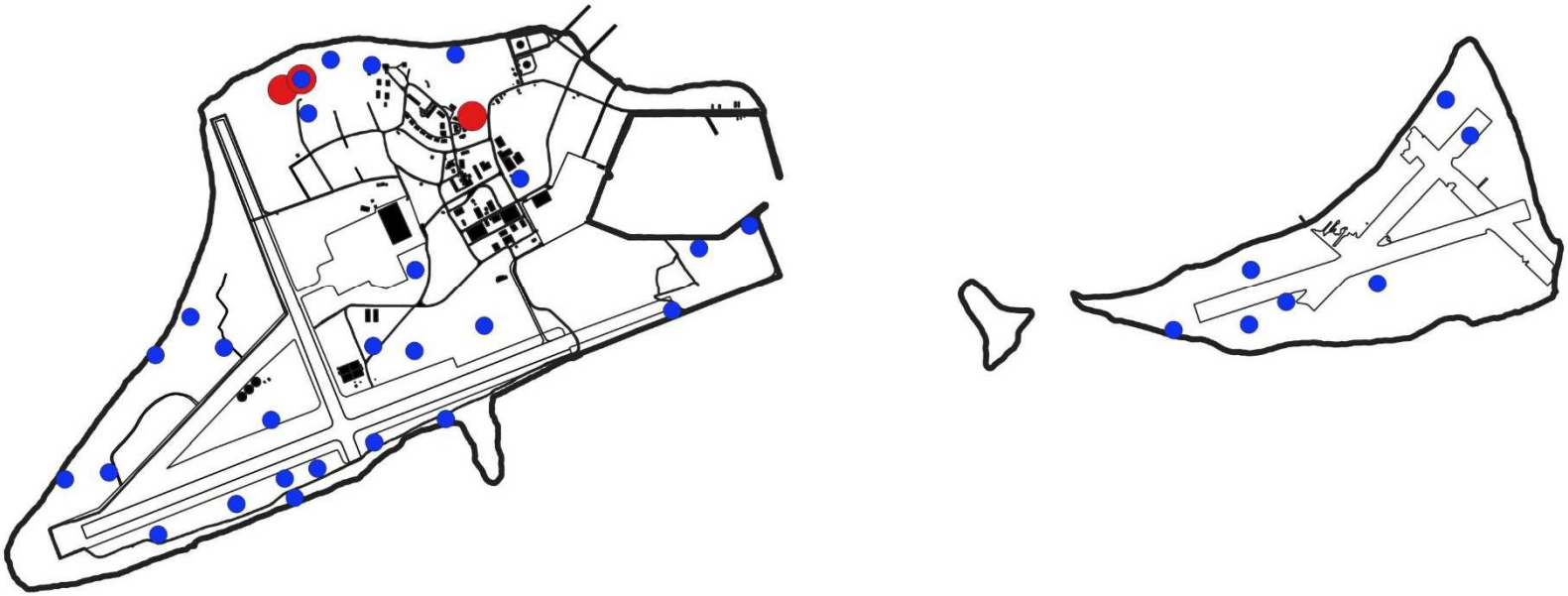
Red=2022, Blue=2017

Tribulus cistoides (Nohu)



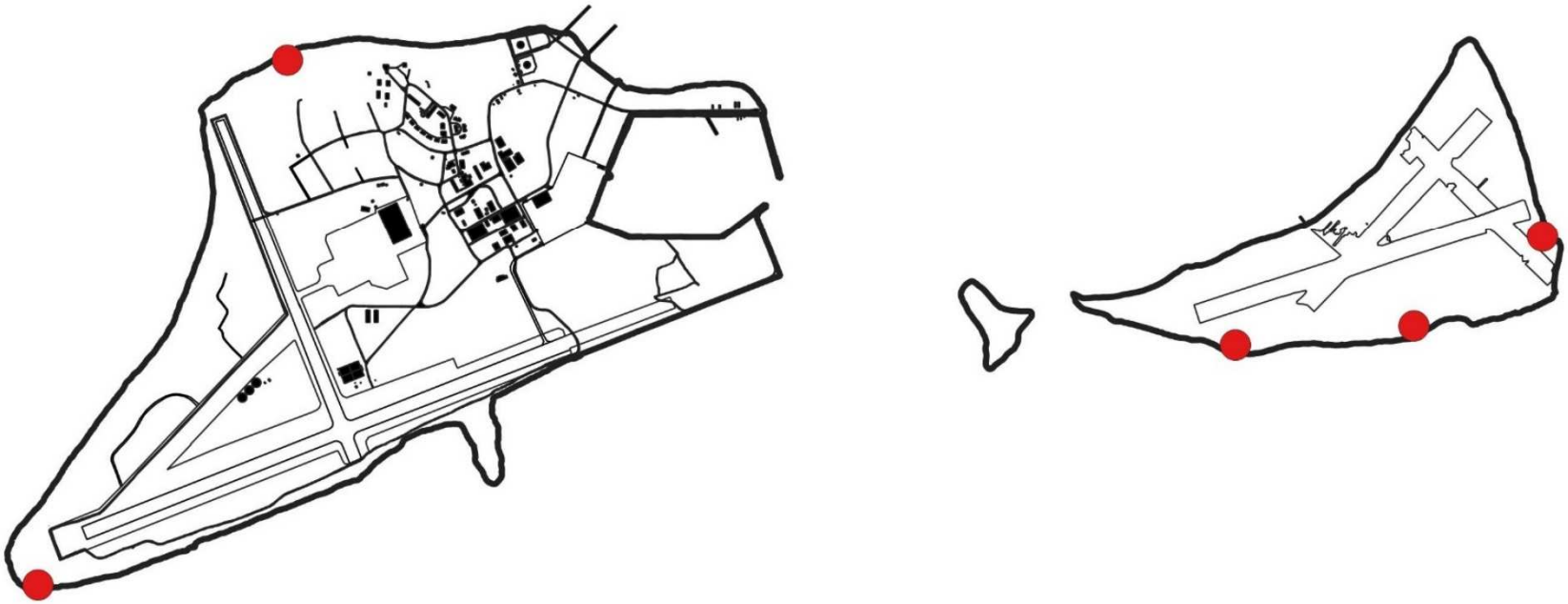
Red=2022, Blue=2017

Verbesina encelioides (Golden crown beard)



Red=2022, Blue=2017

Ocean



Red=2022, Blue=2017

Many of the shorelines on Midway are dynamic. There were five plots this survey partly or wholly in the ocean during high tide that were on land in 2017. Erosion was clearly evident in some locations, such as the east and south sides of Eastern Island, and the north tip of Sand Island. But new land was also gained between the now connected Spit and Eastern Islands, and at the western tip of Sand Island at Frigate Point. Though these insights were not an intended product of the plots, they nonetheless were impossible to ignore.

