

BOTANICAL INVENTORY OF KURE ATOLL

Prepared for:
Department of Land and Natural Resources
Division of Forestry and Wildlife
Honolulu, Hawai'i

Prepared by:
Forest Starr, Kim Martz, and Lloyd Loope
United States Geological Survey
Biological Resources Division
Haleakala Field Station
Contact: fstarr@hawaii.edu

June 2001



INTRODUCTION

We (Starr & Martz) had the opportunity, through the courtesy of the Hawai'i State Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW), and David G. Smith, DLNR-DOFAW Wildlife Manager, to visit Kure Atoll and inventory the plants during the period of May 21-25, 2001. It had apparently been more than two decades since the last plant inventory had been done, and in the interim, the island had seen major changes, including the ending of three decades of occupation by the Coast Guard, the eradication of rats, and the extensive invasion by non-native plants, most notably, golden crown-beard or *Verbesina* (*Verbesina encelioides*). Our goals were to inventory the existing plant species on Kure Atoll, to locate any rare native plants, and to locate and collect any new non-native plants.

HISTORY OF KURE ATOLL

Kure Atoll, the most northwestern Hawaiian Island, is located some 1,175 miles northwest of Honolulu. Kure is an oval shaped atoll about six miles in diameter with one large vegetated island and one much smaller unvegetated island. The larger of these islands, Green Island, reaches a maximum height of 25 feet and is about 1.5 miles long and .5 mile wide. The island is comprised of sand dunes that rise quickly from the beach and surround a low flat plain in the center of the island. In 1923, when the first botanists surveyed the atoll, Kure's vegetation was still predominantly native. However, the construction of a radar reflector in 1955, and the installation of a Coast Guard LORAN station, 625 foot radio tower, and 4,000 foot runway that was maintained around the clock from 1960 to 1993, greatly altered the flora on Kure. Today, we find few of the original endemics that were common up until 1960. Additionally, there are a host of non-natives that have thoroughly invaded the island and, in areas, completely converted the flora to a mix of pantropical weeds. Nonetheless, Kure still supports large stands of many native plants, some of which are found in very few other places. Since 1993, Kure has been managed by the DLNR. There are no longer permanent residents on Kure. The existing presence includes a summer (7-10 week) camp of two seal researchers with the National Marine Fisheries Service (NMFS) and one State DLNR technician.

METHODOLOGY

We did walk-through surveys of Kure Atoll through major vegetation types, taking different lines to maximize area surveyed. Extra time was spent going through areas which had historically been known to harbor rare native plants, such as the central plain. Extra time was also spent near the quarters where most of the new weeds had historically been collected. Plants encountered were identified to species, frequency noted, and collections made if the record was significant. Specimens were deposited at Bishop Museum in Honolulu, Hawai'i. GPS points were taken for ironwood (*Casuarina equisetifolia*) trees, and GPS lines were taken to help with vegetation mapping. Lastly, pictures were taken to visually document the current vegetative status of Kure and for use in a pictorial guide to the common plants of Kure.

RESULTS

While on Kure, we observed 49 plant species, 4 of which had previously not been known from the Atoll. Of these 49, 13 were native and 36 were non-native. We made 16 significant collections, 12 of which were naturalized species, 2 of which were cultivated species, and 2 of which were collected as seeds only. The 13 native species encountered were: 'Alena (*Boerhavia repens*), kauna'oa pehu (*Cassythia filiformis*), dwarf Eragrostis (*Eragrostis paupera*), native bunchgrass or 'emoloa (*Eragrostis variabilis*), mau'u 'aki 'aki (*Fimbristylis cymosa*), 'ena 'ena (*Gnaphalium sandwicense* var. *sandwicense*), koali 'awa (*Ipomoea indica*), pohuehue (*Ipomoea pes-caprae*), sea bean (*M. gigantea*), cow-itch plant (*Mucuna urens*), naupaka (*Scaevola sericea*), 'anunu (*Sicyos maximowiczii*), and nohu (*Tribulus cistoides*). There are 7 additional native species that were known historically that we did not encounter during this survey including: *Lepturus repens*, Nehe (*Lipochaeta integrifolia*), and the 5 rare plants listed below. All other species encountered and mentioned in this report are non-native.

RARE PLANTS

Areas where rare plants previously existed were searched in hopes of finding remnant populations. *Sicyos maximowiczii* and *Eragrostis paupera* were the only rare plants found during this survey. The others, *Achyranthes atollensis*, *Cenchrus agrimonioides* var. *laysanensis*, *Lepidium bidentatum* var. *owaihiense*, *Phyllostegia variabilis*, and *Solanum nelsonii* were not located. However, there may still be a chance that perhaps some were overlooked, or exist as seeds in the soil. Many of these species, or close relatives of these species, still exist on other Hawaiian islands or in herbarium collections. These could potentially be reintroduced.

NON-NATIVE PLANTS

We found 34 non-native plants during this survey, three of which, pearlwort (*Sagina* sp.), *Boerhavia coccinea*, and *Spermacoce* sp., were previously not known from the island, and 12 of which were known from the island, but had not yet been collected and published. Some of the non-native species on Kure tend to be more aggressive than others, often altering the habitat and crowding out native plants and animals. Some of the more invasive plants on Kure include *Verbesina* (*Verbesina encelioides*), ironwood (*Casuarina equisetifolia*), and sand bur (*Cenchrus echinatus*).

RESTORATION PLANTS

Most of the native plants still thriving on Kure would be well suited for restoration efforts in the future. Low growing groundcovers such as *Boerhavia repens* and *Tribulus cistoides* grow vigorously, can help keep out weeds, and are used as nesting material by seabirds. *Eragrostis variabilis* and *Scaevola sericea* provide great seabird habitat, are successful restoration plants on Midway, and would probably be successful on Kure. Some of the rare plants mentioned earlier could also be propagated or reintroduced. Midway and Laysan could help provide a model for restoration on Kure.

VEGETATION TYPES

There are two islands that make up Kure Atoll, Green Island and Sand Island. Sand Island was one island and supported no plants at the time of this survey. In 1923, Sand Island was two sand islets "devoid of higher plant life" (Christophersen & Caum 1923). Lamoureux (1961) found Sand Island as two islands and reported "the vegetation consisted of less than a dozen scattered plants of *Boerhavia diffusa* and one tiny clump of *Eragrostis whitneyi* var. *caumii*. Observation of the smaller sand island from a distance of approximately 50 meters revealed no sign of vascular plants." Woodward (1972) knew Sand Island as "three sand bars...during the winter these islets may wash away."

The larger sand island of Kure Atoll, Green Island, is ringed with scattered heliotrope (*Tournefortia argentea*) trees and an almost impenetrable thicket of naupaka that extends somewhat into the central plain. Most of the central part of the island is covered with a dog hair thicket of *Verbesina*, and the south part of the island is a paved coral runway. The living quarters are located in about the center of the island and are surrounded by a lawn of Bermuda grass (*Cynodon dactylon*) and other lawn weeds. The major vegetation types on Kure include naupaka shrublands, *Verbesina* fields, *Tournefortia* forest, ironwood forest, Bermuda grass lawn, and runways.

NAUPAKA SHRUBLANDS

Naupaka (*Scaevola sericea*) forms a dense ring around the island of Kure that often reaches over ten feet high, generally occurring where *Verbesina* and the runway does not. Common plants of Kure such as *Boerhavia repens*, *Eragrostis variabilis*, *Cenchrus echinatus*, *Tribulus cistoides*, wiregrass (*Eleusine indica*), sweet alyssum (*Lobularia maritima*), *Polypogon interruptus*, and *Sporobolus pyramidatus* inhabit the openings in and adjacent to the naupaka. In addition, *Sicyos maximowiczii* and *Ipomoea indica* crawl on the margins of naupaka and over the few remaining "naupaka islands" in the central plain.

VERBESINA FIELDS

Verbesina (*Verbesina encelioides*) covers most of the inland plain and can be found almost anywhere on the island. Very little grows under *Verbesina*, which often covers 100% of the area and reaches heights of six feet, excluding any other plant species, except the occasional *Boerhavia repens*. More often, other plants only grow in openings within or adjacent to the dense fields of *Verbesina*.

TOURNEFORTIA FOREST

Heliotrope (*Tournefortia argentea*) trees ring the coast, especially the north and east coasts, where a *Tournefortia* forest has developed, often reaching heights in excess of 18 feet tall. *Tournefortia* generally grows between the coast and the band of naupaka ringing the island, often being the closest plant to the ocean.

IRONWOOD FOREST

There are two ironwood (*Casuarina equisetifolia*) groves, one near the radar reflector and one near the quarters. There are also about a couple dozen smaller individual trees scattered on the north coast and along the runway. Most trees are about 12 feet tall, but some reach heights of greater than 30 feet.

