

DEPARTMENT OF THE INTERIOR**Fish and Wildlife Service****50 CFR Part 17**

RIN 1018-AB69

Endangered and Threatened Wildlife and Plants; Proposed Endangered or Threatened Status for 16 Plants From the Island of Molokai, HI**AGENCY:** Fish and Wildlife Service, Interior.**ACTION:** Proposed rule.

SUMMARY: The U.S. Fish and Wildlife Service (Service) proposes endangered status pursuant to the Endangered Species Act of 1973, as amended (Act), for 15 plants: *Bidens wiebkei* (ko'oko'olau), *Brighamia rockii* (pua 'ala), *Canavalia molokaiensis* ('awikiwiki), *Clermontia oblongifolia* ssp. *brevipes* ('oha wai), *Cyanea mannii* (haha), *Cyanea procera* (haha), *Hedyotis mannii* (pilo), *Hibiscus arnottianus* ssp. *immaculatus* (koki'o ke'oke'o), *Melicope reflexa* (alani), *Phyllostegia mannii* (no common name (NCN)), *Pritchardia munroi* (loulou), *Schiedea lydgatei* (NCN), *Silene alexandri* (NCN), *Silene lanceolata* (NCN), and *Stenogyne bifida* (NCN). The Service also proposes threatened status for one plant, *Tetramolopium rockii* (NCN). All known extant populations of the 16 taxa, except one, are found only on the island of Molokai, Hawaii; the exception is also found on the island of Hawaii. Fifteen of these taxa are known from East Molokai and one is also known from West Molokai. The 16 plant taxa and their habitats have been variously affected and are threatened by 1 or more of the following: Habitat degradation and/or predation by wild, feral, or domestic animals (axis deer, goats, pigs, sheep, and cattle); competition for space, light, water, and nutrients by naturalized, alien vegetation; habitat loss from fires; predation by rats; human recreational activities; and military training exercises. Because of the depauperate number of extant individuals and their severely restricted distributions, populations of these taxa are subject to an increased likelihood of extinction from stochastic events. This proposal, if made final, if made final, would implement the Federal protection and recovery provisions provided by the Act. Comments and materials related to this proposal are solicited.

DATES: Comments from all interested parties must be received by November 19, 1991. Public hearing requests must be received by November 4, 1991.

ADDRESSES: Comments and materials concerning this proposal should be sent

to Robert P. Smith, Field Supervisor, Pacific Islands Office, U.S. Fish and Wildlife Service, 300 Ala Moana Boulevard, room 6307, P.O. Box 50167, Honolulu, Hawaii 96850. Comments and materials received will be available for public inspection, by appointment, during normal business hours at the above address.

FOR FURTHER INFORMATION CONTACT: Derral R. Herbst, at the above address (808/541-2749 or FTS 551-2749).

SUPPLEMENTARY INFORMATION:**Background**

Bidens wiebkei, *Brighamia rockii*, *Canavalia molokaiensis*, *Clermontia oblongifolia* ssp. *brevipes*, *Cyanea mannii*, *Cyanea procera*, *Hedyotis mannii*, *Hibiscus arnottianus* ssp. *immaculatus*, *Melicope reflexa*, *Phyllostegia mannii*, *Pritchardia munroi*, *Schiedea lydgatei*, *Silene alexandri*, *Stenogyne bifida*, and *Tetramolopium rockii* are currently known only from the island of Molokai, Hawaii. *Silene lanceolata* is found on both Molokai and on the island of Hawaii.

The island of Molokai, the fifth largest in the Hawaiian island chain, is approximately 38 miles (mi) (61 kilometers (km)) long, up to 10 mi wide, and encompasses an area of about 266 square (sq) mi (688 sq km) (Foote *et al.* 1972, Plasch 1985). Three shield volcanoes make up most of the land mass of Molokai: West Molokai Mountain, East Molokai Mountain, and a volcano that formed Kalaupapa Peninsula (Department of Geography, University of Hawaii 1983). Molokai can also be divided into three major sections: The West Molokai section, comprising West Molokai Mountain; the central Molokai section or Hoolehua Plain formed between the two large mountain masses; and the East Molokai section, incorporating East Molokai Mountain and Kalaupapa Peninsula (Foote *et al.* 1972).

The taller and larger East Molokai Mountain rises 4,970 feet (ft) (1,813 meters (m)) above sea level (Walker 1990) and comprises roughly 50 percent of the island's land area. Topographically, the windward side of East Molokai differs from the leeward side. Precipitous cliffs line the northern windward coast with deep inaccessible valleys dissecting the coastline. The annual rainfall on the windward side is 75 to over 150 inches (in) (200 to over 375 centimeters (cm)), distributed throughout the year. The soils are poorly drained and high in organic matter. The gulches and valleys are usually very steep, but sometimes gently sloping (Foote *et al.* 1972). Much of the native

vegetation on the northern part of East Molokai is intact because of its relative inaccessibility to humans and animals (Culliney 1988), although destructive ungulates have begun to enter the coastline in recent years (Joel Lau, The Nature Conservancy of Hawaii (TNCH), pers. comm., 1990). *Brighamia rockii*, *Canavali molokaiensis*, *Hibiscus arnotianus* ssp. *immaculatus*, and *Stenogyne bifida* extend through various windward vegetation communities, from Coastal Dry Communities along the northern coast to the Montane Mesic Communities found inland on that side of the island. Halawa, on Molokai's extreme eastern end, has the same soil types as the windward side of the island. *Bidens wiebkei* is the only proposed plant taxon that grows in the Lowland to Montane Mesic Shrublands and Forests found on this section of the island.

Although Molokai's windward side receives most of the island's rainfall, some falls onto the upper slopes of the leeward (southern) side, decreasing as elevation decreases, and resulting in diverse leeward communities from wet forests to dry shrub and grasslands. The average annual rainfall on the leeward side of East Molokai is between 30 and 50 in (80 and 130 cm), mostly falling between November and April. The gently sloping to very steep topography of upland regions has predominantly well drained and medium-textured soils. *Clermontia oblongifolia* ssp. *brevipes*, *Cynanea manii*, *Cynanea procera*, *Hedyotis manii*, *Melicope reflexa*, *Phyllostegia manii*, *Pritchardia munroi*, *Schiedea lydgatei*, *Silene alexandri*, and *Silene lanceolata* are found in habitats that extend from upper elevation Montane Wet Forests down to the Lowland Dry Communities on the leeward side of the island.

On the northwestern portion of East Molokai is Kalaupapa Peninsula, created after most of the island had been formed. Kalaupapa is the site of a Hansen's Disease settlement operated by the State Department of Health but with a cooperative agreement with the National Park Service. One population of *Tetramolopium rockii* is located along its ash-covered, basaltic coastline.

With the advent of cattle ranching and later pineapple cultivation, most of Molokai, particularly West Molokai and East Molokai's southern section, was converted to pasture land. The only remaining large tracts of native vegetation are found within the Molokai Forest Reserve on the upper elevation portions of East Molokai; most of the proposed plant taxa are restricted to this forest reserve. *Tetramolopium*

rockii is the only proposed taxon found on West Molokai, restricted to coastal calcareous sand dunes on the island's northeastern corner, where the impacts of ranching activities and development have been quite limited. This Coastal Dry Community extends from sea level to 1,000 ft (300 m) in elevation with annual rainfall of 10 to 40 in (250 to 1,000 millimeters (mm)).

Of the 16 proposed taxa, *Silene lanceolata* is the only species that is currently found on an island other than Molokai. The Hawaii Island populations of *S. lanceolata* grow in the saddle region between Mauna Kea and Mauna Loa Mountains. Hawaii's two largest volcanoes. The Montane Dry Shrub and Grassland communities to which this species belongs extend into the subalpine zone, from 1,600 to 9,500 ft (500 to 2,900 m) in elevation with annual rainfall between 12 and 40 in (300 and 1,000 mm) (Gagne and Cuddihy 1990).

The land that supports these 16 plant taxa is owned by the State of Hawaii, the Federal government, and private entities. The three State agencies are the Department of Land and Natural Resources (including the Natural Area Reserves System and Forest Reserves), the Department of Health, and the Department of Hawaiian Home Lands, the last two of which include cooperative management agreements with the National Park Service. Federally-owned land consists of the Pohakuloa Training Area on the island of Hawaii, under the jurisdiction of the U.S. Army. Among various private owners are the Nature Conservancy of Hawaii (TNCH) and a private owner with a conservation easement with that conservation organization.