PLANT CHECKLIST

The following is a checklist of plant species recorded on Midway in the current and recent surveys

Island Distribution / Abundance
Dominant = Forming a major part of the vegetation within the project area.
Common = Widely scattered throughout the area or locally abundant within a portion.
Occasional = Scattered sparsely throughout the area or occurring in a few small patches.
Rare = Only a few isolated individuals within the project area.

Status
Native = Naturally occurring in Hawai‘i
Non-Native = Introduced by humans to Hawai‘i

Historical Observations / Collections
X = Observed
<u>X</u> = Collected

***Centaurium erythraea* subsp. *erythraea* (Bitter herb) at catchment on Midway Atoll.**

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Abelmoschus esculentus				Okra	Malvaceae	Non-Native	X					X
Abutilon grandifolium				Hairy abutilon	Malvaceae	Non-Native	X		X	X	X	X
Acacia farnesiana				Klu	Fabaceae	Non-Native	X				X	X
Acalypha wilkesiana				Beefsteak plant	Euphorbiaceae	Non-Native	X		X	X	X	X
Achyranthes atollensis				Achyranthes	Amaranthaceae	Native	X					
Achyranthes splendens	R			Achyranthes	Amaranthaceae	Native	X	X				
Adansonia digitata				Baobab tree	Bombacaceae	Non-Native						
Adonidia merilii	R			Manilla palm	Arecaceae	Non-Native	X	X	X	X	X	X
Agave attenuata				Agave	Agavaceae	Non-Native						X
Agave sisalana				Sisal	Agavaceae	Non-Native						X
Aira caryophyllea				Silver hairgrass	Poaceae	Non-Native	X					
Albizia lebbeck	R			Siris tree	Fabaceae	Non-Native	X	X	X	X	X	X
Aleurites moluccanus				Kukui nut tree	Euphorbiaceae	Non-Native	X					
Allamanda cathartica				Allamanda	Apocynaceae	Non-Native						
Allium cepa				Onion	Liliaceae	Non-Native						
Allium fistulosum	R/O			Green onion	Liliaceae	Non-Native		X	X	X		X
Allium porrum				Leek	Liliaceae	Non-Native						
Allium sativum				Garlic	Liliaceae	Non-Native						
Allium schoenoprasum				Chive	Liliaceae	Non-Native						
Allium tuberosum	R			Garlic chive	Liliaceae	Non-Native	X	X	X	X		X
Alocasia cucullata				Chinese taro	Araceae	Non-Native						
Alocasia macrorrhizos				Ape	Araceae	Non-Native						
Aloe vera	R			Aloe	Xanthorrhoeaceae	Non-Native		X	X	X	X	X
Alpinia galanga	R			Galangal	Zingiberaceae	Non-Native		X	X			
Alpinia zerumbet				Shell ginger	Zingiberaceae	Non-Native						
Alternanthera tenella				Joyweed	Amaranthaceae	Non-Native						
Amaranthus blitum				Slender amaranth	Amaranthaceae	Non-Native	X					
Amaranthus dubius				Pakai	Amaranthaceae	Non-Native						
Amaranthus hybridus				Green amaranth	Amaranthaceae	Non-Native						
Amaranthus spinosus				Spiny pigweed	Amaranthaceae	Non-Native	X		X	X	X	X
Amaranthus viridis	O/C			Slender amaranth	Amaranthaceae	Non-Native	X	X	X	X	X	X
Ammophila arenaria				European beachgrass	Poaceae	Non-Native	X					

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Anagallis arvensis	R/O	R/O		Scarlet pimpernel	Primulaceae	Non-Native	X	X	X	X	X	X
Ananas comosus				Pineapple	Bromeliaceae	Non-Native						
Andropogon glomeratus var. pumilus				Broomsedge	Poaceae	Non-Native	X		X	X	X	X
Anethum graveolens	R			Dill	Apiaceae	Non-Native	X	X				X
Annona muricata	R			Soursop	Annonaceae	Non-Native	X	X	X	X	X	X
Anthurium andraeanum				Anthurium	Araceae	Non-Native						
Antigonon leptopus				Mexican creeper	Polygonaceae	Non-Native	X					
Apium graveolens	R			Chinese celery, Khuen chai	Apiaceae	Non-Native	X	X		X		X
Apium graveolens var. dulce				Celery	Apiaceae	Non-Native				X		
Araucaria columnaris	R/O			Cook pine	Araucariaceae	Non-Native	X	X	X	X		X
Araucaria heterophylla				Norfolk island pine	Araucariaceae	Non-Native					X	
Arctium lappa				Gobo, burdock	Asteraceae	Non-Native						
Asparagus densiflorus	R			Asparagus fern	Liliaceae	Non-Native	X	X	X	X	X	X
Asparagus setaceus				Asparagus fern	Liliaceae	Non-Native	X					
Asystasia gangetica				Chinese violet	Acanthaceae	Non-Native						
Atriplex suberecta				Saltbush	Amaranthaceae	Non-Native	X				X	
Averrhoa bilimbi	R			Bilimibi	Oxalidaceae	Non-Native		X				
Averrhoa carambola				Star fruit	Oxalidaceae	Non-Native						X
Bacopa monnieri				‘Ae‘ae	Schrophulariaceae	Native	X					
Basella alba				Ceylon spinach	Basellaceae	Non-Native	X					
Bidens alba var. radiata	R/O			Beggartick	Asteraceae	Non-Native	X	X	X	X	X	X
Bidens pilosa				Spanish needle	Asteraceae	Non-Native	X					
Bidens sp.				not sure which one	Asteraceae	Non-Native	X					
Boerhavia coccinea	R			Scarlet boerhavia	Nyctaginaceae	Non-Native	X	X	X			
Boerhavia repens	D	D	C	Alena	Nyctaginaceae	Native	X	X	X	X	X	X
Bothriochloa pertusa	O			Pitted beard grass	Poaceae	Non-Native	X	X	X	X	X	X
Bougainvillea spectabilis	R			Bougainvillea	Nyctaginaceae	Non-Native	X	X	X	X	X	X
Brassica juncea				Mustard	Brassicaceae	Non-Native	X		X	X	X	
Brassica napus				Rutabaga	Brassicaceae	Non-Native						
Brassica nigra				Black mustard	Brassicaceae	Non-Native	X					X