BERMUDA GRASS LAWN

The areas around the quarters, the base of the radio tower, and the road to the runway were heavily mowed for many years and are covered with predominantly Bermuda grass (*Cynodon dactylon*). These areas harbor many of the common lawn weeds found on Kure, including slender amaranth (*Amaranthus viridis*), *Chamaesyce maculata*, scarlet pimpernel (*Anagallis arvensis*), *Chenopodium murale*, fir leaved celery (*Ciclospermum leptophyllum*), *Boerhavia coccinea*, annual bluegrass (*Poa annua*), and lovegrass (*Eragrostis tenella*).

RUNWAYS

The runway is sparsely covered, primarily with *Fimbristylis cymosa*, and supports very little vegetation, which rarely gets higher than 4 inches. *Sporobolus pyramidatus* is somewhat common, particularly on the margins of the runway, *Boerhavia repens*, *Lobularia maritima*, *Spermacoce* sp., *Eragrostis paupera*, saltmarsh sand spurry (*Spergularia marina*), and *Sagina* sp. can be also be found scattered along the runway.

PREVIOUS BOTANICAL SURVEYS

CHRISTOPHERSEN & CAUM (1923)

E. Christophersen & E.L. Caum were part of the Tanager Expedition of 1923 that surveyed the Northwestern Hawaiian Islands (NWHI). They were the first record of the flora on Kure, and collected thirteen species of plants, all native.

"The largest islet of Kure is completely encircled by dunes, rising rather steeply from the beach. Most of it, including the tops and inner sides of the dunes is covered with a dense, almost impenetrable growth of *Scaevola frutescens*...which averages 5 to 6 feet in height, except in small areas, generally on the tops of the sand hills, where it is only about waist high and fairly open. In these openings and along the outer rim of the thicket are a few other plants, principally the tall bunch-grass *Eragrostis variabilis*, and the creeping *Boerhavia diffusa*. Toward the east central part of the islet is a large, open plain, probably about 20 to 25 acres in extent, entirely surrounded by the tall *Scaevola frutescens*...Here were found many plants seen in no other place on the islet. With the exception of a few 'islands' of *Scaevola frutescens*, scarcely any vegetation in this central plain was over 2 feet high, and most of it was considerably under that height. The two other islets are only small spits devoid of higher plant life".

CLAY (1959)

According to Woodward (1972), H.F. Clay reported a vegetative condition similar to that recorded in 1923. Clay was the first to find *Cynodon dactylon*, *Casuarina equisetifolia*, *Pluchea odorata*, and *Verbesina encelioides* on Kure. He found them growing near the radar reflector and surmised they were brought in on equipment from Midway in 1955 when the radar reflector was built. Clay also reported *Tournefortia argentea* and *Solanum nigrum* for the first time on Kure.

LAMOUREUX (1961)

C.H. Lamoureux inventoried Kure just as it was beginning to be occupied by the Coast Guard. He was the last person to collect many of the rare native plants now presumed extinct on Kure.

"All 13 species of vascular plants collected in 1923 by the Tanager Expedition...were still growing at Kure during the present visit in 1961...in addition one presumed native species, *Phyllostegia variabilis*, and 22 species of newly introduced weeds and cultivated plants are here reported from Kure for the first time".

"The Commanding officer of the Loran Station informed us that approximately 1500 plants for use in landscaping were flown in from Honolulu in March, 1961. Those which have survived are planted in the clearing around the buildings and the tennis court. In addition, *Cynodon dactylon* has been planted as a lawn grass and appears to be thriving. Another 200 pounds of seed of this species is being sown to create more lawn area. The introduction of more shade tree species is being considered. Some of the weed species were obviously introduced with the plants from Honolulu since they occur either in the cans with these plants or a short distance from the cans and not elsewhere on the island".

"It is too early to predict the total impact of the recently introduced plants on the indigenous plant species. However, if no further major construction occurs, most of the indigenous plant species are present in numbers large enough that they do not appear to be in immediate danger".

POBSP (1968)

According to Woodward (1972), the Smithsonian Institution's Pacific Ocean Biological Survey Program (POBSP) studied the plants of Kure during the Coast Guard occupation during the 1960's and reported the vegetation remaining much as it was when Lamoureux visited. However, they note for the first time the threats posed by *Verbesina encelioides*.

"*Verbesina encelioides* is the most important of the introduced species to the island avifauna. First found in October 1959 growing near the radar reflector, it is now widespread and growing in most of the open areas, mainly the central plain and near the radar reflector. Growing in dense stands up to four feet tall, it is a potential danger to the islands ecosystem,

especially its ground nesting birds and native vegetation. Birds have difficulty moving through *Verbesina* stands and when the plant becomes dense enough are no longer able to breed where it grows...Other plants cannot grow under it, so native plant species in the central plain are also threatened. The range of this species continues to expand rapidly on the island".

ANON (1979)

Probably D.R. Herbst. A list of species from DLNR titled "Kure Plant Species List -- 3-5 January, 1979". Though the author is anonymous, it gives us the only glimpse into the plants on Kure during this time period in which many new non-native plants were discovered, and some of the rarer native plants were no longer observed.

HERBST & WAGNER (1992)

A checklist of plants by D.R. Herbst and W.L. Wagner based on the collections in the herbaria of B.P. Bishop Museum and the University of Hawaii, literature citations, and personal collections and observations.

"Three taxa of plants endemic to the Leeward Islands are believed to have become extinct within the last 20 or 25 years. These are *Cenchrus agrimonioides* var. *laysanensis*, *Achyranthes atollensis*, and *Phyllostegia variabilis*. On Green Island, all three grew only in the central plain area. Competition from the golden crown-beard and sweet alyssum undoubtedly had a major role in their extinction on that island".

Their recommendations include: closely monitoring the vegetation to determine changes in composition and to detect new introductions, more vegetation mapping in conjunction with aerial photographs, more long term vegetation studies, and the creation of a well-illustrated, nontechnical manual of the plants of the Leeward Islands.

CONCLUSION

Kure has undergone many changes during the last century. It is still ringed by a dense thicket of *Scaevola*, and has many large stands of native plants. However, some of the rarest plants have recently gone extinct as a result of the central plain being over-run by *Verbesina*, which has proven to be a highly successful invader on Kure, threatening native plants and birds, and demonstrating the damage that invasive non-native plants can inflict on these sand atolls. We agree with Herbst & Wagner (1992) that the flora of Kure and other NWHI needs more monitoring and hope this report helps in that endeavor.

ANNOTATED CHECKLIST OF PLANTS ON KURE ATOLL

***Achyranthes atollensis* -- Achyranthes -- (Amaranthaceae) -- [Endemic]**

Not observed in 2001. First observed in 1923 by the Tanager Expedition who called it *A. splendens* var. *reflexa* and reported "only three or four plants were seen, in the central plain". Lamoureux (1961) reported finding it "Here and there on the central plain." Wagner et al. (1999) reported it "is either extinct or existing as seeds in the soil; no plants could be located during a complete survey of these islands by D. Herbst in 1988". Formerly scattered on the low sand islands of Kure Atoll, Midway Atoll, Pearl and Hermes Atoll, and Laysan, *Achyranthes* was never known to be common on Kure, and we concur with Herbst that it may be extinct or may exist as seeds in the soil. We also feel that it could possibly be hidden in the sea of *Verbesina* that occupies the area it was historically known from, the central plain. Though *A. atollensis* is now presumed extinct, it could possibly be brought back from seeds in herbariums or replaced by a close relative from the main Hawaiian Islands.

***Aleurites moluccana* -- Kukui nut -- (Euphorbiaceae) -- [Non-Native]**

Observed as seed in beach flotsam during this survey. Also observed as beach flotsam by Christophersen and Caum (1931).

***Aloe* sp. -- Aloe -- (Aloaceae) -- [Non-Native]**

Not observed in 2001. First reported as cultivated on Kure by Herbst & Wagner (1992). Probably killed during transition from Coast Guard to DLNR some time near 1993.

***Amaranthus spinosus* -- Spiny amaranth -- (Amaranthaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). It is generally a common lawn weed and the combination of reduced mowing and *Verbesina* expansion has probably led to its demise.

***Amaranthus viridis* -- Slender amaranth -- (Amaranthaceae) -- [Non-Native]**

Uncommon near quarters. First reported as naturalized on Kure by Herbst & Wagner (1992).

***Anagallis arvensis* -- Scarlet pimpernel -- (Primulaceae) -- [Non-Native]**

Occasional near quarters and on runway in compacted sand. First reported from Kure in 1979 (Anon 1979). This collection in 2001 (Starr & Martz 010522-6 BISH) represents a new island record for Kure.

***Araucaria heterophylla* -- Norfolk Island pine -- (Aruacariaceae) -- [Non-Native]**

One tree cultivated near quarters. First reported from Kure in 1979 (Anon 1979). Collected in 2001 (Starr & Martz 010522-10 BISH).