Discussion of the 16 Taxa Proposed for Listing

Bidens wiebkei was named by the Earl Edward Sherff in honor of Henry Wiebke, a school principal on Molokai, who, with Otto Degener, discovered the plant in 1928 (Sherff 1928b). Sherff (1928a) named *Bidens campylothea* var. *nematocera* based on Wilhelm Hillebrand's (1888) description of an unnamed variety of *Campylothea grandiflora* from Molokai; he later raised this taxon to specific status and published the combination *Bidens nematocera* (Sherff 1935a). Hillebrand's type, the only specimen of *B. nematocera* collected, was deposited in Berlin and destroyed during World War II. Nevertheless, in the current treatment of the genus, Fred R. Ganders and Kenneth M. Nagata (1990) tentatively consider *B. nematocera* to be synonymous with *B. wiebkei*.

Bidens wiebkei, a member of the aster family (Asteraceae), is a perennial herb which is somewhat woody at the base and grows from 1.6 to 3.3 ft (0.5 to 1 m) tall. The opposite, pinnately compound leaves are 2.8 to 5.1 in (7 to 13 cm) long and each has three to seven leaflets, 1 to 3 in (2.5 to 8 cm) long and 0.4 to 1 in (1 to 2.5 cm) wide. Flower heads are arranged on side branches in clusters of usually 10 to 30, each 0.6 to 1 in (1.6 to 2.5 cm) in diameter and comprising 4 to 6 sterile, yellow ray florets, about 0.5 in (10 to 12 mm) long and 0.08 to 0.2 in (2 to 5 mm) wide, and 9 to 18 bisexual, yellow disk florets. Fruits are brownish-black achenes (dry, one-seeded fruits), which are curved or twisted and winged and measure 0.2 to 0.4 in (6 to 9 mm) long and 0.04 to 0.08 in (0.9 to 2 mm) wide. This plant is distinguished from other *Bidens* species which grow on Molokai by its erect habit and the curved or twisted, winged achenes (Degener and Sherff 1932a, 1932b; Ganders and Nagata 1990).

Historically, *Bidens wiebkei* was known from Pelekunu and the easternmost section of Molokai at Halawa (Hawaii Heritage Program (HHP) 1990a1, 1990a6). It is still found near Halawa and was recently discovered on Puu Kolekole, just south of its historical range, on privately-owned land (HHP 1990a1 to 1990a5). The five known populations of this species are scattered along steep, exposed slopes (Gagne and Cuddihy 1990; HHP 1990a2, 1990a3, 1990a5) in *Metrosideros polymorpha* ('ohi'a) dominated mesic shrublands and forests at 820 to 3,450 ft (250 to 1,050 m) in elevation (Ganders and Nagata 1990), extending over a distance of 2.5 by 1 mi (4 by 1.6 km), and numbering no more than 60 individuals. Other associated plant species include *Antidesma* (hame), *Nestegis sandwicensis* (olopua), *Pisonia* (papala kepa), and *Scaevola gaudichaudii* (naupaka kuahiwi) (Cuddihy et al. 1982, HHP 1990a5). The major threats to *Bidens wiebkei* include habitat degradation and possible predation by deer and feral goats, competition with alien plants (*Melinis minutiflora* (molasses grass) and *Schinus terebinthifolius* (Christmas berry)), and fire. Damage or vandalism by humans of those plants found along trails is also a serious threat.

Asa Gray (Mann 1868) described *Brighamia insignis* based upon alcohol-preserved flowers and fruits collected by William Tufts Brigham on Molokai and a dried specimen collected on Kauai or Niihau by Ezechiel Jules Remy. Brigham's bottled material has since been lost. In his monograph, Harold St.

John (1969) named plants collected on Molokai *B. rockii* and *B. rockii* f. *longiloba*, based, respectively, upon specimens collected by Frances Raymond Fosberg and Charles Noyes Forbes. The specific epithet was chosen to honor Joseph F. Rock. St. John (1969) also described *B. remyi*, based upon a specimen collected on Maui by Remy. In the current treatment of the genus, Thomas G. Lammers (1990) recognizes only two species: *B. rockii* for plants which presently can be found on Molokai and possibly for those which were formerly found on Lanai and Maui, and *B. insignis* for the Kauai and Niihau plants.

Brighamia rockii, a member of the bellflower family (Campanulaceae), grows as an unbranched plant 3.3 to 16 ft (1 to 5 m) tall with a thickened, succulent stem which tapers from the base. The fleshy, oval leaves are widest at their tips and are arranged in a rosette at the top of the plant. They measure 2.4 to 8.7 in (6 to 22 cm) long and 2 to 6 in (5 to 15 cm) wide. The fragrant flowers are clustered in groups of three to eight in the leaf axils (the point between the leaf and the stem). Each flower cluster is on a stalk 1.4 to 3.0 in (3.5 to 7.5 cm) long, and each flower is on a stalk 0.2 to 0.5 in (6 to 12 mm) long. The green basal portion of the flower (hypanthium) has 10 ribs and is topped by 5 calyx lobes 0.01 to 0.3 in (2.5 to 8 mm) long. The petals are fused into a green to yellowish-green tube 3.1 to 5.1 in (8 to 13 cm) long and 0.1 to 0.2 in (0.2 to 0.4 cm) wide which flares into five white, elliptic lobes 0.7 to 1.5 in (1.7 to 3.7 cm) long and 0.3 to 0.5 in (0.8 to 1.3 cm) wide. The fruit is a capsule 0.5 to 0.8 in (13 to 20 mm) long, 0.3 to 0.4 in (7 to 10 mm) wide, and 0.1 to 0.2 in (3 to 4 mm) thick which contains numerous seeds about 0.05 in (1.1 to 1.2 mm) long. This species is a member of a unique endemic Hawaiian genus with only one other species, found on Kauai, from which it differs by the color of its petals, its longer calyx lobes, and its shorter flower stalks (Lammers 1990, St. John 1969).

Brighamia rockii once ranged along the northern coast of East Molokai from Kalaupapa to Halawa and may possibly have grown on Lanai and Maui (HHP 1990b1, 1990b2, 1990b4; Lammers 1990). Today its range has decreased to scattered populations on steep, inaccessible sea cliffs along East Molokai's northern coastline from Anapuhi Beach to Wailau Valley on private land, and on the relatively inaccessible State-owned sea stack of Huelo, east of Anapuhi Beach (HHP 1990b3, 1990b5 to 1990b8; Hawaii Plant

Conservation Center (HPCC) 1990a). The 5 known populations of *Brighamia rockii* that extend over this 6.5 mi (10.5 km) long stretch total fewer than 200 individuals (HHP 1990b3, 1990b5 to 1990b8). The plants are found in rock crevices on steep sea cliffs, often within the spray zone, in Coastal Dry to Mesic Forests or Shrublands at an elevation of sea level to 1,540 ft (0 to 470 m) with such associated species as 'ohi'a, *Canthium odoratum* (alahe'e), *Diospyros sandwicensis* (lama), *Osteomeles anthyllidifolia* ('ulei), and *Scaevola* (naupaka) (HHP 1990b1 to 1990b3, 1990b5 to 1990b7; HPCC 1990a; Lammers 1990). Ungulate damage (and possibly predation) by deer and goats poses a serious threat to *Brighamia rockii*. Although there is no evidence that rats feed on the fruits, rats are a potential threat as evidenced by predation on related Hawaiian genera. Competition with the alien plant Christmas berry is also a potential threat.

Forbes first collected *Canavalia molokaiensis* on Molokai in 1912, and 50 years later Otto Degener, Isa Degener, and J. Sauer described the species (Degener *et al.* 1962). Fosberg (1966) reduced several Hawaiian species of the genus to varieties, resulting in the name *C. galeata* var. *molokaiensis* for this taxon. In his revision of the Hawaiian taxa of the genus, St. John (1970) accepted *C. molokaiensis* and published two additional names, *C. peninsularis* and *C. stenophylla*, for Molokai plants. In the current treatment (Wagner and Herbst 1990), however, only *C. molokaiensis* is recognized.