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Brassica oleracea	R			Cabbage, Kale	Brassicaceae	Non-Native		X	X	X		
Brassica oleracea var. botrytis				Broccoli, Cauliflower	Brassicaceae	Non-Native						
Brassica oleracea var. gongylodes				Kohlrabi	Brassicaceae	Non-Native						
Brassica rapa	R			Pak-choi, Chinese cabbage	Brassicaceae	Non-Native	X	X	X	X		X
Brassica sp.	R			Mustard	Brassicaceae	Non-Native	X	X	X	X	X	X
Breynia disticha				Snow bush	Euphorbiaceae	Non-Native						
Bromus catharticus				Prairie grass	Poaceae	Non-Native	X		X	X	X	X
Cajanus cajan	R			Pigeon pea	Fabaceae	Non-Native	X	X				X
Caladium bicolor				Caladium	Araceae	Non-Native					X	X
Calendula officinalis				English marigold	Asteraceae	Non-Native	X					
Calophyllum inophyllum	R			Kamani	Clusiaceae	Non-Native	X	X	X	X	X	X
Calyptocarpus vialis	R			Calyptocarpus	Asteraceae	Non-Native	X	X	X	X	X	X
Calystegia soldanella	R			Sea bindweed	Convolvulaceae	Non-Native	X	X				
Canavalia cathartica	R			Maunaloa	Convolvulaceae	Non-Native	X	X				
Canna indica				Canna	Cannaceae	Non-Native						
Canna x generalis	R/O			Canna	Cannaceae	Non-Native	X	X	X	X	X	X
Capparis sandwichiana	R			Maia pilo, pua pilo	Capparaceae	Native	X	X	X			
Capsella bursa-pastoris				Shepard's purse	Brassicaceae	Non-Native	X			X	X	
Capsicum annuum	O			Red pepper, Bell Pepper	Solanaceae	Non-Native	X	X	X	X	X	X
Carica papaya	O			Papaya	Caricaceae	Non-Native	X	X	X	X	X	X
Carissa macrocarpa				Natal plum	Apocynaceae	Non-Native	X					
Casuarina equisetifolia	D	R	R	Ironwood	Casuarinaceae	Non-Native	X	X	X	X	X	X
Casuarina glauca	O/C			Longleaf ironwood	Casuarinaceae	Non-Native	X	X	X	X	X	X
Catharanthus roseus				Rosy periwinkle	Apocynaceae	Non-Native	X					
Cenchrus agrimonioides var. laysanensis				Native bur grass	Poaceae	Native	X					
Cenchrus ciliaris				Buffel grass	Poaceae	Non-Native	X		X	X	X	X
Cenchrus echinatus				Sand bur	Poaceae	Non-Native	X				X	X
Centaurium erythraea ssp. erythraea	R			Bitter herb	Gentianaceae	Non-Native	X	X	X	X	X	X
Cerastium fontanum ssp. vulgare				Common mouse ear chickweed	Caryophyllaceae	Non-Native						

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Cerastium glomeratum				Sticky mouse ear chickweed	Caryophyllaceae	Non-Native	X			X	X	
Cestrum nocturnum				Night cestrum	Solanaceae	Non-Native	X				X	X
Chenopodium murale				Goosefoot	Chenopodiaceae	Non-Native	X		X	X	X	X
Chenopodium oahuense	O/C	R		ʻĀweoweo	Chenopodiaceae	Native	X	X	X	X	X	X
Chloris barbata				Swollen finger grass	Poaceae	Non-Native	X		X		X	X
Chloris divaricata var. divaricata				Star grass	Poaceae	Non-Native	X					
Chloris virgata				Feather finger grass	Poaceae	Non-Native	X				X	
Chlorophytum comosum				Spider plant	Liliaceae	Non-Native						X
Chrysanthemum sp.				Chrysanthemum	Asteraceae	Non-Native						
Cibotium sp.				Tree fern	Dicksoniaceae	Non-Native						
Citrullus lanatus	R			Watermelon	Cucurbitaceae	Non-Native		X			X	X
Citrus aurantifolia	R			Lime	Rutaceae	Non-Native		X	X	X	X	X
Citrus hystrix	O			Kaffir lime	Rutaceae	Non-Native	X	X	X	X	X	X
Citrus jambhiri				Rough or bumpy lemon	Rutaceae	Non-Native			X	X		
Citrus sp.	R/O			Unknown or various citrus	Rutaceae	Non-Native		X	X	X	X	X
Citrus x limon	R			Meyer lemon	Rutaceae	Non-Native		X	X	X	X	
Citrus x paradisi				Grapefruit, star-ruby, white	Rutaceae	Non-Native			X	X	X	
Citrus x sinensis	R			Orange, valencia, navel, blood	Rutaceae	Non-Native		X	X	X	X	
Cleome gynandra				Wild spider flower	Brassicaceae	Non-Native	X					
Clusia rosea				Autograph tree	Clusiaceae	Non-Native						
Coccinia grandis				Ivy gourd	Cucurbitaceae	Non-Native	X				X	X
Coccoloba uvifera	C	O		Sea grape	Polygonaceae	Non-Native	X	X	X	X	X	X
Cocos nucifera	O/C			Coconut	Arecaceae	Non-Native		X	X	X	X	X
Codiaeum variegatum	R			Croton	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Colocasia esculenta				Taro	Araceae	Non-Native						
Commelina diffusa				Honohono	Commelinaceae	Non-Native	X					
Conocarpus erectus				Buttonwood	Combretaceae	Non-Native						
Conyza bonariensis	O			Hairy horseweed	Asteraceae	Non-Native	X	X	X	X	X	X
Conyza canadensis var. pusilla	O/C	R		Horseweed	Asteraceae	Non-Native	X	X	X	X	X	X