***Bidens alba* var. *radiata* -- Spanish needles -- (Asteraceae) -- [Non-Native]**

Not observed in 2001. First reported as naturalized on Kure by Herbst & Wagner (1992).

***Boerhavia coccinea* -- 'Alena haole -- (Nyctaginaceae) -- [Non-Native]**

Uncommon. Found only near quarters. First observed on Kure in 2001, this collection (Starr & Martz 010523-1 BISH) represents a new island record for Kure.

***Boerhavia repens* -- 'Alena, boerhavia -- (Nyctaginaceae) -- [Indigenous]**

Common in all parts of the island, even under dense *Verbesina*. Often found at margins of naupaka. First observed by Christophersen & Caum (1923) who called it *B. diffusa* and reported it "growing in the central plain also in fairly open places of the *Scaevola* scrub, and at its outer edge". Lamoureux (1961) collected *B. repens* and reported "abundant all over Green Island under and around *Scaevola* bushes and on the central plain. *Boerhavia* is growing rapidly in recently cleared areas and has covered the albatross runways which were cleared in October 1959. It is growing through the black top at the east end of the landing strip. About a dozen plants are growing on the larger sand island".

***Cassytha filiformis* -- Kauna'oa pehu -- (Lauraceae) -- [Indigenous]**

First reported as *Cuscuta sandwichiana* by Ethan Shiinoki (2000). In 2001, a small patch of this parasitic vine was observed on the northeastern coast hosting mainly on naupaka. This collection (Starr & Martz 010522-12 BISH) represents a new island record for Kure and a new record for the NWHI.

***Casuarina equisetifolia* -- Ironwood -- (Casuarinaceae) -- [Non-Native]**

Occasional. The skeletons of about a dozen or so large trees that were killed around 1993 stand around the quarters, near the reflector tower, and along the runway. Four large trees are still alive near the reflector tower, and there are a few lone trees alive along the coast, and along the runway. About a dozen or so small trees have grown up near the quarters since 1993. The ironwoods were probably planted by the Coast Guard. Lamoureux (1961) notes "In addition to the larger trees reported by Clay, several young plants are being grown around the quarters". Most of the cone bearing trees were flagged and will be controlled later this summer. There is still a lot of seed bank under these trees so follow up control will be needed. A few male trees, or non-cone bearing trees, will probably be left for shade and roosting/nesting areas.

***Cenchrus agrimonioides* var. *laysanensis* -- Kamanomano -- (Poaceae) -- [Endemic]**

Not observed in 2001. Never common on Kure. Christophersen and Caum (1923) reported observing it "in two clumps only, one in the *Scaevola* scrub and one on the edge of the central plain; growing to a height of 6 feet". Lamoureux (1961) reported "half a dozen clumps in one small area of the central plain, intermixed with *Boerhavia* and *Scaevola*". Though probably extinct on Kure, a close relative in the main Hawaiian Islands (*C. a.* var. *agrimonioides*) could be used in restoration efforts.

***Cenchrus echinatus* -- Sandbur -- (Poaceae) -- [Non-Native]**

Common almost anywhere on the island, especially in open areas. Lamoureux (1961) collected sandbur for the first time on Kure and reported "two plants observed, one near the living quarters, the other near the east end of the landing strip. Both had set large quantities of seed so this plant will probably spread." *Cenchrus echinatus* has spread in open areas and is constantly clinging to shoelaces, socks, and perhaps feathers of those that pass by. As proven by the Laysan eradication, with enough resources, it can be eradicated.

***Chamaesyce hirta* -- Hairy spurge -- (Euphorbiaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). This spurge, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended in 1993.

***Chamaesyce hypericifolia* -- Graceful spurge -- (Euphorbiaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) called it *Euphorbia glomerifera* and reported "weed in cans with cultivated plants near quarters and spreading into areas nearby". This spurge, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended in 1993.

***Chamaesyce maculata* -- Spurge -- (Euphorbiaceae) -- [Non-Native]**

Occasional to common near quarters, on runway, and elsewhere. Collected in 2001 (Starr & Martz 010522-11 BISH) for confirmation of identification.

***Chenopodium murale* -- Goosefoot -- (Chenopodiaceae) -- [Non-Native]**

Occasional near quarters, southwest end of runway, and near base of old LORAN tower. First reported as naturalized on Kure by Herbst & Wagner (1992).

***Chloris barbata* -- Swollen fingergrass -- (Poaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) called it *C. inflata* and reported finding it in "disturbed areas near quarters and on roadsides". This grass, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended.

***Chloris virgata* -- Feather fingergrass -- (Poaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) reported finding it in "disturbed areas near quarters". This grass, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended.

***Ciclospermum leptophyllum* -- Fir leaved-celery -- (Apiaceae) -- [Non-Native]**

Common in lawn areas, runways, and other open areas. First reported from Kure in 1979 (Anon 1979), but not known from Wagner et al. (1999). This collection (Starr & Martz 010522-7 BISH) represents a new island record for Kure.

***Coccoloba uvifera* -- Sea grape -- (Polygonaceae) -- [Non-Native]**

One tree planted near quarters which will probably be controlled this summer. First reported from Kure in 1979 (Anon 1979). Collected in 2001 (Starr & Martz 010523-2 BISH).

***Cocos nucifera* -- Coconut, niu -- (Arecaceae) -- [Non-Native]**

No live trees were observed in 2001. However, about a dozen dead coconuts were found washed up on the beach, and further inland on the side of the runway. Christophersen & Caum (1923) found two dead nuts as beach drift. Lamoureux (1961) reported "seedlings planted near quarters".

***Codiaeum variegatum* -- Croton -- (Euphorbiaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) reported "cultivated near quarters". Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

***Conyza bonariensis* -- Hairy horseweed -- (Asteraceae) -- [Non-Native]**

Occasional in lawn areas. First collected by Lamoureux (1961) who reported "one clump noted near quarters".

***Coronopus didymus* -- Swinecress -- (Brassicaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). We know of no collections of this species from Kure. It is easily mistaken for *Ciclospermum leptophyllum* and could have either been misidentified as such, or has disappeared.

***Crinum asiaticum* -- Spider lily -- (Liliaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

***Cynodon dactylon* -- Bermuda grass -- (Poaceae) -- [Non-Native]**

Common near quarters and near base of old LORAN tower. Lamoureux (1961) reported finding it "on dunes and beach near radar reflector tower, and used around quarters as lawn grass". He adds "*Cynodon dactylon* has been planted as a lawn grass and appears to be thriving. Another 200 pounds of seed of this species is being sown to create more lawn areas". Bermuda grass has survived since Coast Guard occupation ended, and seems likely to remain a conspicuous member of Kure's flora for some time.

***Cyperus rotundus* -- Purple nut sedge -- (Cyperaceae) -- [Non-Native]**

Rare in exposed areas near the quarters. Lamoureux (1961) reported "a few plants in disturbed areas near quarters".

***Digitaria ciliaris* -- Henry's crab grass -- (Poaceae) -- [Non-Native]**

Occasional near quarters. Lamoureux (1961) called it *D. sanguinalis* and reported finding it in "disturbed areas near quarters".

***Eleusine indica* -- Wiregrass -- (Poaceae) -- [Non-Native]**

Occasional to common near quarters and in open areas. Lamoureux (1961) reported finding it in "disturbed areas near quarters".

***Emilia fosbergii* -- Pualele -- (Asteraceae) -- [Non-Native]**

Not observed in 2001. First collected by Lamoureux (1961) who called it *E. javanica* and reported "weed in cans with cultivated plants near quarters and spreading into open areas nearby". This weedy aster, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended in 1993.

***Entada phaseoloides* -- St. Thomas bean -- (Fabaceae) -- [Indigenous ?]**

Not observed in 2001. Christophersen and Caum (1931) reported collecting one seed of *Entada scandens* as beach drift.

***Eragrostis paupera* -- Dwarf bunch grass -- (Poaceae) -- [Indigenous]**

Occasional to common on runway. Kure probably supports the largest population in the NWHI. This rare grass is one of the natives that has actually benefited from coast guard occupation, specifically the building of the runway. Christophersen & Caum (1923), who called it *E. falcata*, reported it "grows sparingly on the outer side of the dunes at the northwest corner of the islet; most of the tufts seen were dead". Lamoureux (1961) called it *E. whitneyi* var. *caumii* and reported "common in open sandy areas on lagoon side. One clump on the larger sand island."

***Eragrostis tenella* -- Love grass -- (Poaceae) -- [Non-Native]**

Rare. Near water tank. Lamoureux (1961) called it *E. amabilis* and reported finding it in "disturbed areas near quarters". Collected in 2001 (Starr & Martz 010522-5 BISH) representing a new island record for Kure.

***Eragrostis variabilis* -- 'Emoloa, bunch grass -- (Poaceae) -- [Endemic]**

Occasional. Scattered around island, especially on margins of naupaka and exposed sandy areas. More common on North and East end of island. David Smith (pers. comm.) says there has been a decline of naupaka in the central plain in recent years. Christophersen & Caum (1923) reported that it "grows in the central plain and in isolated clumps in openings in the *Scaevola* scrub".