Canavalia molokaiensis, a member of the pea family (Fabaceae), is a perennial climbing herb with twining branches. Each leaf is made up of three lance-shaped or sometimes oval leaflets which usually measure 1.4 to 3 in (3.5 to 8 cm) long and 0.5 to 2.1 in (1.3 to 5.4 cm) wide. Four to 15 flowers are arranged along a stalk 1.2 to 3.5 in (3 to 9 cm) long. The calyx (fused sepals), which is 0.8 to 1.1 in (20 to 28 mm) long, comprises a larger upper lip with two lobes and a smaller lower lip with three lobes. The five rose-purple petals vary from 1.4 to 1.9 in (36 to 47 mm) in length. The flattened pods, 4.7 to 6.3 in (12 to 16 cm) long and 0.9 to 1.4 in (2.3 to 3.5 cm) wide, enclose flattened, dark reddish-brown, oblong-elliptic seeds which are 0.7 to 0.9 in (17 to 22 mm) long and about 0.5 in (12 to 14 mm) wide. The only species of its genus found on Molokai, this plant can be distinguished from others in the genus by its narrower leaflets and its larger, rose-purple flowers (Degener *et al.* 1962, Sauer 1964, Wagner and Herbst 1990).

Historically, *Canavalia molokaiensis* was known from East Molokai, at Kalaupapa, Pelekunu, and farther south in Kahuaawi Gulch and the region of Manawai (HHP 1990c1 to 1990c3, 1990c9). It now has a more restricted range: From Kalaupapa to Waialeia, Kaunakakai, and Kamakou (HHP 1990c3 to 1990c10). This species typically grows in exposed dry sites on steep slopes in mesic shrublands and forests at 2,790 to 3,050 ft (850 to 930 m) in elevation (HHP 1990c7, 1990c10; Wagner and Herbst 1990). The 7 known populations, which contain an estimated 50 individuals, are on State and private land and are distributed over a 7 by 3.5 mi (11 by 5.5 km) area. The largest population of roughly 20 plants lies within a 0.2 acre (ac) (930 sq m) area (J. Lau, pers. comm., 1990). Associated plant species include 'ohi'a, *Chamaesyce* ('akoko), *Dodonaea viscosa* ('a'ali'i), *Styphelia tameiameia* (pukiawe), and *Wikstroemia* ('akia) (Cuddihy *et al.* 1982, HHP 1990c5). Feral ungulates such as goats and pigs degrade the habitat of *Canavalia molokaiensis* (extensively and pose an immediate threat to this species. Predation on a related species of *Canavalia* suggests that goats may possibly consume this species. Competition with the alien plant, molasses grass, is also an immediate threat.

Franz Elfried Wimmer (1943) described *Clermontia oblongifolia* f. *brevipes* based upon a specimen collected by Forbes on Molokai in 1912. The name of the form refers to the plant's short leaves, leaf stalks, and flower stalks. Lammers (1988) raised this taxon to the subspecific level when he published the new combination *C. oblongifolia* ssp. *brevipes*.

Clermontia oblongifolia ssp. *brevipes*, a member of the bellflower family, is a terrestrial shrub or tree which reaches a height of 6.6 to 23 ft (2 to 7 m). The leaves, on petioles 0.7 to 1.2 in (1.8 to 3 cm) long, are lance-shaped; have thickened, rounded teeth; and reach a length of 2.8 to 4.3 in (7 to 11 cm) and a width of 0.8 to 2 in (2 to 5 cm). Two or sometimes three flowers are grouped together on a stalk 0.2 to 0.4 in (5 to 10 mm) long, each flower having a stalk 0.4 to 1.8 in (1 to 4.5 cm) long. The flower is 2.4 to 3.1 in (6 to 7.8 cm) long; the calyx and corolla are similar in size and appearance, and each forms an arched tube which is greenish-white or purplish on the outside and white or cream colored on the inside. The nearly spherical, orange fruit is a berry, 0.7 to 1.2 in (17 to 30 mm) long. This species is distinguished from others in the genus by the structure of its calyx and corolla

as well as by the lengths of the flower, the floral lobes, and the green hypanthium. This subspecies differs from others of the species by the shape of its leaves and the lengths of its leaves, leaf stalks, and flower stalks (Lammers 1988, 1990).

The only two known populations of *Clermontia oblongifolia* ssp. *brevipes*, located within 1 mi (1.6 km) of each other in the Kamakou region of East Molokai, occur on private land (HHP 1990d1, 1990d2). Otherwise, the historical range is not known. One population has not been seen for over 40 years and may have been extirpated (HHP 1990d2). The habitat of the other is relatively intact and contains a single individual (HHP 1990d1). This taxon typically grows in shallow soil on gulch slopes in wet 'ohi'a-dominated forests at elevations between 3,500 and 3,900 ft (1,100 and 1,200 m) (HHP 1990d1, 1990d2; J. Lau, pers. comm., 1990). Associated plant species include *Cheirodendron triginum* ('olapa) (J. Lau, pers. comm., 1990). Feral pigs are an immediate threat to the habitat of the single remaining population of *Clermontia oblongifolia* ssp. *brevipes*. Its limited number makes the taxon vulnerable to extinction by a single stochastic event. Predation on related species suggests that rats may possibly feed on the fruit or plant parts of this taxon.

Brigham named *Delissea mannii* in honor of Horace Mann, Jr., with whom he collected the plant on Molokai in the 1860s and in whose "Enumeration" Brigham published the name (Mann 1867). Hillebrand (1888) transferred the taxon to the genus *Cyanea*, resulting in the name *Cyanea mannii*.

Cyanea mannii, a member of the bellflower family, is a branched shrub 5 to 10 ft (1.5 to 3 m) tall. The leaves are narrowly elliptic or lance-shaped, 4.7 to 8.3 in (12 to 21 cm) long and 1 to 2 in (2.5 to 5 cm) wide, and have petioles 0.9 to 3.9 in (2.2 to 10 cm) long and hardened teeth along the leaf margins. Each flower cluster, arising from the axil of a leaf on a stalk 0.8 to 1.4 in (20 to 35 mm) long, comprises 6 to 12 flowers, each on a stalk 0.3 to 0.5 in (8 to 12 mm) long. Each flower has a smooth, green hypanthium which measures about 0.2 in (4 to 6 mm) long and 0.1 to 0.2 in (3 to 5 mm) wide and is topped by triangular calyx lobes 0.1 to 0.2 in (3 to 5 mm) long and 0.08 to 0.1 in (2 to 3 mm) wide. The purplish corolla forms a nearly upright tube 1.2 to 1.4 in (30 to 35 mm) long and 0.1 to 0.2 in (3 to 4 mm) wide, which ends in five spreading lobes. Berries have not been observed. This species is distinguished from the seven other species of the genus on Molokai by a

combination of the following characters: A branched, woody habit; leaves with small, hardened, marginal teeth; and a purplish corolla (Lammers 1990, Rock 1919, Wimmer 1943).

Historically, *Cyanea mannii* was known only from Kalae on East Molokai (HHP 1990e2). In 1984, a single plant was discovered by Thomas Lammers and others west of Puu Kolekole on East Molokai on privately-owned land (HHP 1990e1, Lammers 1990). Since then, five populations have been discovered within Kamakou Preserve on East Molokai. The 6 populations are distributed over an area of about 2 by 0.8 mi (3.2 by 1.2 km) and total about 40 individuals (Edwin Misaki, TNCH, pers. comm., 1991). This species typically grows on the sides of deep gulches (HHP 1990e1; E. Misaki, pers. comm., 1991) in 'ohi'a-dominated mesic to wet forests at elevations of about 3,300 to 3,540 ft (1,000 to 1,080 m) (Lammers 1990). Associated plant species include 'akia, 'olapa, *Dicranopteris linearis* (uluhe), and *Vaccinium* ('ohelo) (E. Misaki, pers. comm., 1991). Feral pigs threaten the habitat of *Cyanea mannii*. Rodents such as rats may feed on the fruit or other parts of the plant, as shown by predation on related species. Because of the small number of remaining individuals, one stochastic event could extirpate a significant proportion of the populations.

Hillebrand discovered *Cyanea procera* on Molokai and formed the specific epithet from a Latin word meaning "tall," in reference to the height of the plant (Hillebrand 1888). St. John (1987, St. John and Takeuchi 1987), believing there to be no generic distinction between *Cyanea* and *Delissea*, transferred the species to the genus *Delissea*, the older of the two generic names, creating *D. procera*. The current treatment, however, maintains the separation of the two genera (Lammers 1990).