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Cordia sebestena	R			Kou haole	Boraginaceae	Non-Native	X	X	X	X	X	X
Cordyline fruticosa	R			Ti leaf	Agavaceae	Non-Native	X	X	X	X	X	X
Cordyline sp.				Cordyline	Agavaceae	Non-Native					X	
Coreopsis grandiflora				Coreopsis	Asteraceae	Non-Native	X					
Coreopsis tinctoria				Golden tickseed	Asteraceae	Non-Native	X					
Coriandrum sativum	R			Cilantro	Apiaceae	Non-Native		X	X	X		X
Coronopus didymus	R/O	R		Swine cress	Brassicaceae	Non-Native	X	X	X	X	X	X
Cosmos bipinnatus				Cosmos	Asteraceae	Non-Native	X					
Crassula sp.				Stonecrop	Crassulaceae	Non-Native						
Crinum asiaticum	O	R		Crinum lily	Liliaceae	Non-Native	X	X	X	X	X	X
Crotalaria incana				Fuzzy rattle pod	Fabaceae	Non-Native	X		X			X
Crotalaria pallida				Rattle pod	Fabaceae	Non-Native	X					
Cucumis melo	R			Cantaloupe, Canary melon	Cucurbitaceae	Non-Native	X	X				
Cucumis sativus	R			Cucumber	Cucurbitaceae	Non-Native		X	X	X		
Cucurbita maxima				Pumpkin	Cucurbitaceae	Non-Native			X			
Cucurbita pepo	R			Squash, zucchini	Cucurbitaceae	Non-Native	X	X			X	X
Cycas circinalis	R			Sago palm	Cycadaceae	Non-Native	X	X	X	X	X	X
Cycas revoluta				Sago palm	Cycadaceae	Non-Native						
Cyclospermum leptophyllum	O			Fir-leaved celery	Apiaceae	Non-Native	X	X	X	X	X	X
Cymbopogon citratus	O			Lemon grass	Poaceae	Non-Native	X	X	X	X	X	X
Cynara scolymus				Artichoke	Asteraceae	Non-Native						
Cynodon dactylon	D	D		Bermuda grass	Poaceae	Non-Native	X	X	X	X	X	X
Cyperus involucratus				Umbrella plant	Cyperaceae	Non-Native	X		X	X	X	X
Cyperus javanicus				Ahu'awa	Cyperaceae	Native	X					
Cyperus laevigatus	R	R		Makaloa	Cyperaceae	Native	X	X	X	X	X	X
Cyperus papyrus				Papyrus	Cyperaceae	Non-Native						
Cyperus pennatiformis var. bryanii				Cyperus	Cyperaceae	Native						Y
Cyperus polystachyos	C/D			Pycreus	Cyperaceae	Native	X	X	X	X	X	X
Cyperus rotundus	O			Purple nut sedge	Cyperaceae	Non-Native	X	X	X	X	X	X
Dactyloctenium aegyptium	O	C		Beach wire grass	Poaceae	Non-Native	X	X	X	X	X	X
Daucus carota				Carrot	Apiaceae	Non-Native						

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Delonix regia	R			Royal poinciana	Fabaceae	Non-Native	X	X	X	X	X	X
Desmanthus pernambucanus				Slender mimosa	Fabaceae	Non-Native	X		X		X	X
Desmodium sandwicense				Spanish clover	Fabaceae	Non-Native	X					
Dianthus caryophyllus				Carnation	Caryophyllaceae	Non-Native	X					
Dianthus chinensis				Carnation	Caryophyllaceae	Non-Native	X					
Dichorisandra thysiflora				Blue ginger	Commelinaceae	Non-Native						
Dieffenbachia sp.				Dumb cane	Araceae	Non-Native						
Digitaria ciliaris	R	O/C		Henry's crab grass	Poaceae	Non-Native	X	X	X	X	X	X
Digitaria insularis				Sour grass	Poaceae	Non-Native	X			X	X	X
Dracaena fragrans	O			Dracaena	Agavaceae	Non-Native	X	X	X	X		X
Dracaena marginata	O			Money tree	Agavaceae	Non-Native	X	X	X	X	X	X
Dracaena reflexa				Pineapple dracaena	Agavaceae	Non-Native						
Dracaena sp.				Unknown dracaena	Agavaceae	Non-Native						
Duranta erecta				Golden dewdrop	Verbenaceae	Non-Native	X					
Echinochloa crus-galli				Barnyard grass	Poaceae	Non-Native	X					
Eleusine indica	C/D	O		Goose grass	Poaceae	Non-Native	X	X	X	X	X	X
Epiphyllum oxypetalum				Gooseneck cactus	Cactaceae	Non-Native	X					
Epipremnum pinnatum	R/O			Golden pothos	Araceae	Non-Native	X	X	X	X	X	X
Eragrostis paupera	R			Native bunch grass	Poaceae	Native	X	X	X	X	X	X
Eragrostis amabilis	O			Love grass	Poaceae	Non-Native	X	X	X	X	X	X
Eragrostis variabilis	C	O	O/C	ʻEmaloa, Kāwelu	Poaceae	Native	X	X	X	X	X	X
Eriochloa procera				Cupgrass	Poaceae	Non-Native	X		X		X	X
Eryngium foetidum	R			Long or thorny coriander	Apiaceae	Non-Native	X	X	X	X		X
Erythrina variegata	R			Tiger's claw	Fabaceae	Non-Native	X	X	X	X	X	X
Eugenia uniflora				Suriname cherry	Myrtaceae	Non-Native	X					X
Euphorbia cyathophora	R			Wild poinsettia	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Euphorbia degeneri	R/O			ʻAkoko	Euphorbiaceae	Native	X	X				
Euphorbia heterophylla				Fire plant	Euphorbiaceae	Non-Native	X					
Euphorbia hirta	O/C			Hairy spurge	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Euphorbia hypericifolia	O			Graceful spurge	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Euphorbia hyssopifolia				Spurge	Euphorbiaceae	Non-Native	X				X	