***Erythrina* sp. -- Coral tree -- (Fabaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR. *E. variegata* var. *orientalis* is cultivated on nearby Midway Atoll (Starr & Martz 1999) and the same species could have been the one previously cultivated on Kure.

***Euphorbia peplus* -- Petty spurge -- (Euphorbiaceae) -- [Non-Native]**

Uncommon. Found sparingly near quarters. First reported from Kure in 1979 (Anon 1979), but not noted in Wagner et al. (1999). This collection (Starr & Martz 010522-4 BISH) represents a new island record for Kure.

***Fimbristylis cymosa* -- Button sedge, Mau'u 'aki 'aki -- (Cyperaceae) -- [Indigenous]**

Common on runway, and occasionally found in compacted sand. This is another native species that appears to have benefited from Coast Guard occupation and the runway. First reported from Kure in 1979 (Anon 1979), this hardy sedge could have hitched a ride from the runway on Midway Atoll where it is common (Starr & Martz 1999).

***Gaillardia pulchella* -- Firewheel -- (Asteraceae) -- [Non-Native]**

Not observed in 2001. Reported for the only time from Kure by Herbst and Wagner (1992).

***Gnaphalium sandwicense* var. *sandwicense* -Cudweed-(Asteraceae)-[Endemic]**

Occasional in disturbed areas, especially near quarters in areas with compacted sand. First collected by Lamoureux (1961) who called it *G. sandwicense* and reported "abundant in recently cleared areas around quarters".

***Helianthus annuus* -- Sunflower -- (Asteraceae) -- [Non-Native]**

Not observed in 2001. First observed by Lamoureux (1961) who reported "cultivated near quarters". Sunflowers are ephemeral and probably did not persist more than a year.

***Hibiscus* sp. -- Hibiscus -- (Malvaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) reported "cultivated near quarters". Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

***Ipomoea indica* -- Morning glory, Koali 'awa -- (Convolvulaceae) -- [Indigenous]**

Common on the ground near quarters in open areas, and found on naupaka in the central plain and along the runway. Christophersen and Caum (1923) reported "common, climbing over the *Scaevola* bushes". Lamoureux (1961) reported "common on central plain".

***Ipomoea pes-caprae* -- Beach morning glory -- (Convolvulaceae) -- [Indigenous]**

Rare. Found only at the south west point of the island. First reported from Kure in 1979 (Anon 1979), but not known from Wagner et al. (1999). This collection (Starr & Martz 010522-9 BISH) represents a new island record for Kure.

***Lepidium bidentatum* var. *owaihiense* -- 'Anaunau -- (Brassicaceae) -- [Endemic]**

Not observed in 2001. Could have been overlooked or mistaken for *L. virginicum*. Christophersen & Caum (1923) called it *L. owaihiense* and reported "growing in open places of the *Scaevola* scrub and in the central plain". Lamoureux (1961) reported finding it "abundant on the central plain and invading areas recently cleared for installation of radio tower guy wires". Though presumed extinct on Kure, seed from Pearl & Hermes Atoll could be used in restoration efforts.

***Lepidium virginicum* -- Virginia pepperweed -- (Brassicaceae) -- [Non-Native]**

Occasional. Found near quarters. First reported from Kure in 1979 (Anon 1979), but not noted by Wagner et al. (1999). Collected in 2001 (Starr & Martz 010522-1 BISH) representing a new island record for Kure.

***Lepturus repens* -- Lepturus -- (Poaceae) -- [Indigenous]**

Not observed in 2001. Apparently, there was never too much of this grass on Kure. Christophersen & Caum (1923) reported "observed in one place only, a fairly open space of the *Scaevola* scrub". Lamoureux (1961), who called it *L. r. var. subulatus*, found "several clumps near radar reflector tower and near east end of plain". Though presumed extinct on Kure, seed from Midway Atoll could be used in restoration efforts.

***Lipochaeta integrifolia* -- Nehe -- (Asteraceae) -- [Endemic]**

Not observed in 2001. Christophersen & Caum (1923) reported finding it "growing in the central plain only". Lamoureux (1961) reported "common on central plain, moving into disturbed areas". Though presumably extinct on Kure, this prostrate native could be reintroduced from the main Hawaiian Islands, where it is still common.

***Lobularia maritima* -- Sweet alyssum -- (Brassicaceae) -- [Non-Native]**

Common and widespread over almost the entire island. Similar to Midway Atoll (Starr & Martz 1999), Kure is covered with a mat of *Lobularia* in almost all open places. First reported from Kure in 1979 (Anon 1979). Herbst & Wagner (1992) reported that "golden crown-beard and sweet alyssum (*Lobularia maritima*) have become widespread on Green Island and are undergoing population explosions (Corn et al. 1981)" and add "three taxa of plants endemic to the Leeward Hawaiian Islands are believed to have become extinct within the past 20 or 25 years...On Green Island, all three grew only in the central plain area. Competition from the golden crown-beard and sweet alyssum undoubtedly had a major role in their extinction on that island". We agree that sweet alyssum is out-competing native plants. However, because it is sweet smelling and allows nesting for seabirds, it is tolerated by most.

***Medicago polymorpha* -- Bur clover -- (Fabaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). This plant, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended in 1993.

***Mucuna gigantea*. -- Sea bean -- (Fabaceae) -- [Indigenous]**

Found in the bolus (barfed up undigestible items) of a dead albatross in the center of the island. Previously not known from Kure (Wagner et al. 1999). This collection (Starr & Martz 010524-1 BISH) represents a new island record for Kure.

***Mucuna urens* -- Cow itch bean -- (Fabaceae) -- [Indigenous ?]**

Found in beach flotsam on NW part of island by Patti Haase with NMFS. Christophersen & Caum (1923) reported finding two seeds of *Mucuna urens* as beach flotsam. However, Wagner et al. (1999) did not report it from Kure. This collection (Starr & Martz 010523-3 BISH) represents a new island record for Kure.

***Nerium oleander* -- Oleander -- (Apocynaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) reported "cultivated near quarters". Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

***Noronhia emarginata* -- Madagascar olive -- (Oleaceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure in 1979 (Anon 1979). Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

***Oenothera lacinata* -- Evening primrose -- (Onagraceae) -- [Non-Native]**

Common over most of the island, especially in open areas and near the coast. First reported on Kure by Herbst & Wagner (1992), but not known from Kure in Wagner et al. (1999). This species still needs to be collected from Kure.

***Oxalis corniculata* -- Yellow wood sorrel -- (Oxalidaceae) -- [Non-Native]**

Occasional near quarters. First reported from Kure in 1979 (Anon 1979). This collection (Starr & Martz 010522-8 BISH) represents a new island record for Kure.

***Pandanus* sp. -- Hala -- (Pandanaeae) -- [Native to Hawaii, but not NWHI]**

Not observed in 2001. Lamoureux (1961) reported "variegated variety planted near the living quarters". Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

***Paspalum fimbriatum* -- Panama paspalum -- (Poaceae) -- [Non-Native]**

Not observed in 2001. First reported as naturalized on Kure by Herbst & Wagner (1992). This grass, along with many other lawn weeds, appears to have disappeared since the Coast Guard occupation ended in 1993.

***Paspalum* sp. -- Paspalum grass -- (Poaceae) -- [Non-Native]**

Not observed in 2001. First reported as naturalized on Kure by Herbst & Wagner (1992). Could have possibly been *P. setaceum*, which is one of the most common lawn grasses on Midway Atoll (Starr & Martz 1999).

***Phyllostegia variabilis* -- Native mint -- (Lamiaceae) -- [Endemic]**

Not observed in 2001. Lamoureux (1961) reported "two sterile plants were found on the central plain growing in a patch of *Boerhavia diffusa* and *Solanum nelsonii* about 100 meters from the tennis courts. The vegetative characters match those of *Phyllostegia variabilis*, a species previously recorded only from Laysan and Midway. Certain identification, however, awaits the collection of fertile material". Fertile material was never collected, and this species is now presumed extinct over its entire range.

***Pluchea symphytifolia* -- Sourbush -- (Asteraceae) -- [Non-Native]**

Not observed in 2001. First reported from Kure by Clay who reported "growing near the radar reflector" and surmised seeds were unintentionally brought from Midway in 1955 (Woodward 1972).

***Poa annua* -- Annual bluegrass -- (Poaceae) -- [Non-Native]**

Uncommon. Only found around quarters. First reported as naturalized on Kure by Herbst & Wagner (1992).

***Polypogon interruptus* -- Ditch polypogon -- (Poaceae) -- [Non-Native]**

Common near quarters, on the runway, and in open areas. First reported as naturalized on Kure by Herbst & Wagner (1992). This grass is easily mistaken for 'aki 'aki (*Sporobolus virginicus*).