Cyanea procera, a member of the bellflower family, is a palm-like tree 10 to 30 ft (3 to 9 m) tall with stalkless, lance-shaped leaves 24 to 30 in (60 to 75 cm) long and 3.9 to 6.7 in (10 to 17 cm) wide with tiny hardened teeth along the margins. Each flower cluster has a stalk 1.0 to 1.6 in (25 to 40 mm) long and comprises 10 to 20 flowers, each on a stalk 0.2 to 0.4 in (6 to 10 mm) long. Each flower has a hypanthium, 0.6 to 0.8 in (15 to 20 mm) in length and 0.3 to 0.5 in (8 to 13 mm) in width, topped by shallow triangular calyx lobes 0.1 to 0.2 in (3 to 4 mm) long and about 0.2 in (4 to 5 mm) wide. The purplish corolla forms a nearly upright or slightly curved tube 2.4 to 3.1 in (60 to 80 mm) long and 0.2 to 0.4

in (6 to 11 mm) wide, which ends in five downwardly curving lobes which make the flower appear one-lipped. The ellipse- or egg-shaped berries are 1.2 to 1.8 in (3.0 to 4.5 cm) long and 0.8 to 1.1 in (2.0 to 2.8 cm) wide. This species can be distinguished from other species of the genus and from *C. mannii* by its growth habit, its sessile leaves, and the single-lipped appearance of the corolla (Lammers 1990, Rock 1919, Wimmer 1943).

Historically, *Cyanea procera* was only known from an unspecified site in the Kamalo region of East Molokai (HHP 1991a) until its discovery in 1987 at Puu O Kaeha, west of Kamalo on private land. Two individuals were found in a wet 'ohi'a-dominated forest at an elevation of 3,480 ft (1,060 m). The plants grow within 6.5 ft (2 m) of each other on a steep rock wall with thin soil on the southwest slope of a narrow gulch. Associated plant species include various species of *Asplenium*, *Coprosma ochracea* (pilo), *Pipturus albidus* (mamaki), and *Touchardia latifolia* (olona) (David Lorence, National Tropical Botanical Garden, pers. comm., 1991). Only two plants of *Cyanea procera* are known to exist, making this species vulnerable to extinction if one stochastic event were to occur. Like other *Cyanea* species and related genera, *C. procera* is potentially threatened by predation by rats. Habitat degradation by feral pigs is a potential threat.

Based upon a specimen he collected with Mann on West Maui, Brigham described *Kadua laxiflora* in Mann's list of 1867. In his revision of *Hedyotis*, Fosberg (1943) included *Kadua* in the genus *Hedyotis*, and he published the following names, which are synonymized under *Hedyotis mannii* in the current treatment of the genus (Wagner et al. 1990): *H. mannii* var. *laxiflora*, *H. mannii* var. *munroi*, *H. mannii* var. *scaposa*, *H. molokaiensis*, *H. thyrsoides*, and *H. thyrsoides* var. *hillebrandii* (Fosberg 1943), as well as *H. mannii* var. *cuspidata* (Fosberg 1956).

Hedyotis mannii, a member of the coffee family (Rubiaceae), is a perennial plant with smooth, usually erect stems 1 to 2 ft (30 to 60 cm) long which are woody at the base and four-angled or winged. The leaves are opposite, thin in texture, elliptic to sometimes lance-shaped, and are usually 3 to 7 in (8 to 18 cm) long and 1 to 2.6 in (2.5 to 6.5 cm) wide. Stipules (leaf-like appendages), which are attached to the slightly winged leaf stalks where they join and clasp the stem, are triangular, 0.2 to 0.6 in (5 to 14 mm) long, and have a point usually 0.2 to 0.4 in (4 to 11 mm) long.

Flowers are arranged in loose clusters up to 1 ft (30 cm) long at the ends of the stems and are either bisexual or female. The green hypanthium is top-shaped, about 0.05 in (1 to 1.5 mm) long, with sepals 0.06 to 0.1 in (1.5 to 3 mm) long and 0.04 to 0.08 in (1 to 2 mm) wide at the top. The greenish-white, fleshy petals are fused into a trumpet-shaped tube 0.2 to 0.6 in (5 to 14 mm) long. Capsules are top-shaped and measure 0.08 to 0.1 in (2 to 3 mm) long and about 0.1 in (3 to 4 mm) in diameter. This species' growth habit; its quadrangular or winged stems; the shape, size, and texture of its leaves; and its dry capsule which opens when mature separate it from other species of the genus (Hillebrand 1888, Wagner *et al.* 1990).

Hedyotis mannii was once widely scattered on three islands: Lanai, West Maui, and Molokai (HHP 1990f2 to 1990f10). After not being seen for 50 years, this species was rediscovered in 1987 by Steve Perlman on private land in Kawela Gulch on East Molokai (HHP 1990f1). Only two plants are known to exist (Center for Plant Conservation (CPC) 1991). *Hedyotis mannii* typically grows on dark, narrow, rocky gulch walls in mesic and perhaps wet forests (Wagner *et al.* 1990) at 490 to 3,450 ft (150 to 1,050 m) in elevation (HHP 1990f1 to 1990f10). Associated plant species include mamaki, *Cibotium* (hapu'u), *Cyanea* (haha), and *Psychotria* (kopiko) (HHP 1990f1). The limited number of individuals of *Hedyotis mannii* makes it extremely vulnerable to extinction by a single stochastic event. Feral pigs and alien plants such as molasses grass degrade the habitat of this species and contribute to its vulnerability.

Sister Margaret James Roe (1961) described *Hibiscus immaculatus* based upon specimens collected by Forbes on Molokai in 1912. The specific epithet refers to the plant's pure white flowers. In his current treatment of the genus, David M. Bates regards the taxon as *Hibiscus arnotianus* ssp. *immaculatus* (Bates 1990, Wagner *et al.* 1989).

Hibiscus arnotianus ssp. *immaculatus*, a member of the hibiscus family (Malvaceae), is a tree up to 10 ft (3 m) tall with alternate, oval, toothed leaves measuring 2 to 2.8 in (5 to 7 cm) long and 1.6 to 2.6 in (4 to 6.5 cm) wide. Six lance-shaped bracts, 0.2 to 0.3 in (5 to 8 mm) long, are found under each of the faintly fragrant flowers, which are arranged singly near the ends of the branches. The calyx is 1 to 1.2 in (2.5 to 3.0 cm) long and cleft into five teeth with long, narrow points. The flaring petals are white and measure 3.1 to 4.3 in (8 to 11 cm) long and 1 to 1.4 in (2.5 to 3.5 cm) wide. Anthers, on spreading filament

tips 0.4 to 0.8 in (1 to 2 cm) long, are arranged along the upper third of the white staminal column, which measures 4 to 5.5 in (10 to 14 cm) in length. Capsules are enclosed by the sepals and contain 0.2 in (4 mm) long seeds which are covered with yellowish-brown hair. This subspecies is distinguished from other native Hawaiian members of the genus by its white petals and white staminal column (Bates 1990; Neal 1965; Rock 1913; Roe 1959, 1961; St John 1981).

Hibiscus arnotianus ssp. *immaculatus* once ranged from Waihanau Valley east to Papalaua Valley on East Molokai (HHP 1990g3, 1990g4). This taxon is now confined to a 3 mi (5 km) stretch of the northern coast of East Molokai from Waiehu to between Papalaua and Wailau valleys (Bates 1990; HHP 1990g1, 1990 g2, 1990g5) on private and State land. The 4 populations, scattered along steep sea cliffs with native plant species such as alaha'e, hame, lama, mamaki, and 'ohi'a, are believed to total no more than 50 individuals (HHP 1990g1, 1990g5; HPCC 1990b). *Hibiscus arnotianus* ssp. *immaculatus* typically occurs in mesic forests between 50 and 1,600 ft (15 and 480 m) in elevation (Bates 1990, HHP 1990g1 to 1990g5, HPCC 1990b). The major threats to *Hibiscus arnotianus* ssp. *immaculatus* are habitat destruction by feral goats and the small number of remaining populations.

St. John (1944) described and named *Pelea reflexa* based upon a specimen Rock collected on Molokai in 1910. The specific epithet refers to the slightly reflexed capsules. After further study of the genus, Thomas G. Hartley and Benjamin C. Stone (1989) placed *Pelea* into synonymy with *Melicope*, resulting in the new combination *M. reflexa* (Wagner *et al.* 1990).