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Euphorbia maculata	O/C	O/C		Spurge	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Euphorbia milii	R/O			Crown of thorns	Euphorbiaceae	Non-Native		X	X	X	X	X
Euphorbia peplus	C			Petty spurge	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Euphorbia prostrata	O/C	R		Small ground fig	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Euphorbia pulcherrima				Poinsettia	Euphorbiaceae	Non-Native	X				X	X
Euphorbia serpens	O/C			Matted sandmat	Euphorbiaceae	Non-Native	X	X	X	X		X
Euploca procumbens	O/C			Heliotropium	Boraginaceae	Non-Native	X	X	X	X	X	X
Eustachys petraea	C	O/C	O/C	Eustachys	Poaceae	Non-Native	X	X	X	X	X	X
Ficus benghalensis	R			Indian banyan	Moraceae	Non-Native	X	X	X	X	X	X
Ficus benjamina	R			Benjamin tree	Moraceae	Non-Native	X	X	X	X	X	X
Ficus elastica				Indian Rubber Tree	Moraceae	Non-Native						
Ficus macrophylla				Moreton Bay Fig	Moraceae	Non-Native	X			X		X
Ficus microcarpa	O			Chinese banyan	Moraceae	Non-Native	X	X	X	X	X	X
Ficus sp.				Unknown ficus	Moraceae	Non-Native						
Fimbristylis cymosa	O/C	R	O	Button sedge	Cyperaceae	Native	X	X	X	X	X	X
Fimbristylis cymosa spp. umbellato-capitata				Button sedge	Cyperaceae	Native	X					
Fimbristylis cymosa ssp. spathacea				Button sedge	Cyperaceae	Native	X					
Fragaria chiloensis	R			Alpine strawberry	Rosaceae	Non-Native		X				
Fragaria x ananassa	R			Strawberry	Rosaceae	Non-Native	X	X			X	
Fragaria x ananassa 'Quinault'				Strawberry	Rosaceae	Non-Native	X					
Gamochaeta purpurea				Purple cudweed	Asteraceae	Non-Native						
Gardenia sp.				Gardenia	Rubiaceae	Non-Native						
Glycine max				Soy bean	Fabaceae	Non-Native						
Gomphrena globosa				Globe amaranth	Amaranthaceae	Non-Native	X					
Gossypium tomentosum	R			Ma‘o, Hawaiian cotton	Malvaceae	Native	X	X				
Guilandina bonduc				Yellow knickers	Fabaceae	Native	X				X	X
Gynura bicolor				Asian spinach	Asteraceae	Non-Native	X		X	X	X	X
Hedychium gardnerianum				Kahili ginger	Zingiberaceae	Non-Native						
Helianthus annuus				Sunflower	Asteraceae	Non-Native						X
Heliconia psittacorum				Heliconia	Musaceae	Non-Native						
Heliotropium curasavicum				Nena	Boraginaceae	Native						

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Hemerocallis sp.				Day lily	Liliaceae	Non-Native						
Hibiscus rosa-sinensis	O			Red hibiscus	Malvaceae	Non-Native	X	X	X	X	X	X
Hibiscus sp.				Unknown hibiscus	Malvaceae	Non-Native						
Hibiscus tiliaceus	O/C			Hau	Malvaceae	Native	X	X	X	X	X	X
Hibiscus waimeae	R			Koki‘o kea	Malvaceae	Native	X	X	X	X	X	X
Hippeastrum sp.				Amaryllis	Liliaceae	Non-Native						
Hordeum murinum ssp. leporinum				Barley	Poaceae	Non-Native	X					
Hylocereus undatus				Night blooming cereus	Cactaceae	Non-Native						
Impatiens balsamina				Balsam, candlestick plant	Balsaminaceae	Non-Native	X					
Indigofera spicata				Creeping indigo	Fabaceae	Non-Native	X		X		X	X
Ipomoea aquatica	R			Swamp cabbage	Convolvulaceae	Non-Native	X	X	X	X	X	X
Ipomoea batatas	R			Sweet potato	Convolvulaceae	Non-Native	X	X			X	X
Ipomoea indica	O			Koali ‘awa	Convolvulaceae	Native	X	X	X	X	X	X
Ipomoea pes-caprae ssp. brasiliensis	O/C	R		Pōhuehue, beach morning glory	Convolvulaceae	Native	X	X	X	X	X	X
Ipomoea triloba				Little bell	Convolvulaceae	Non-Native	X					
Jasminum sambac				Pikake	Oleaceae	Non-Native						
Juniperus bermudiana	R			Bermuda cedar	Cupressaceae	Non-Native	X	X	X	X	X	X
Kalanchoe daigremontiana x tubiflora				Kalanchoe hybrid	Crassulaceae	Non-Native						
Kalanchoe tubiflora	R			Chandelier plant	Crassulaceae	Non-Native	X	X	X	X	X	X
Kalanchoe fedtschenkoi				Lavender scallops	Crassulaceae	Non-Native	X				X	X
Kalanchoe pinnata				Air plant	Crassulaceae	Non-Native	X			X	X	X
Lactuca sativa	R			Lettuce	Asteraceae	Non-Native	X	X	X	X	X	
Lantana camara				Lantana	Verbenaceae	Non-Native	X			X	X	X
Lathyrus odoratus				Sweet pea	Fabaceae	Non-Native	X					
Lepidium bidentatum var. o-wahiense	R			Anaunau	Brassicaceae	Native	X	X	X			Y
Lepidium virginicum	C			Pepper grass	Brassicaceae	Non-Native	X	X	X	X	X	X
Leptochloa fusca ssp. uninervia				Sprangletop	Poaceae	Non-Native	X		X			
Lepturus repens		R		Lepturus	Poaceae	Native	X	X	X	X	X	X
Leucaena leucocephala				Koa haole	Fabaceae	Non-Native	X		X	X	X	X