***Portulaca* sp. -- Pigweed, 'ihi -- (Portulacaceae) -- [Unknown]**

Uncommon near quarters and edge of runway in exposed, compacted sand. First reported from Kure in 1979 (Anon 1979). There was no fertile material to determine which species was present. If fertile material is found, it should be collected.

***Sagina* sp. -- Pearlwort -- (Caryophyllaceae) -- [Non-Native]**

Occasional in compacted soils on and near the runway. First observed in 2001, this collection (Starr & Martz 010522-3 BISH) represents a new island record for Kure.

***Scaevola sericea* -- Naupaka -- (Goodeniaceae) -- [Indigenous]**

Common over entire island. Dominant near coast, forming an almost impenetrable thicket that rings the island's coastal dunes. Christophersen & Caum (1923) called it *S. frutescens* and reported "the dominant plant, forming a dense scrub over the island, leaving a fairly open plain towards the eastern end, in which it was only found scattered in isolated 'islands'". Lamoureux (1961) reported "abundant all over island forming dense thickets from one to three meters high". Though naupaka is declining in the central plain, presumably because it is being out-competed by *Verbesina*, it seems likely to remain a dominant member of Kure's flora.

***Setaria verticillata* -- Bristly foxtail -- (Poaceae) -- [Non-Native]**

Occasional in open areas. First collected by Lamoureux (1961) who reported "one plant near the west end of the landing strip".

***Sicyos maximowiczii* -- 'Anunu -- (Cucurbitaceae) -- [Endemic]**

Occasional in remnant naupaka patches in center of island. Christophersen & Caum (1923) called it *S. hispidus* and reported finding it "growing on the 'Scaevola islands' in the central plain and on the inner edge of the scrub". Lamoureux (1961) reported "common on central plain". This is probably the rarest native plant present on Kure today.

***Solanum americanum* -- American nightshade -- (Solanaceae) -- [Non-Native ?]**

Occasional near quarters, at margins of naupaka in central plain, in *Verbesina*, and in open areas. Lamoureux (1961) called it *S. nigrum* and reported "common on central plain, especially in disturbed areas".

***Solanum nelsonii* -- Popolo -- (Solanaceae) -- [Endemic]**

Not observed in 2001. Christophersen & Caum (1923) who called it *S. n.* var. *intermedium* reported "in the central plain and in openings of the *Scaevola* scrub nearby; elsewhere rare". Lamoureux (1961) reported "common around edges of and occasionally in *Scaevola* thickets on central plain". Though presumed extinct on Kure, seed from Midway Atoll could be used in restoration efforts.

***Sonchus oleraceus* -- Sow thistle -- (Asteraceae) -- [Non-Native]**

Occasional in grassy open areas especially near the quarters. First collected by Lamoureux (1961) who reported "disturbed areas near quarters".

***Spergularia marina* -- Saltmarsh sand spurry -- (Caryophyllaceae) -- [Non-Native]**

Occasional to common on runway and compacted soils. First collect by Lamoureux (1961) who reported "one plant growing in the center of the landing strip, a few others noted along the road leading to the radio tower".

***Spermacoce* sp. ? -- Buttonweed -- (Rubiaceae) -- [Non-Native]**

An unidentified low growing plant with Melastome like leaves and yellow flowers clustered in a group at the leaf axils was found to be common on runway, near quarters, and southwest tip of island. We have tentatively identified it as *Spermacoce* sp. No Rubiaceae have been recorded in previous surveys. First observed in 2001, this collection (Starr & Martz 010522-2 BISH) represents a new island record for Kure.

***Sporobolus pyramidatus* -- Dropseed -- (Poaceae) -- [Non-Native]**

Common on runway margins and in open areas. First reported as naturalized on Kure by Herbst & Wagner (1992). This grass is easily mistaken for 'aki 'aki (*Sporobolus virginicus*).

***Stellaria media* -- Common chickweed -- (Caryophyllaceae) -- [Non-Native]**

Uncommon around quarters and edge of runway. First reported as naturalized on Kure by Herbst & Wagner (1992).

***Terminalia catappa* -- False kamani -- (Combretaceae) -- [Non-Native]**

The skeleton of one large tree near the quarters still stands where it was killed sometime near 1993. Lamoureux (1961) reported "cultivated near quarters".

***Thespesia populnea* -- Milo -- (Malvaceae) -- [Non-Native]**

Not observed in 2001. Lamoureux (1961) reported "cultivated near quarters". Probably removed during transfer of Kure Atoll from Coast Guard to State DLNR.

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

Common in open areas and in margins of naupaka. Christophersen & Caum (1923) reported "growing in the central plain only". Lamoureux (1961) reported "here and there in the central plain and on roadsides". Nohu seems to be doing quite well on Kure at this time.

***Tournefortia argentea* -- Tree Heliotrope -- (Boraginaceae) -- [Non-Native]**

Common along the coast. Large stands of mature trees can be found along the North and East shores. First observed in 1959 by Clay who reported observing one young *Tournefortia* tree growing on the windward shore. Lamoureux (1961) who called it *Messerschmidia argentea* reported "several trees near eastern tip of island, one on south-central part". It seems likely that *Tournefortia* will continue to expand its range on Kure.

***Verbesina encelioides* -- Golden crown-beard -- (Asteraceae) -- [Non-Native]**

Common and widespread over almost the entire island, especially the interior of the island. Lamoureux (1961) reported "several plants near radar reflector tower and spreading onto nearby lagoon beach, with seedlings also present in disturbed areas near quarters". Both seabirds and native plants have been displaced by this highly invasive plant. Not much grows under the dense, shady dog hair thickets, except occasionally *Boerhavia repens* and a few others in light gaps and edges. Currently, *Verbesina* control includes keeping it away from naupaka and weed-whacking it around camp and the old antenna radials. More resources would be needed in order to reverse its invasion.

PLANTS RECORDED FROM KURE ATOLL

Scientific Name	Common Name	Status	Starr	Herbst	Anon	POBSP	Lamoureux	Clay	Christoph.
			& Martz	& Wagner					2001
			2001	1992	1979	1968	1961	1959	1923
<i>Achyranthes atollensis</i>	Achyranthes	E	-	R	-	X	X	-	X
<i>Aleurites moluccana</i>	Kukui	N	S	-	-	-	-	-	S
<i>Aloe</i> sp.	Aloe	C	-	R	-	-	-	-	-
<i>Amaranthus spinosus</i>	Spiny pigweed	N	-	R	-	X	-	-	-
<i>Amaranthus viridis</i>	Slender amaranth	N	X	R	-	-	-	-	-
<i>Anagallis arvensis</i>	Scarlet pimpernel	N	X	R	X	-	-	-	-
<i>Araucaria heterophylla</i>	Norfolk Island Pine	C	X	R	X	-	-	-	-
<i>Bidens alba</i> var. <i>radiata</i>	Spanish needles	N	-	R	-	-	-	-	-
<i>Boerhavia coccinea</i>	Boerhavia	N	X	-	-	-	-	-	-
<i>Boerhavia repens</i>	'Alena	I	X	R	X	X	X	X	X
<i>Cassytha filiformis</i>	Kauna'oa pehu	I	X	-	-	-	-	-	-
<i>Casuarina equisetifolia</i>	Ironwood	C	X	R	-	X	X	X	-
<i>Cenchrus agrimonioides</i> var. <i>laysanensis</i>	Kamanomano	E	-	R	-	X	X	-	X
<i>Cenchrus echinatus</i>	Sandbur	N	X	R	X	X	X	-	-
<i>Chamaesyce hirta</i>	Hairy spurge	N	-	R	X	X	-	-	-
<i>Chamaesyce hypericifolia</i>	Graceful spurge	N	-	R	X	X	X	-	-
<i>Chamaesyce maculata</i>	Middle spurge	N	X	R	X	-	-	-	-
<i>Chenopodium murale</i>	Goosefoot	N	X	R	-	-	-	-	-
<i>Chloris barbata</i>	Swollen fingergrass	N	-	R	X	X	X	-	-
<i>Chloris virgata</i>	Feather fingergrass	N	-	R	-	X	X	-	-
<i>Ciclospermum leptophyllum</i>	Fine-leaved celery	N	X	R	X	-	-	-	-
<i>Coccoloba uvifera</i>	Sea grape	C	X	R	X	-	-	-	-
<i>Cocos nucifera</i>	Coconut	C	S	R	-	X	X	-	S
<i>Codiaeum variegatum</i>	Croton	C	-	R	-	-	X	-	-
<i>Conyza bonariensis</i>	Hairy horseweed	N	X	R	-	X	X	-	-
<i>Coronopus didymus</i>	Swine cress	N	-	R	X	-	-	-	-
<i>Crinum asiaticum</i>	Spider lily	C	-	R	X	-	-	-	-
<i>Cynodon dactylon</i>	Bermuda grass	N	X	R	X	X	X	X	-
<i>Cyperus rotundus</i>	Nutgrass	N	X	R	X	X	X	-	-