Melicope reflexa, a member of the citrus family (Rutaceae), is a sprawling shrub 3.3 to 10 ft (1 to 3 m) tall with short, yellowish-brown, short-lived hairs on new growth. The opposite, thin, and leathery leaves are elliptical and measure 3.1 to 5.5 in (8 to 14 cm) long and 1.6 to 2.8 in (4 to 7 cm) wide. Flowers arise singly or in clusters of two or three from the leaf axil. The flower cluster has a stalk 0.1 to 0.6 in (3 to 15 mm) long, and each flower is on a stalk 0.6 to 0.8 in (15 to 20 mm) long. Male flowers have not been seen, but female flowers are made up of four overlapping sepals about 0.1 in (3 to 4 mm) long; four petals about 0.2 in (4.8 mm) long; an eight-lobed nectary disk; eight reduced, nonfunctional stamens; and a style about 0.2 in (4 mm) long. The capsules are 0.8 to 1.3 in (20 to 33 mm) wide with four sections 0.4 to 0.7 in (10 to 17 mm)

long which are fused to each other along about one-fourth of their length. One or two glossy black seeds, about 0.3 in (7 to 8 mm) long, are found in each section of the capsule. This species' opposite leaves with leaf stalks usually over 0.4 in (1 cm) long, its larger leaves and fruit, and the partially fused sections of its capsule separate it from other species of the genus (Stone *et al.* 1990).

Historically, *Melicope reflexa* occurred from a ridge between Hanalilolilo and Pepeopae in Kamakou Preserve to as far east as Halawa on East Molokai (HHP 1990h1, 1990h2, 1990h5 to 1990h7). The 3 populations of fewer than 1,000 individuals remain on private land at the headwall of Waikolu Valley, Wailau-Mapulehu summit, and at Honomuni, and are distributed over a distance of about 7.5 mi (12 km) (HHP 1990h2 to 1990h4). *Melicope reflexa* typically grows in wet 'ohi'a-dominated forests with native trees such as 'olapa at elevations between 2,490 and 3,900 ft (760 and 1,190 m) (Stone *et al.* 1990). Major threats to *Melicope reflexa* include habitat degradation by ungulates (axis deer and feral pigs) and competition with the alien plant *Clidemia hirta* (Koster's curse). Because this species is known from a single population, it is possible for one human-caused or natural event to destroy all or a significant portion of the extant individuals. Predation by deer or pigs is a potential threat in areas inhabited by these animals.

Mann (1868) published the name *Stenogyne parviflora* for a plant he and Brigham collected on Haleakala, Maui. Sherff (1934a) published the name *Phyllostegia racemosa* var. *bryanii* for plants collected on Molokai and synonymized *S. parviflora* under the new name *Phyllostegia mannii* (Sherff 1934b). In the current treatment (Wagner *et al.* 1990), *P. mannii* is the name applied to both the Molokai plants and specimens of the apparently extinct Maui plants.

Phyllostegia mannii, a nonaromatic member of the mint family (Lamiaceae), is a climbing vine with many-branched, four-sided, hairy stems. The opposite, hairy leaves, which are shaped like narrow triangles or narrow triangular ovals, measure 0.8 to 2.2 in (2 to 5.5 cm) long and 0.3 to 0.9 in (0.7 to 2.3 cm) wide and have coarsely toothed margins. Clusters of four to six flowers are arranged in each of several false whorls along an unbranched flowering stem 1.6 to 6 in (4 to 15 cm) long. The calyx is a bell-shaped, lobed structure. The slightly curved, two-lipped corolla tube is about 0.3 in (7 to 8 mm) long and is thought to be white. The fleshy, dark-green to

black nutlets are 0.08 to 0.1 in (2 to 2.5 mm) long. This species is distinguished from others in the genus by its hairiness; its thin, narrow leaves which are not pinnately divided; and the usual six flowers per false whorl in a terminal inflorescence (Wagner *et al.* 1990).

Historically, *Phyllostegia mannii* was found from Hanalilolilo to Ohialele on East Molokai and at Ukulele on east Maui (HHP 1990i2 to 1990i8). It has been seen on Maui for over 70 years and is apparently extinct on that island (Lammers 1990). This species is now known only from Hanalilolilo within Kamakou Preserve on privately-owned land (HHP 1990i1). The only currently known population contains four individuals. It grows in shaded sites in sometimes foggy and windswept, wet, open, 'ohi'a-dominated forests with a native shrub and tree fern (hapu'u) understory (HHP 1990i1 to 1990i3) at 3,300 to 5,000 ft (1,010 to 1,525 m) in elevation (Wagner *et al.* 1990). Associated plant species include 'olapa, a few native ferns, and *Hedyotis* (manono). The only known population of *Phyllostegia mannii* is threatened by feral pigs. Because of the small number of individuals, a natural or human-caused event could extirpate all or a significant portion of the population.

Joseph F. Rock discovered a new palm on Molokai in 1920 and named it *Pritchardia munroi* in honor of James Munro, manager of Molokai Ranch (Beccari and Rock 1921).

Pritchardia munroi, a member of the palm family (Arecaceae), is a tree about 13 to 16 ft (4 to 5 m) tall with a trunk up to about 7.8 in (20 cm) in diameter. The leaf blade is about 35 in (88 cm) long and has a petiole about 33 in (85 cm) long. The leaves and petioles have scattered or deciduous scales and hairs, somewhat larger on the lower leaf ribs. The leaves are deeply divided into segments which have long, drooping tips. Numerous bisexual or functionally male flowers are arranged in clusters on hairy, branching stalks about 20 in (52 cm) long which originate at the leaf bases. The flower consists of a cup-shaped, three-lobed calyx, three petals, six stamens, and a three-lobed stigma. The mature fruit is shiny, black, nearly spherical, and about 0.8 in (2 to 2.2 cm) in diameter. This species is distinguished from others of the genus by its relatively smooth leaves; the grayish-brown hair on the inflorescence stalks, which are shorter than the petioles; and the small size of the fruits (Beccari and Rock 1921, Read and Hodel 1990, St. John 1981).

Historically, *Pritchardia munroi* was found in leeward East Molokai, above Kamalo and near Kapuaokoolau (HHP

1990j1, Read and Hodel 1990). The last known wild specimen grows near the base of a small ravine in remnant dry to mesic forest at an elevation of about 2,000 ft (610 m) on privately-owned land (Garnett 1989, HHP 1990j1, Read and Hodel 1990). Associated plant species include 'a'ali'i, 'ohi'a, pukiawe, and *Pleomele aurea* (hala pepe) (Garnett 1989, HHP 1990ji). A variety of threats affects the only known wild individual of *Pritchardia munroi*. Ungulates (axis deer, goats, and pigs) continue to degrade the habitat around its fenced enclosure and prevent the establishment of seedlings. Other serious threats include fire and predation of seeds by rats. The one known wild individual is vulnerable to extinction in its natural habitat because a single stochastic event could destroy the plant.

Hillebrand (1888) described *Schiedea lydgatei*, naming it in honor of the Reverend John M. Lydgate, who, as a student, accompanied Hillebrand on collecting trips. Otto Degener and Sherff (Sherff 1944) described variety *attenuata*, but no subspecific taxa are recognized in the current treatment (Wagner *et al.* 1990).

Schiedea lydgatei, a member of the pink family (Caryophyllaceae), is a low, hairless perennial plant with branched stems 4 to 16 in (10 to 40 cm) long which are woody at the base. The opposite, three-veined leaves are elliptic, 0.8 to 1.8 in (2 to 4.5 cm) long, and 0.2 to 0.6 in (0.6 to 1.5 cm) wide. Bisexual flowers are arranged in loosely spreading clusters 4 to 6.6 in (10 to 17 cm) long. The flowers comprise usually 5 distinct but overlapping, narrowly oval, green sepals, 0.1 to 0.2 in (3 to 4.5 mm) long; 5 nectaries about 0.1 in (2.5 to 3 mm) long; 10 stamens; and usually 3 styles. Petals are lacking. The capsules are about 0.2 in (4 to 5.5 mm) long and open when mature to reveal dark reddish-brown seeds about 0.03 in (0.8 mm) long. The opposite, thin, three-veined leaves with petioles and the smooth, open flower clusters with relatively larger, green sepals separate this species from other members of the genus (Degener and Degener 1956, Sherff 1944, Wagner *et al.* 1990).