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Lobularia maritima	D	D	R	Sweet alyssum	Brassicaceae	Non-Native	X	X	X	X	X	X
Luffa acutangula	R			Ridged gourd	Cucurbitaceae	Non-Native		X	X			
Macroptilium lathyroides				Cow pea	Fabaceae	Non-Native	X				X	
Malva parviflora				Cheese weed	Malvaceae	Non-Native	X		X	X	X	X
Malvastrum coromandelianum spp. coromandelianum				False mallow	Malvaceae	Non-Native	X		X	X	X	X
Malvaviscus arboreus				Erect Turk's cap	Malvaceae	Non-Native						
Malvaviscus penduliflorus				Turks cap hibiscus	Malvaceae	Non-Native	X		X	X	X	X
Malus pumila	R			Apple	Rosaceae	Non-Native		X				
Mangifera indica	R			Mango	Anacardiaceae	Non-Native		X				X
Medicago lupulina				Black medic	Fabaceae	Non-Native	X		X	X	X	X
Medicago orbicularis				Blackdisk medic	Fabaceae	Non-Native	X					
Medicago polymorpha				Bur clover	Fabaceae	Non-Native	X		X	X	X	
Medicago sativa				Alfalfa	Fabaceae	Non-Native						
Megathyrsus maximus				Guinea grass	Poaceae	Non-Native	X				X	X
Melanthera integrifolia	R/O			Nehe	Asteraceae	Native	X	X				
Melilotus albus				White sweet clover	Fabaceae	Non-Native	X					
Melilotus indicus	O/C			Yellow sweet clover	Fabaceae	Non-Native	X	X	X	X	X	X
Melinis repens				Natal red top	Poaceae	Non-Native	X					
Mentha spicata	O			Mint	Lamiaceae	Non-Native	X	X	X	X	X	X
Merremia tuberosa				Wood rose	Convolvulaceae	Non-Native						
Mirabilis jalapa				Four o'clock	Nyctaginaceae	Non-Native	X		X	X	X	X
Momordica charantia	R/O			Bitter melon, Balsam pear	Cucurbitaceae	Non-Native	X	X	X	X	X	X
Monstera deliciosa				Monstera	Araceae	Non-Native						
Moringa oleifera	R			Drumstick tree	Moringanaceae	Non-Native	X	X	X	X	X	X
Morus alba	R			White mulberry	Moraceae	Non-Native	X	X	X	X	X	X
Murraya paniculata				Mock orange	Rutaceae	Non-Native	X					
Musa x paradisiaca	O			Banana	Musaceae	Non-Native		X	X	X	X	X
Mucuna sp.	R			Mucuna	Fabaceae	Non-Native		X				
Myoporum sandwicense?	R			Naio	Myoporaceae	Native	X	X				
Myoporum stellatum?	R			Naio	Myoporaceae	Native	X	X				

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Nama sandwicensis				Nama	Boraginaceae	Native						X
Nephrolepis hirsutula				Sword fern	Nephrolepiadaceae	Non-Native						
Nephrolepis multiflora				Sword fern	Nephrolepiadaceae	Non-Native	X		X			X
Nerium oleander	O/C			Oleander	Apocynaceae	Non-Native	X	X	X	X	X	X
Noronhia emarginata	R			Madagascar olive	Oleaceae	Non-Native	X	X	X	X	X	X
Ocimum basilicum	R			Basil	Lamiaceae	Non-Native	X	X	X		X	X
Ocimum tenuiflorum	R			Thai holy basil	Lamiaceae	Non-Native		X	X	X		
Odontonema tubiforme				Odontonema	Acanthaceae	Non-Native						
Oenothera laciniata	O/C			Evening primrose	Onagraceae	Non-Native	X	X	X	X	X	X
Olea europaea ssp. cuspidata	R			African olive	Oleaceae	Non-Native	X	X	X	X	X	X
Opuntia cochenillifera				Cochineal cactus	Cactaceae	Non-Native	X					X
Origanum majorana				Sweet marjoram	Lamiaceae	Non-Native						
Oroxylum indicum	R			Indian trumpet tree	Bignonaceae	Non-Native		X				
Oryza sp.				Rice	Poaceae	Non-Native						X
Oxalis corniculata	R			Yellow wood sorrel	Oxalidaceae	Non-Native	X	X	X	X	X	X
Oxalis debilis var. corymbosa				Shamrock	Oxalidaceae	Non-Native	X		X	X	X	X
Pancratium littorale				Spider lily	Liliaceae	Non-Native						
Pandanus amaryllifolius				Tea Pandanus	Pandanaceae	Non-Native	X		X	X		X
Pandanus tectorius	R			Hala, screwpine	Pandanaceae	Non-Native	X	X	X	X	X	X
Paspalum setaceum	O/C			Paspalum	Poaceae	Non-Native	X	X	X	X	X	X
Paspalum urvillei	O/C			Vasey grass	Poaceae	Non-Native	X	X	X	X	X	X
Passiflora edulis				Lilikoi, passion vine	Passifloraceae	Non-Native	X					X
Pedilanthus tithymaloides	R			Slipper flower	Euphorbiaceae	Non-Native	X	X	X	X	X	X
Pelargonium x hortorum				Fish geranium	Geraniaceae	Non-Native	X			X		X
Peperomia obtusifolia				Alien peperomia	Piperaceae	Non-Native	X					
Persea americana	R			Avocado	Lauraceae	Non-Native		X				
Persicaria odorata	R			Vietnamese coriander	Polygonaceae	Non-Native		X	X			
Petroselinum crispum	R			Parsley	Apiaceae	Non-Native	X	X				
Phaseolus vulgaris				Common bush bean	Fabaceae	Non-Native						
Philodendron sp.				Philodendron	Araceae	Non-Native						