Scientific Name	Common Name	Status	Starr	Herbst	Anon	POBSP	Lamoureux	Clay	Christoph.
			& Martz	& Wagner					& Caum
			2001	1992	1979	1968	1961	1959	1923
<i>Digitaria ciliaris</i>	Henry's crabgrass	N	X	R	X	X	X	-	-
<i>Eleusine indica</i>	Goosegrass	N	X	R	X	X	X	-	-
<i>Emilia fosbergii</i>	Red pualele	N	-	R	-	X	X	-	-
<i>Entada scandens</i>	St. Thomas bean	I?	-	-	-	-	-	-	S
<i>Eragrostis paupera</i>	Dwarf Eragrostis	I	X	R	X	X	X	X	X
<i>Eragrostis tenella</i>	Japanese lovegrass	N	X	R	X	-	X	-	-
<i>Eragrostis variabilis</i>	Emoloa	E	X	R	X	X	X	X	X
<i>Erythrina</i> sp.	False wiliwili	C	-	R	X	-	-	-	-
<i>Euphorbia peplus</i>	Petty spurge	N	X	R	X	-	-	-	-
<i>Fimbristylis cymosa</i>	Button sedge	I	X	R	X	-	-	-	-
<i>Gaillardia pulchella</i>	Firewheel	N	-	R	-	-	-	-	-
<i>Gnaphalium sandwicense</i> var. <i>sand.</i>	Ena ena	E	X	R	-	X	X	-	-
<i>Helianthus annuus</i>	Sunflower	C	-	R	-	-	X	-	-
<i>Hibiscus</i> sp.	Hibiscus	C	-	R	-	-	X	-	-
<i>Ipomoea indica</i>	Koali awa	I	X	R	X	X	X	X	X
<i>Ipomoea pes-caprae</i>	Pohuehue	I	X	R	X	-	-	-	-
<i>Lepidium bidentatum</i> var. <i>o-waihiense</i>	Anaunau	E	-	R	X	X	X	X	X
<i>Lepidium virginicum</i>	Pepper grass	N	X	R	-	X	-	-	-
<i>Lepturus repens</i>	Lepturus	I	-	R	X	X	X	X	X
<i>Lipochaeta integrifolia</i>	Nehe	I	-	R	-	X	X	X	X
<i>Lobularia maritima</i>	Sweet alyssum	N	X	R	X	-	-	-	-
<i>Medicago polymorpha</i>	Bur clover	N	-	R	X	-	-	-	-
<i>Mucuna gigantea</i>	Sea bean	I	S	-	-	-	-	-	-
<i>Mucuna urens</i>	Cow-itch plant	I?	S	-	-	-	-	-	S
<i>Nerium oleander</i>	Oleander	C	-	R	-	X	X	-	-
<i>Noronhia emarginata</i>	Madagascar olive	C	-	R	X	-	-	-	-
<i>Oenothera lacinata</i>	Evening primrose	N	X	R	-	-	-	-	-
<i>Oxalis corniculata</i>	Yellow wood sorrel	N	X	R	X	-	-	-	-
<i>Pandanus tectorius</i>	Hala	C	-	R	-	-	X	-	-
<i>Paspalum fimbriatum</i>	Columbia grass	N	-	R	-	-	-	-	-
<i>Paspalum</i> sp.	Unknown Paspalum	N	-	R	-	-	-	-	-

Scientific Name	Common Name	Status	Starr	Herbst	Anon	POBSP	Lamoureux	Clay	Christoph.
			& Martz	& Wagner					2001
<i>Phyllostegia variabilis</i>	Native mint	E	-	R	-	X	X	-	-
<i>Pluchea symphytifolia</i>	Sour bush	N	-	R	-	X	-	X	-
<i>Poa annua</i>	Annual bluegrass	N	X	R	-	-	-	-	-
<i>Polypogon interruptus</i>	Ditch polypogon	N	X	R	-	-	-	-	-
<i>Portulaca</i> sp.	Common purslane	N	X	R	X	-	-	-	-
<i>Sagina</i> sp.	Pearlwort	N	X	-	-	-	-	-	-
<i>Scaevola sericea</i>	Naupaka	I	X	R	X	X	X	X	X
<i>Setaria verticillata</i>	Bristly foxtail	N	X	R	-	X	X	-	-
<i>Sicyos maximowiczii</i>	Anunu	E	X	R	X	X	X	X	X
<i>Solanum americanum</i>	Glossy nightshade	N?	X	R	X	X	X	X	-
<i>Solanum nelsonii</i>	Popolo	E	-	R	X	X	X	X	X
<i>Sonchus oleraceus</i>	Sow thistle	N	X	R	X	X	X	-	-
<i>Spergularia marina</i>	Salt marsh sand spurry	N	X	R	-	X	X	-	-
<i>Spermacoce</i> sp.	Spermacoce ?	N	X	-	-	-	-	-	-
<i>Sporobolus pyramidatus</i>	Sporobolus	N	X	R	-	-	-	-	-
<i>Stellaria media</i>	Common chickweed	N	X	R	-	-	-	-	-
<i>Terminalia catappa</i>	False kamani	C	-	R	-	-	X	-	-
<i>Thespesia populnea</i>	Milo	C	-	R	-	-	X	-	-
<i>Tournefortia argentea</i>	Tree heliotrope	N	X	R	-	X	X	X	-
<i>Tribulus cistoides</i>	Nohu	I	X	R	X	X	X	X	X
<i>Verbesina encelioides</i>	Golden crown-beard	N	X	R	X	X	X	X	-

(X) = Present.

(-) = Not present.

(C) = Cultivated -- Non-native.

(N) = Naturalized -- Non-native.

(I) = Indigenous -- Native.

(E) = Endemic -- Native.

(S) = Seed found as beach flotsam or albatross bolus.

(R) = Reports as of 1992 of any collections, literature citations, or observations ever made on Kure. It does not indicate presence or absence in 1992.

BIBLIOGRAPHY

- Christophersen, E. and E.L. Caum. 1931. Vascular Plants of the Leeward Islands, Hawaii. Bernice P. Bishop Museum, Bulletin 81, Tanager Expedition, publication Number 7. Bishop Museum Press, Honolulu, Hawaii.
- Clay, H.F. 1961. Narrative Report of Botanical Field Work on Kure Island. In: Atoll Research Bulletin, No. 78. The Smithsonian Institution, Washington, D.C.
- Corn, C.A., D.R. Herbst, and C.H. Lamoureux. 1981. Floristic Changes on Green Island, Kure Atoll. In: Abstracts, XIII Internatl. Bot. Congr., coll. D.J. Carr, 110.
- Herbst, D.R. and W.L. Wagner. 1992. Alien Plants on the Northwestern Hawaiian Islands. In: Alien Plant Invasions in Native Ecosystems of Hawaii. C.P. Stone, C.W. Smith, and J.T. Tunison, eds. University of Hawaii Cooperative National Park Resources Studies Unit, University of Hawaii Press, Honolulu, Hawaii.
- Lamoureux, C.H. 1961. Botanical Observations on Leeward Hawaiian Atolls. In: Atoll Research Bulletin, No. 79. The Smithsonian Institution, Washington, D.C.
- Shiinoki, E. 2000. Kure Atoll Field Camp. Trip report for State Department of Land and Natural Resources, Division of Forestry and Wildlife.
- Starr, F. and K. Martz. 1999. Botanical Survey of Midway Atoll 1999 Update. In: 1995-1999 Baseline Surveys for Alien Species in Marine and Terrestrial Habitats on Midway Atoll National Wildlife Refuge. United States Fish and Wildlife Service, Honolulu, Hawaii.
- Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the Flowering Plants of Hawaii, 2 vols. Bishop Museum Special Publication 83. University of Hawaii Press and Bishop Museum Press, Honolulu, Hawaii.
- Woodward, P.W. 1972. The Natural History of Kure Atoll, Northwestern Hawaiian Islands. In: Atoll Research Bulletin, No. 164. The Smithsonian Institution, Washington, D.C.

VEGETATION TYPES OF KURE ATOLL -- LIST OF FIGURES

The following figures help document the different vegetation types present on Kure Atoll better than words can alone. Pictures were taken during the period of May 21-25, 2001.

Figure 1. 1972 Vegetation map of Kure Atoll from (Woodward 1972)

Figure 2. 2001 Vegetation map of Kure Atoll (Starr, Martz, and Loope 2001)

Figure 3. Looking north from pier. The beach rises steeply to a naupaka (*Scaevola sericea*) thicket that rings the island. Large heliotrope (*Tournefortia argentea*) trees can be seen above the naupaka.

Figure 4. Dense naupaka thicket with *Tournefortia* trees lining coast of northeast tip of island.

Figure 5. Bermuda grass (*Cynodon dactylon*) lawn with golden crown-beard (*Verbesina encelioides*) fields in background. Lone ironwoods (*Casuarina equisetifolia*) can be seen in the distance.