Historically, *Schiedea lydgatei* was found in Kalae, Pohoia, Makolelau, and Ohia Gulch on East Molokai (HHP 1990k2, 1990k4, 1990k7, 1990k8). This species is now known from scattered populations in a more restricted area in Makakupaia, Kawela, and Makolelau. All 5 populations are distributed over an area of less than 1 by 3.5 mi (1.6 by 5.6 km), totalling fewer than 1,000 individuals (HHP 1990k1, 1990k3, 1990k5, 1990k6, 1990k9). This species is found along ridges and on cattle trails in dry to

mesic grasslands, shrublands, and forests with scattered native and alien trees at elevations of about 2,000 to 2,100 ft (600 to 650 m) (HHP 1990k5, 1990k6; Wagner *et al.* 1990). Associated plant species include 'a'ali'i, 'ohi'a, pukiawe, and uluhe (Gagne and Cuddihy 1990). The major threats to *Schiedea lydgatei* are fire and habitat degradation and competition with the alien plant species molasses grass. Because fire is such a pervasive threat in this species' dry, windswept habitat, a single fire could destroy as many as four of the five populations.

Hillebrand (1888) described *Silene alexandri* based upon a specimen he found on Molokai, and this is the currently accepted name (Wagner *et al.* 1990).

Silene alexandri, a member of the pink family, is an erect, perennial plant 1 to 2 ft (30 to 60 cm) tall which is woody at the base. The narrow, elliptic leaves are 1.2 to 2.5 in (30 to 65 mm) long by 0.2 to 0.6 in (6 to 14 mm) wide and hairless except for a fringe of hairs along the margins. Flowers are arranged in open clusters with stalks 0.4 to 0.7 in (10 to 19 mm) long. The 5-lobed, 10-veined, tubular calyx is 0.7 to 1 in (19 to 25 mm) long, and the 5 white, deeply-lobed, clawed petals extend about 0.2 in (4 to 6 mm) beyond the calyx. The capsule is about 0.6 in (14 to 16 mm) long, but seeds have never been seen. The hairless stems, flowering stalks, and sepals and the larger flowers with white petals separate this species from other members of the genus (Hillebrand 1888, Wagner *et al.* 1990, Williams 1896).

Historically, *Silene alexandri* was known from Makolelau and Kamalo on East Molokai, but now it occurs only at the former site on privately-owned land (HHP 1990L1, 1990L2). The sole population of fewer than 10 individuals is found on a cattle trail in remnant dry forest and shrubland (HHP 1990L1, Wagner *et al.* 1990) at an elevation between 2,000 and 2,500 ft (610 and 760 m) (Wagner *et al.* 1990). Associated plant species include 'a'ali'i, 'ohi'a, pukiawe, and uluhe (Gagne and Cuddihy 1990). Feral goats continue to degrade the habitat of *Silene alexandri* and pose a serious threat to remaining populations. Predation of this species may possibly occur. Fire and the small number of individuals are also immediate threats, because a single destructive event could extirpate the entire species.

Gray (1854) based his description of *Silene lanceolata* upon fertile specimens collected on Kauai during the United States Exploring Expedition in 1840, as well as vegetative material collected the

following year on Maui for the same expedition. The specific epithet refers to the plant's narrow leaves. Hillebrand (1888) recognized a variety, and later Sherff (1946) described and named two varieties, *hillebrandii* and *forbesii*. No subspecific taxa are recognized in the current treatment (Wagner *et al.* 1990).

Silene lanceolata, a member of the pink family, is an upright, perennial plant with stems 6 to 20 in (15 to 50 cm) long, which are woody at the base. The narrow leaves are 1 to 3 in (25 to 80 mm) long, 0.08 to 0.4 in (2 to 11 mm) wide, and smooth except for a fringe of hairs near the base. Flowers are arranged in open clusters with stalks 0.3 to 0.9 in (8 to 23 mm) long. The 5-toothed, 10-veined calyx is about 0.3 in (7 to 9 mm) long, and the wide portion of the 5 white, deeply-lobed, clawed petals is about 0.2 in (6 mm) long. The capsule is about 0.3 in (8 to 9 mm) long and opens at the top to release reddish-brown seeds about 0.04 in (1 mm) long. This species is distinguished from *S. alexandri*, the only other member of the genus found on Molokai, by its smaller flowers and capsules and its stamens, which are shorter than the sepals (Gray 1854, Hillebrand 1888, Wagner *et al.* 1990, Williams 1896).

The historical range of *Silene lanceolata* included four Hawaiian islands: Kauai, below Puu Kolekole on East Molokai, Maunalei on Lanai, and Mauna Kea on Hawaii Island (HHP 1990m1 to 1990m3, Wagner *et al.* 1990). *Silene lanceolata* now grows on the islands of Molokai and Hawaii. A single population of approximately five individuals was found in 1987 on Molokai, where it remains on private land near Puu Kolekole (HHP 1990m1). The Hawaii Island population at Puu Ahi has not been observed since 1949. However, two populations of this species were discovered in 1991 on Federal land in Kipuka Kalawamauna and Kipuka Alala at Pohakuloa Training Area on the saddle region between Mauna Kea and Mauna Loa. The three Hawaii Island populations are distributed over a distance of roughly 9 mi (15 km) between about 5,200 and 6,000 ft (1,600 and 1,800 m) in elevation (HHP 1990m1; Robert Shaw, Colorado State University, pers. comm., 1991). It is not known whether the Puu Ahi population still exists after decades of ungulate, human-caused, and natural disturbance. The 2 populations at Pohakuloa Training Area number between 95 and 125 individuals (R. Shaw, pers. comm. 1991), giving a total of fewer than 130 known individuals for the species. The populations on the island of Hawaii grow in two dry

habitat types: shrubland dominated by dense *Myoporum sandwicense* (naio), *Sophora chrysophylla* (mamane), and pukiawe with 'a'ali'i, pilo, and *Pennisetum setaceum* (fountain grass); and on 'a' lava in a former *Chamaesyce olowaluana* ('akoko) forest now converted to fountain grass grassland with 'a'ali'i, mamane, naio, and *Chenopodium oahuense* ('aheahea) (R. Shaw, pers. comm., 1991). On Molokai, this species grows on cliff faces and ledges of gullies in dry to mesic shrubland at an elevation of about 2,600 ft (800 m) (HHP 1990m1 to 1990m3, Wagner *et al.*, 1990). Habitat destruction by feral ungulates (goats, pigs, and sheep); wildfire and fire due to hunting activities and military maneuvers; and alien plant invasion (fountain grass) are immediate threats to *Silene lanceolata*. Military exercises and predation by goats and sheep pose probable threats.

Hillebrand discovered *Stenogyne bifida* on Molokai in 1870 and, when naming the species, chose the specific epithet in reference to the deeply two-lobed upper lip of the corolla (Hillebrand 1888). This name is accepted in the current treatment (Weller and Sakai 1990).

Stenogyne bifida, a nonaromatic member of the mint family, is a perennial herb, evidently climbing, with smooth or slightly hairy, four-angled stems. The opposite, membranous, toothed leaves are oval or elliptical in shape, measure 1.7 to 4 in (4.2 to 10 cm) long and 0.7 to 1.4 in (1.7 to 3.6 cm) wide, and are hairless except on the midribs. Flowers are usually arranged in groups of two to six in each of several false whorls at the ends of the stems. The sepals are fused into a toothed calyx which is almost hairless, radially symmetrical, narrowly bell-shaped, and 0.3 to 0.5 in (8 to 12 mm) long. The petals are fused into a nearly straight, yellow tube 0.4 to 0.6 in (10 to 16 mm) long which flares into pale-brown lobes comprising an upper lip about 0.2 in (4 to 6 mm) long and a lower lip about 0.1 in (2 to 4 mm) long. The fruits are fleshy, black nutlets about 0.1 in (2.5 to 3 mm) long. The long, narrow calyx teeth and the deep lobe in the upper lip of the yellow corolla separate this species from others of the genus (Hillebrand 1888, Sherff 1935b, Weller and Sakai 1990).