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Phoenix sp.				Date palm	Arecaceae	Non-Native						
Phyla nodiflora	C			Phyla	Verbenaceae	Non-Native	X	X	X	X	X	X
Phyllostegia variabilis				Native mint	Lamiaceae	Native						
Phymatosorus grossus				Laua‘e	Polypodiaceae	Non-Native						
Pilea microphylla	O/C			Artillery plant	Urticaceae	Non-Native	X	X	X	X	X	X
Piper sarmentosum	R			Thai Piper	Piperaceae	Non-Native	X	X	X	X		X
Pithecellobium dulce				Opiuma, Manila tamarind	Fabaceae	Non-Native	X					X
Plantago lanceolata	O/C			Narrow leaved plantian	Plantaginaceae	Non-Native	X	X	X	X	X	X
Plantago major				Common plantain	Plantaginaceae	Non-Native	X				X	
Plectranthus amboinicus				Mexican oregano	Lamiaceae	Non-Native					X	X
Plectranthus scutellarioides				Coleus	Lamiaceae	Non-Native						
Pluchea carolinensis				Sour bush	Asteraceae	Non-Native	X		X	X	X	X
Pluchea indica				Indian pluchea	Asteraceae	Non-Native	X					
Pluchea x fosbergii				Hybrid pluchea	Asteraceae	Non-Native	X					
Plumbago auriculata				Plumbago	Plumbaginaceae	Non-Native						
Plumeria obtusa	R			Singapore plumeria	Apocynaceae	Non-Native	X	X	X	X	X	X
Plumeria rubra	O			Red plumeria, frangipani	Apocynaceae	Non-Native	X	X	X	X	X	X
Poa annua				Blue grass	Poaceae	Non-Native	X			X	X	X
Polypogon interruptus				Perrenial ditch beard grass	Poaceae	Non-Native	X					X
Polypogon monspeliensis	R			Annual ditch beard grass	Poaceae	Non-Native	X	X	X	X	X	X
Polyscias guilfoylei				Panax	Araliaceae	Non-Native	X		X	X	X	X
Portulaca lutea				‘Ihi	Portulacaceae	Native	X					
Portulaca oleracea	O	O		Common purslane	Portulacaceae	Non-Native	X	X	X	X	X	X
Portulacaria afra				Jade tree	Portulacaceae	Non-Native	X				X	X
Pritchardia hillebrandii	R			Loulu lelo	Arecaceae	Native		X	X	X		X
Pritchardia pacifica				Fiji fan palm	Arecaceae	Non-Native				X		X
Pritchardia remota	R/O	R		Nīhoa loulu palm	Arecaceae	Native		X	X	X		
Pritchardia spp.				Loulu palm	Arecaceae	?					X	
Prosopis pallida				Kiawe	Fabaceae	Non-Native						
Prunus persica var. persica	R			Peach	Rosaceae	Non-Native		X	X			

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Pseudognaphalium sandwicensium var. sandwicensium	O/C			ʻEnaʻena	Asteraceae	Native	X	X	X	X	X	X
Psidium guajava				Guava	Myrtaceae	Non-Native					X	X
Psilotum nudum				Moa	Psilotaceae	Native	X					
Psophocarpus tetragonolobus	R			Wing bean	Fabaceae	Non-Native	X	X	X	X	X	X
Punica granatum				Pomegranite	Myrtaceae	Non-Native						
Raphanus sativus	R			Radish, daikon	Brassicaceae	Non-Native	X	X	X			
Ricinus communis				Castor bean	Euphorbiaceae	Non-Native			X	X	X	X
Rosa sp.	R/O			Rose	Rosaceae	Non-Native	X	X	X	X	X	X
Rosmarinus officinalis	R			Rosemary	Lamiaceae	Non-Native		X	X	X		
Roystonea sp.				Royal palm	Arecaceae	Non-Native						
Rubus sp.	R			Thornless blackberry	Rosaceae	Non-Native		X				
Ruellia simplex	R			Ruellia	Acanthaceae	Non-Native	X	X	X	X	X	X
Russelia equisetiformis				Coral / firecracker plant	Schrophulariaceae	Non-Native	X				X	X
Saccharum sp.	R			Sugar cane	Poaceae	Non-Native		X	X	X	X	
Sagina japonica				Japanese pearlwort	Caryophyllaceae	Non-Native	X			X	?	
Sagina procumbens				Birdseye pearlwort	Caryophyllaceae	Non-Native	X			X	?	
Salvia officinalis				Sage	Lamiaceae	Non-Native			X	X		
Samanea saman				Monkey pod	Fabaceae	Non-Native	X				X	X
Sansevieria trifasciata	R			Mother in law tongue	Agavaceae	Non-Native	X	X	X	X	X	X
Santalum ellipticum				ʻIliahi a loʻe, coast sandalwood	Santalaceae	Native					Y	
Scaevola taccada	D	C/D	D	Naupaka kahakai	Goodeniaceae	Native	X	X	X	X	X	X
Schefflera actinophylla	R			Octopus tree	Araliaceae	Non-Native	X	X	X	X	X	X
Schinus terebinthifolius				Christmas berry	Anacardiaceae	Non-Native	X					
Senna siamea				Pheasant wood	Fabaceae	Non-Native	X					X
Senna surattensis				Kolomona	Fabaceae	Non-Native						
Sesbania grandiflora	R			Sesban	Fabaceae	Non-Native	X	X	X	X	X	X
Sesbania tomentosa	R			ʻŌhai	Fabaceae	Native	X	X				
Sesuvium portulacastrum	O	O/C	C	ʻAkulikuli	Aizoaceae	Native	X	X	X	X	X	X
Setaria verticillata	O	C		Bristly foxtail	Poaceae	Non-Native	X	X	X	X	X	X
Sicyos pachycarpus				ʻĀnunu	Cucurbitaceae	Native						Y