Figure 6. Field of *Verbesina* in the central plain, the area where all the rare plants were historically known from.

Figure 7. Looking west, herbs and grasses cover the runway, naupaka borders it, a *Tournefortia* grove can be seen on the left, and an ironwood grove is visible on the right.

Figure 8. East end of runway. Covered with nohu (*Tribulus cistoides*) and 'alena (*Boerhavia repens*).

Figure 9. Camp (quarters). Visible is a *Cynodon* lawn, dead ironwood trees, young ironwood trees, one dead false kamani (*Terminalia catappa*) tree, and fields of *Verbesina* behind the quarters.

Figure 10. Taken from camp facing east. Visible is a *Cynodon* lawn, small ironwood trees, *Verbesina* fields, and a remnant naupaka island. *Tournefortia* and ironwood trees can also be seen in the distance.

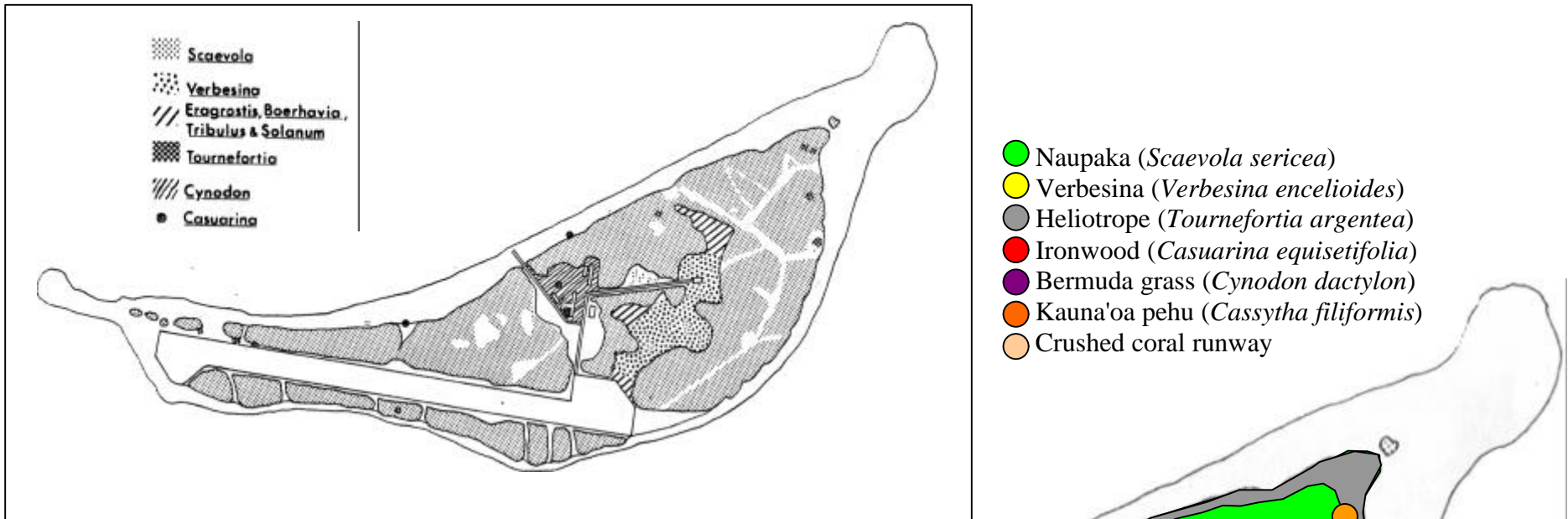


Figure 1. 1972 Vegetation map of Kure Atoll from (Woodward 1972)

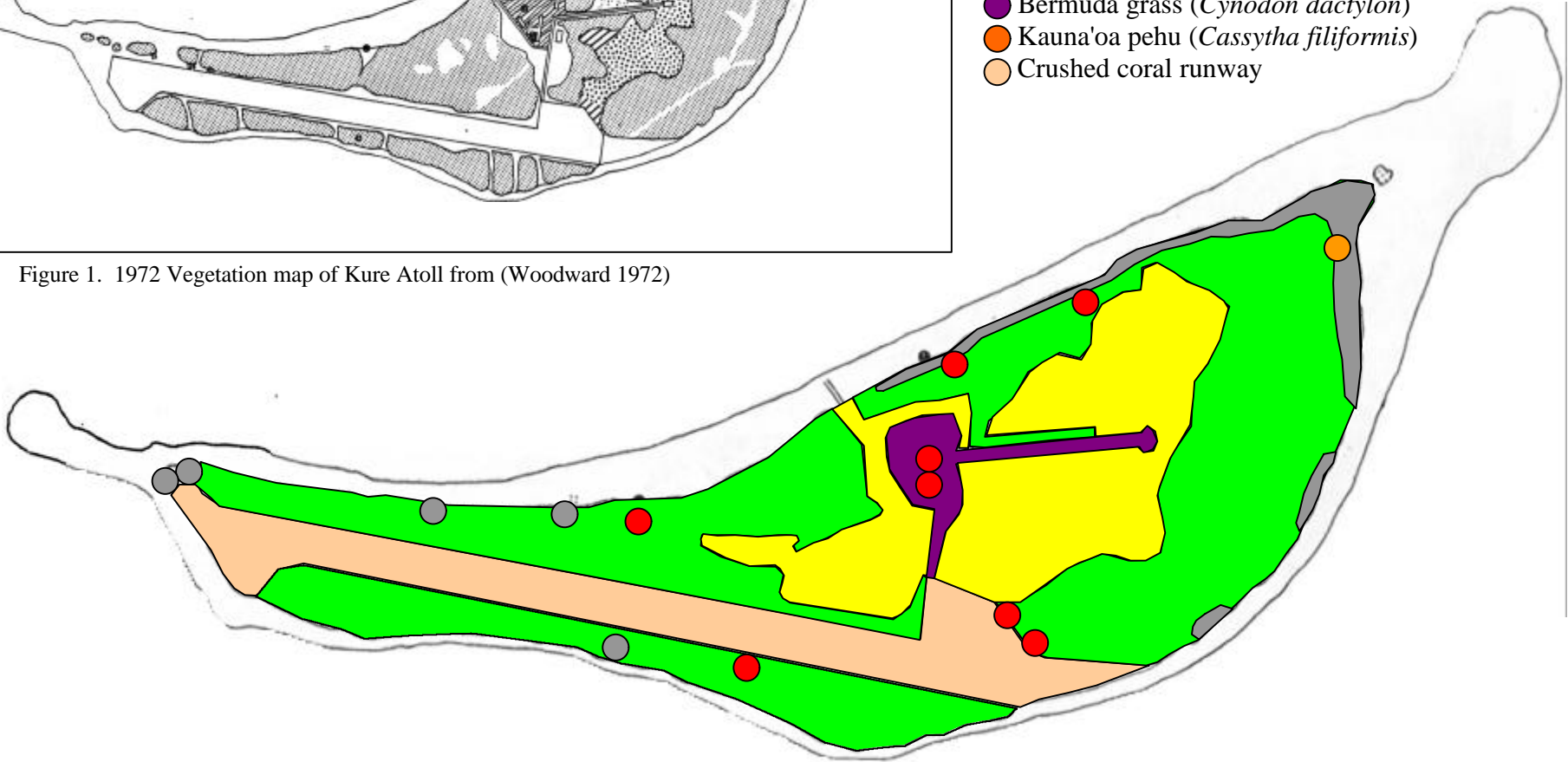


Figure 2. 2001 Vegetation map of Kure Atoll (Starr, Martz, and Loope 2001)



Figure 3. Looking north from pier. The beach rises steeply to a naupaka (*Scaevola sericea*) thicket that rings the island. Large heliotrope (*Tournefortia argentea*) trees can be seen above the naupaka.



Figure 4. Dense naupaka thicket with *Tournefortia* trees lining coast of northeast tip of island.



Figure 5. Bermuda grass (*Cynodon dactylon*) lawn with golden crown-beard (*Verbesina encelioides*) fields in background. Lone ironwoods (*Casuarina equisetifolia*) can be seen in the distance.



Figure 6. Field of *Verbesina* in the central plain. This is the area where all the rare plants were historically known from.



Figure 7. Looking west, herbs and grasses cover the runway, naupaka borders it, a *Tournefortia* grove can be seen on the left, and an ironwood grove is visible on the right.



Figure 8. East end of runway. Covered with nohu (*Tribulus cistoides*) and 'alena (*Boerhavia repens*).



Figure 9. Camp (quarters). Visible is a *Cynodon* lawn, dead ironwood trees, young ironwood trees, one dead false kamani (*Terminalia catappa*) tree, and one Norfolk Island pine (*Araucaria heterophylla*).