Historically, *Stenogyne bifida* was known from scattered populations from Waiianui in central Molokai to Pukoo Ridge on East Molokai (HHP 1990n3 to 1990n9, Wagner *et al.* 1990). This species is now known from only 3 East Molokai populations totalling fewer than 10

individuals: On Manawai-Kahananui Ridge along a private/State land boundary, on Kolo Ridge, and on the eastern fork of Kawela Gulch in privately-owned Pelekunu Preserve (HHP 1990n1, 1990n2; Steve Anderson Haleakala National Park, pers. comm., 1990). These three populations are scattered over an area of 6.6 sq mi (17 sq km). *Stenogyne bifida* typically grows on steep ridges in 'ohi'a-dominated Montane Mesic to Wet Forests with native species such as hapu'u, manono, 'olapa, *Broussaisia arguta* (kanawao), and *Pouteria* ('ala'a) at elevations between 1,450 and 4,000 ft (450 and 1,200 m) (HHP 1990n1 to 1990n9, HPCC 1990c). Ungulates (axis deer, goats, and pigs) are pervasive threats to populations of *Stenogyne bifida* and may eat this species when available. One trailside population that represents a significant portion of the species could be collected or vandalized.

Sherff (1934c) described *Tetramolopium rockii*, naming it in honor of Rock, who first collected the plant on Molokai in 1910. St. John (1974) described a new genus, *Luteidiscus*, for the species of *Tetramolopium* with yellow disk flowers. He transferred *T. rockii* to the new genus and also described a new species, *L. calcisabulorum*. The current treatment (Lowrey 1981, 1986, 1990) reduces St. John's two species to varieties of *Tetramolopium rockii*: the typical variety and var. *calcisabulorum*.

Tetramolopium rockii, a member of the aster family, is a glandular, hairy, prostrate shrub which forms complexly branching mats 2 to 4 in (5 to 10 cm) tall and 3 to 16 in (8 to 40 cm) in diameter. Leaves of variety *calcisabulorum* are 0.8 to 1.2 in (2 to 3 cm) long and 0.2 to 0.3 in (5 to 7 mm) wide, have slightly inrolled edges, and are whitish due to the long silky hairs on their surfaces. Variety *rockii* has smaller, less hairy, flat, yellowish-green leaves, 0.6 to 0.8 in (1.5 to 2.1 cm) long and about 0.2 in (4 to 6 mm) wide. The leaves of both varieties are spatula-shaped with glands and smooth margins. Flower heads, arranged singly at the ends of flowering stalks 1.6 to 4.7 in (4 to 12 cm) long, have a hemispherical involucre (set of bracts beneath the florets) 0.2 to 0.3 in (4 to 8 mm) high and 0.4 to 0.7 in (10 to 18 mm) in diameter. Approximately 60 to 100 white ray florets, 0.1 to 0.2 in (3 to 4.5 mm) long and 0.02 to 0.04 in (0.5 to 1 mm) wide, surround 30 to 55 functionally male, yellow, funnel-shaped disk florets. Fruits are achenes, 0.08 to 0.1 in (2 to 2.5 mm) long and about 0.03 in (0.7 to 0.9 mm) wide when fertile, and are topped with white bristles 0.1 to 0.2 in (2.5 to 4

mm) long. This species differs from others of the genus by its growth habit, its hairy and glandular surfaces, its spatulate leaf shape, and its yellow disk florets (Degener and Degener 1965; Lowrey 1981, 1986, 1990; Sohmer and Gustafson 1987).

Of the two recognized varieties of *Tetramolopium rockii*, variety *rockii* was first discovered at Moomomi about 80 years ago. Still found there, *T. rockii* var. *rockii* remains in two areas: From Kapalauoa to Kahinaakalani on West Molokai (HHP 1990o3; HPCC 1990e; Lowrey 1990), and north of Kalawao on Kalaupapa Peninsula on East Molokai (HHP 1990o4; Canfield, in press; J. Lau, pers. comm., 1990). Variety *calcisabulorum* is only reported west of Moomomi, from west of Manalo Gulch to Kalani, intergrading with variety *rockii* where their ranges overlap (HHP 1990o1, 1990o2; HPCC 1990d). The only known population of *T. rockii* var. *calcisabulorum* and the scattered West Molokai population of *T. rockii* var. *rockii* extend over a distance of about 4.5 mi (7 km) along the northern coast, sometimes dominating the vegetation (HHP 1990o1, 1990o3). Twelve mi (19 km) to the east, the Kalawao population of variety *rockii* encompasses approximately 95 ac (35 ha) (HHP 1990o4). The species is estimated to number 174,000 individuals (HHP 1990o1 to 1990o4). *Tetramolopium rockii* is restricted to hardened calcareous sand dunes or ash-covered basalt in the coastal spray zone or Coastal Dry Shrublands and Grasslands between 30 and 650 ft (10 and 200 m) in elevation (Lowrey 1990). Native plant species associated with this species include *Fimbristylis cymosa*, *Heliotropium anomalum* (hinahina), *Lipochaeta integrifolia* (nehe), *Sida fallas* ('ilima), and *Sporobolus virginicus* ('aki'aki) (Canfield, in press; HHP 1990o1 to 1990o4). The major threats to *Tetramolopium rockii* are ungulate (asix deer and cattle) activity, competition with the alien plant *Prosopis pallida* (kiawe), human recreational impacts, and fire. Predation by deer and cattle are potential threats. Although the threat to this species is limited because of the large number of existing individuals, *T. rockii* is likely to become endangered in the foreseeable future if the threats are not curbed.

Previous Federal Action

Federal action on these plants began as a result of section 12 of the Act, which directed the Secretary of the Smithsonian Institution to prepare a report on plants considered to be endangered, threatened, or extinct in the United States. This report, designated as

House Document No. 94-51, was presented to Congress on January 9, 1975. In that document, *Bidens wiebkei*, *Brighamia rockii*, *Canavalia molokaiensis*, *Hedyotis mannii* (as *H. thyrsoides* var. *thyrsoides*), *Hibiscus arnottianus* ssp. *immaculatus* (as *H. immaculatus*), *Melicope reflexa* (as *Pelea reflexa*), *Pritchardia munroi* (as *P. munroi*), *Silene alexandri*, and one of the varieties of *Silene lanceolata* accepted at that time were considered to be endangered. Three of the four varieties of *Hedyotis mannii* accepted in 1975 and three of the varieties of *Silene lanceolata* then accepted were considered to be threatened, and *Tetramolopium rockii* was considered to be extinct. On July 1, 1975, the Service published a notice in the **Federal Register** (40 FR 27823) of its acceptance of the Smithsonian report as a petition within the context of section 4(c)(2) (now section 4(b)(3)) of the Act, and giving notice of its intention to review the status of the plant taxa named therein. As a result of that review, on June 16, 1976, the Service published a proposed rule in the **Federal Register** (41 FR 24523) to determine endangered status pursuant to section 4 of the Act for approximately 1,700 vascular plant species, including all of the above taxa considered to be endangered or thought to be extinct. The list of 1,700 plant taxa was assembled on the basis of comments and data received by the Smithsonian Institution and the Service in response to House Document No. 94-51 and the July 1, 1975, **Federal Register** publication.

General comments received in response to the 1976 proposal are summarized in an April 26, 1978, **Federal Register** publication (43 FR 17909). In 1978, amendments to the Act required that all proposals over 2 years old be withdrawn. A 1-year grace period was given to proposals already over 2 years old. On December 10, 1979, the Service published a notice in the **Federal Register** (44 FR 70796) withdrawing the portion of the June 16, 1976, proposal that had not been made final, along with other proposals that had expired.

The Service published updated notices of review for plants on December 15, 1980 (45 FR 82479), September 27, 1985 (50 FR 39525), and February 21, 1990 (55 FR 6183). In these notices, nine of the taxa that had been in the 1976 proposed rule were treated as category 1 candidates for Federal listing. Category 1 taxa are those for which the Service has on file substantial information on biological vulnerability and threats to support preparation of listing proposals. Other than *Hedyotis*

mannii, all the aforementioned taxa that were either proposed as endangered or considered possibly extinct in the June 16, 1976, proposed rule were considered category 1 candidates on all three of the notices of review. *Hedyotis mannii* (as *H. thyrsoides*) was considered as a category 1* species on the 1980 and 1985 notices, but *H. thyrsoides* is now regarded as synonymous with *H. mannii* (Wagner et al. 1990) *Hedyotis mannii* (as *H. mannii*) was considered a category 2 species on the 1980 and 1985 notices and was included as a category 1 candidate on the 1990 notice. Category 1* taxa are those which are possibly extinct; category 2 taxa are those for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at the time. *Schiedea lydgatei* first appeared on the 1985 notice as a category 1 species and remained so on the 1990 notice. *Clermontia oblongifolia* ssp. *mauiensis*, *cyanea mannii*, *Phyllostegia mannii*, and *Stenogyne bifida* first appeared on the 1990 notice as category 1 taxa. *Cyanea procera* first appeared on the 1990 notice as a category 1* taxon, but information regarding the current existence of individuals of this species became available in 1991.