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Sida fallax	O			ʻIlima	Malvaceae	Native	X	X	X	X	X	X
Sida rhombifolia				Cuba jewt	Malvaceae	Non-Native	X					
Solanum americanum	O	R		Pōpolo, glossy nightshade	Solanaceae	Native	X	X	X	X	X	X
Solanum lycopersicum	R/O			Tomato	Solanaceae	Non-Native	X	X	X	X	X	X
Solanum melongena	O			Eggplant	Solanaceae	Non-Native	X	X	X	X	X	X
Solanum nelsonii	O			Pōpolo	Solanaceae	Native	X	X	X	X	X	X
Solanum torvum	R			Turkey berry	Solanaceae	Non-Native	X	X	X	X	X	X
Sonchus oleraceus	R	R		Sow thistle	Asteraceae	Non-Native	X	X	X	X	X	X
Spathodea campanulata				African tulip tree	Bignonaceae	Non-Native	X					X
Spergularia marina	R	R		Saltmarsh sand spurry	Caryophyllaceae	Non-Native	X	X	X	X	X	X
Sphagneticola trilobata				Wedelia	Asteraceae	Non-Native	X					
Spinacia oleracea				Spinach	Chenopodiaceae	Non-Native						
Spondias sp.				Makok	Anacardiaceae	Non-Native					X	X
Sporobolus africanus				African dropseed	Poaceae	Non-Native	X					
Sporobolus diandrus	R			Indian dropseed	Poaceae	Non-Native	X	X				
Sporobolus indicus	O/C			Indian dropseed	Poaceae	Non-Native	X	X	X	X	X	X
Sporobolus pyramidatus	O/C	O/C		Sporobolus	Poaceae	Non-Native	X	X	X	X	X	X
Sporobolus virginicus	O			ʻAkiʻaki, Beach dropseed	Poaceae	Native	X	X	X	X	X	
Stachys arvensis				Staggerweed	Lamiaceae	Non-Native	X			X	X	
Stachytarpheta cayennensis				Vervain	Verbenaceae	Non-Native						
Stachytarpheta jamaicensis				Jamaican vervain	Verbenaceae	Non-Native	X				X	X
Stellaria media				Chickweed	Caryophyllaceae	Non-Native	X				X	
Stenotaphrum secundatum	C			St. Augustine grass	Poaceae	Non-Native	X	X	X	X	X	X
Strelitzia reginae				Bird of paradise	Musaceae	Non-Native						
Syngonium podophyllum	R			Syngonium	Araceae	Non-Native	X	X	X	X	X	X
Tabebuia heterophylla	R			Tabebuia	Bignonaceae	Non-Native	X	X	X	X	X	X
Tabernaemontana sp.				Crape jasmine	Apocynaceae	Non-Native						
Tagetes erecta	R			Marigold	Asteraceae	Non-Native	X	X				
Tamarindus indica	R			Tamarind	Fabaceae	Non-Native	X	X	X	X	X	X
Tamarix sp.				Tamarix	Tamaricaceae	Non-Native						

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Terminalia catappa	O/C			False kamani	Combretaceae	Non-Native	X	X	X	X	X	X
Tetragonia tetragonioides				New Zealand spinach	Aizoaceae	Non-Native	X					
Thespesia populnea	O			Milo	Malvaceae	Native	X	X	X	X	X	X
Thevetia peruviana				Be still tree	Apocynaceae	Non-Native	X					X
Thymus vulgaris	R			Thyme	Lamiaceae	Non-Native		X	X			
Tournefortia argentea	C	C	C	Tree heliotrope	Boraginaceae	Non-Native	X	X	X	X	X	X
Tradescantia pallida	R			Purple heart, Day flower	Commelinaceae	Non-Native	X	X	X	X	X	X
Tradescantia spathacea	R			Oyster plant	Commelinaceae	Non-Native	X	X	X	X	X	X
Tradescantia zebrina				Wandering jew	Commelinaceae	Non-Native						
Tribulus cistoides	R	C/D	O	Nohu	Zygophyllaceae	Native	X	X	X	X	X	X
Trichosanthes cucumerina				Gourd	Cucurbitaceae	Non-Native	X					
Tridax procumbens				Coat buttons	Asteraceae	Non-Native	X				X	X
Tropaeolum majus				Nasturtium	Tropaeolaceae	Non-Native						
Unknown Apiaceae				Apiaceae	Apiaceae	Non-Native	X					X
Unknown Cactaceae	R			Cactus	Cactaceae	Non-Native		X				
Unknown Cupressaceae				Cypress tree	Cupressaceae	Non-Native	X					
Unknown Liliaceae				Unknown liliaceae	Liliaceae	Non-Native						
Unknown Orchidaceae	R			Unknown orchids	Orchidaceae	Non-Native		X	X			X
Unknown Poaceae				Unknown grass	Poaceae	Non-Native	X				X	
Unknown sp.				Unknown	Aloeaceae	Non-Native						
Unknown sp.				Vigna or Canavalia ?	Fabaceae	?						
Unknown sp.				Pencil like cactus	Cactaceae	Non-Native			X			
Unknown sp.				Unknown pea ?	Fabaceae	Non-Native						
Urochloa mutica				California grass	Poaceae	Non-Native	X					
Verbena litoralis	R			Vervain	Verbenaceae	Non-Native	X	X	X	X	X	X
Verbesina encelioides	R			Golden crown-beard	Asteraceae	Non-Native	X	X	X	X	X	X
Vigna unguiculata ssp. sesquipedalis	R			Long bean	Fabaceae	Non-Native	X	X	X			X
Viola odorata				Sweet violet	Violaceae	Non-Native						
Viola x wittrockiana				Violet, pansy	Violaceae	Non-Native	X					
Vitex rotundifolia	R			Pōhinahina	Verbenaceae	Native	X	X	X	X		X
Vitex trifolia				Tree Vitex	Verbenaceae	Non-Native	X				X	X

Species	Sand	Eastern	Spit	Common name	Family	Nativity	Coll.	2022	2017	2015	2012	2008
Vitis vinifera				Grape	Vitaceae	Non-Native	X				X	X
Vulpia myuros				Fox/rat tail fescue	Poaceae	Non-Native	X					
Waltheria indica				Uhaloa	Sterculiaceae	Native	X		X			
Wikstroemia uva-ursi				Akia	Thymelaeaceae	Native	X					X
Xanthium stumarium var. canadense				Cocklebur	Asteraceae	Non-Native	X					
Xanthosoma robustum				Ape	Araceae	Non-Native	X		X	X	X	X
Xanthosoma sp.				Ape	Araceae	Non-Native						
Zea mays				Corn	Poaceae	Non-Native			X			
Zingiber officinale	R			Ginger	Zingiberaceae	Non-Native		X				
Zinnia violacea	R			Zinnia	Asteraceae	Non-Native	X	X				
Ziziphus sp.				Jujube	Rhamnaceae	Non-Native	X					X
Total	191	32	10		Total	434	291	192	198	189	204	225
Native	32	12	6		Native	50	42	33	27	24	23	28
Non-Native	159	20	4		Non-Native	382	250	159	171	165	180	197
?	0	0	0		?	2	0	0	0	0	1	0

2022 Botanical Survey of Midway Atoll - Forest & Kim Starr