Figure 10. Taken from camp facing east. Visible is a *Cynodon* lawn, small ironwood trees, *Verbesina* fields, and a remnant naupaka island. *Tournefortia* and ironwood trees can also be seen in the distance.

COMMON PLANTS OF KURE ATOLL: A PICTORIAL GUIDE

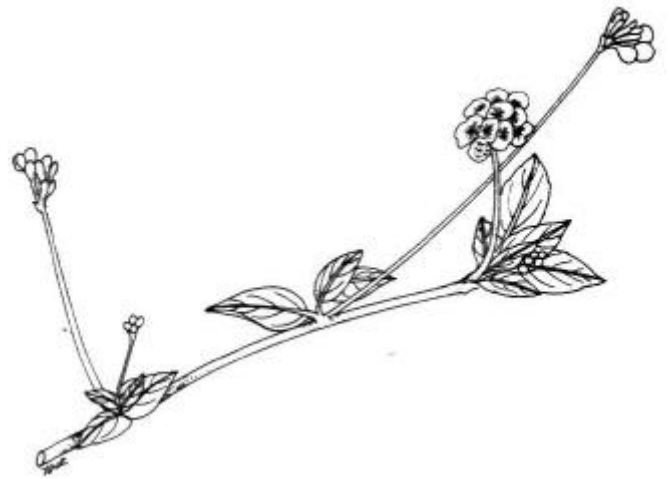
We hope this pictorial guide will help familiarize those who visit Kure Atoll with some of the common plants of the island. We also included a plant that used to be common, but is now presumed extinct on Kure (*Solanum nelsonii*) in hopes that if it is seen again on Kure, it will be recognized. Most of the pictures were taken by the authors (Starr & Martz) on a trip to Kure Atoll during May 21-25, 2001, though some of the photos were taken on Midway Atoll and Maui Island. We also used one photo taken by C.H. Lamoureux. The line drawings are from: Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999. Manual of the Flowering Plants of Hawaii, 2 vols. Bishop Museum Special Publication 83. University of Hawaii Press and Bishop Museum Press, Honolulu, Hawaii.

LIST OF SPECIES ILLUSTRATED

'Alena	(<i>Boerhavia repens</i>)
Kauna'oa pehu	(<i>Cassytha filiformis</i>)
Ironwood	(<i>Casuarina equisetifolia</i>)*
Sandbur	(<i>Cenchrus echinatus</i>)*
Bermuda grass	(<i>Cynodon dactylon</i>)*
Dwarf bunchgrass	(<i>Eragrostis paupera</i>)
'Emoloa, bunchgrass	(<i>Eragrostis variabilis</i>)
Button sedge	(<i>Fimbristylis cymosa</i>)
Morning glory, koali awa	(<i>Ipomoea indica</i>)
Sweet alyssum	(<i>Lobularia maritima</i>)*
Evening primrose	(<i>Oenothera laciniata</i>)*
Naupaka	(<i>Scaevola sericea</i>)
'Anunu	(<i>Sicyos maximowiczii</i>)
Glossy nightshade	(<i>Solanum americanum</i>)*
Popolo	(<i>Solanum nelsonii</i>)
Tree heliotrope	(<i>Tournefortia argentea</i>)*
Nohu	(<i>Tribulus cistoides</i>)
Golden crown beard	(<i>Verbesina encelioides</i>)*

(*) = Non-Native Species

'Alena
(*Boerhavia repens*)



Kauna'oa pehu
(*Cassytha filiformis*)



Ironwood
(*Casuarina equisetifolia*)



Sand bur
(*Cenchrus echinatus*)



Bermuda grass
(*Cynodon dactylon*)



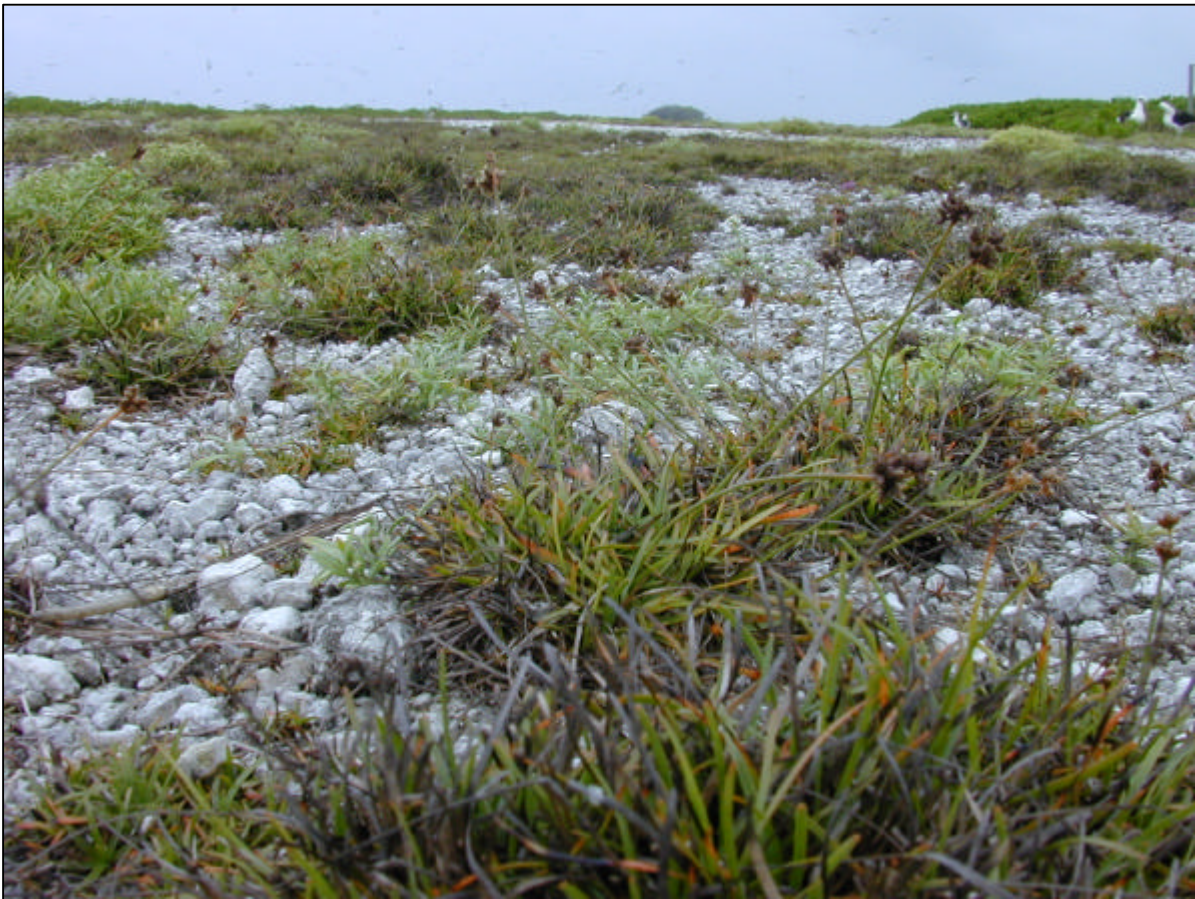
Dwarf Eragrostis
(*Eragrostis paupera*)



'Emoloa
(*Eragrostis variabilis*)



Button sedge, mau'u 'aki 'aki
(*Fimbristylis cymosa*)



Koali 'awa (Morning glory)
(*Ipomoea indica*)



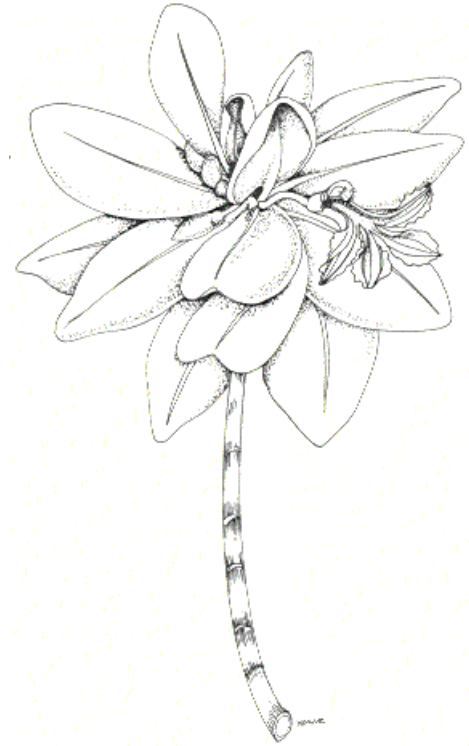
Sweet alyssum
(*Lobularia maritima*)



Evening primrose
(*Oenothera lacinata*)



Naupaka
(*Scaevola sericea*)



'Anunu
(*Sicyos maximowiczii*)



Glossy nightshade
(*Solanum americanum*)



Popolo
(*Solanum nelsonii*)



Tree heliotrope
(*Tournefortia argentea*)



Nohu
(*Tribulus cistoides*)



Golden crown-beard
(*Verbesina encelioides*)