Section 4(b)(3)(B) of the Act requires the Secretary to make findings on certain pending petitions within 12 months of their receipt. Section 2(b)(1) of the 1982 amendments further requires all petitions pending on October 13, 1982, be treated as having been newly submitted on that date. On October 13, 1983, the Service found that the petitioned listing of these taxa was warranted but precluded by other pending listing actions, in accordance with section 4(b)(3)(B)(iii) of the Act; notification of this finding was published on January 20, 1984 (49 FR 2485). Such a finding requires the petition to be recycled, pursuant to section 4(b)(3)(C)(i) of the Act. The finding was reviewed in October of 1984, 1985, 1986, 1987, 1988, 1989, and 1990. Publication of the present proposal constitutes the final 1-year finding for these taxa.

Summary of Factors Affecting the Species

Section 4 of the Endangered Species Act (16 U.S.C. 1533) and regulations (50 CFR part 424) promulgated to implement the Act set forth the procedures for adding species to the Federal Lists. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1). The threats facing these 16 taxa are summarized in Table 1.

TABLE 1.—SUMMARY OF THREATS

Species	Feral animal activity					Alien plants	Fire	Human impacts	Rodents	Limited numbers ¹
	Deer	Goats	Pigs	Sheep	Cattle					
<i>Bidens weibkei</i>	X	X				X	X	X		X
<i>Brighamia rockii</i>	X	X				P			P	
<i>Canavalia molokaiensis</i>		X				X				X
<i>Clermontia oblongifolia</i> ssp. <i>brevipes</i>			X						P	X
<i>Cyanea mannii</i>			X						P	X
<i>Cyanea procera</i>			X						P	X
<i>Hedyotis mannii</i>			X			X				X
<i>Hibiscus arnotianus</i> ssp. <i>immaculatus</i>		X								X
<i>Melicope reflexa</i>	X		X			X				X
<i>Phyllostegia mannii</i>			X							X
<i>Pritchardia munroi</i>	X	X	P				X		X	X
<i>Schiedea lydgatei</i>						X	X			
<i>Silene alexandri</i>		X					X			X
<i>Silene lanceolata</i>		X	X	X		X	X	X		X
<i>Stenogyne bifida</i>	X	X	X			X	X		X	X
<i>Tetramolopium rockii</i>	X				X	X	P	X		

X = Immediate and significant threat

P = Potential threat

¹ No more than 100 individuals.

These factors and their application to *Bidens weibkei* Sherff (ko'oko'olau), *Brighamia rockii* St. John (pua 'ala), *Canavalia molokaiensis* Degener, I. Degener & J. Sauer ('awikiwiki), *Clermontia oblongifolia* Gaud. ssp. *brevipes* (F. Wimmer) Lammers ('ohawai), *Cyanea mannii* (Brigham) Hillebr. (haha), *Cyanea procera* Hillebr. (haha), *Hedyotis mannii* Fosb. (pilo), *Hibiscus arnotianus* A. Gray ssp. *immaculatus* (M. Roe) D. Bates (koki'o ke'oke'o), *Melicope reflexa* (St. John) T. Hartley and B. Stone (alani), *Phyllostegia mannii* Sherff (NCN), *Pritchardia munroi* Rock (loulou), *Schiedea lydgatei* Hillebr. (NCN), *Silene alexandri* Hillebr. (NCN), *Silene lanceolata* A. Gray (NCN), *Stenogyne bifida* Hillebr. (NCN), and *Tetramolopium rockii* Sherff (NCN) are as follows:

A. The present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range.

Native vegetation on the islands of Molokai and Hawaii has undergone extreme alterations because of past and present land management practices including ranching activities, deliberate animal and alien plant introductions, and agricultural development (Cuddihy and Stone 1990, Wagner *et al.* 1985). Ongoing and threatened destruction and adverse modification of habitat by feral animals and competition with alien plants are the primary threats facing the 16 taxa being proposed.

Fifteen of the 16 proposed taxa are variously threatened by feral animals. Of the ungulates that have become established on Molokai during the past 150 years, the axis deer (*Cervus axis*) has probably had the greatest impact on

the native vegetation. Eight axis deer, introduced to Molokai in 1868 (Culliney 1988, Tomich 1986), increased to thousands of animals by the 1960s (Graf and Nichols 1966). By the turn of the century, the deer had occupied much of the dry to mesic lowland areas and were also found in the wet forests of East Molokai (Graf and Nichols 1966, van Riper and van Riper 1982), where herds so damaged the vegetation that professional hunters were hired to control their numbers (Culliney 1988). The native vegetation has suffered irreparable damage from overgrazing by these animals. Deer degrade the habitat by trampling, consuming, and overgrazing vegetation, which removes ground cover, exposing the soil to erosional actions (J. Lau, pers. comm., 1990). Alien plant species are then able to exploit the newly disturbed areas.

A large portion of the axis deer population on Molokai has been actively managed for recreational hunting by the Division of Forestry and Wildlife since 1959. The maximum allowable limit is only one male deer per hunting trip; the remainder are managed to provide a sustainable yield (Hawaii Department of Land and Natural Resources (DLNR) 1988). Its future as a game species is assured because of its popularity among hunting organizations and its adaptability to the environment of Molokai (Tomich 1986). At present, five of the seven managed hunting areas on Molokai are within the Molokai Forest Reserve. Many areas lack maintained boundary fences that would prevent deer from entering more fragile habitats to the north (Cuddihy *et al.* 1982) and non-game areas to the east. Recently axis deer have begun to enter the windward valleys and northern

coastline of East Molokai where they were not previously observed (J. Lau, pers. comm., 1990). Axis deer are threatening the coastal habitats of *Brighamia rockii* and *Tetramolopium rockii* and the montane habitats of *Melicope reflexa*, *Pritchardia munroi*, and *Stenogyne bifida* (Bruegmann 1990; HHP 1990h2, 1990o1; J. Lau, pers. comm., 1990). The lowland habitat of *Bidens weibkei* is also threatened by axis deer (CPC 1991).

Introduced to Molokai in the early 1800s, the goat (*Capra hircus*) population flourished despite losses to the goatskin trade that spanned most of that century (Cuddihy and Stone 1990). Currently feral goats, unlike axis deer, degrade Molokai's higher elevation dry forests (Stone 1985) and are now invading the wetter regions along the northern coast of East Molokai (J. Lau, pers. comm., 1990). The impact of feral goats on native vegetation is similar to that described for deer (Cuddihy *et al.* 1982, Scott *et al.* 1986). Although northeastern Molokai is considered one of the most remote and inaccessible places in the main Hawaiian islands, the vegetation there is predominantly exotic (Culliney 1988). The replacement of native vegetation is attributed to the large number of goats. Due to their agility, goats are able to reach vegetation not usually accessible to other animals (Culliney 1988). As a result, various native plants are confined to areas inaccessible to goats. For example, *Brighamia rockii* persists on steep ledges out of the reach of goats and is unlikely to reestablish in any place accessible to them (Culliney 1988, HHP 1990b3). The sole populations of *Silene alexandri* and *Silene lanceolata* at Makolelau, the *Bidens weibkei*

population at Makakupaia, populations of *Canavalia molokaiensis*, *Hibiscus arnotianus* ssp. *immaculatus*, and *Stenogyne bifida* along the northern shore of East Molokai, and the only known wild *Pritchardia munroi* palm are threatened by goats (Bruegmann 1990; CPC 1991; Garnett 1989; Gerum 1989; HHP 1990g5, 1990j1, 1990L1, J. Lau, pers. comm., 1990). The Hawaii Island populations of *Silene lanceolata* located at Pohakuloa Training Area are also threatened by feral goats found throughout the region. Because goats are managed by the State as a game animal, hunting is encouraged. This activity increases the potential of vegetation being trampled by hunters and increases the threat of hunting-related fires.

Unlike axis deer and goats, pigs (*Sus scrofa*) are generally restricted to the wetter forested regions of Molokai, predominantly in the Molokai Forest Reserve where the majority of the proposed plants are located. Well known as a major destroyer of these forest habitats, feral pigs root extensively, trample native vegetation cover, and generally degrade native habitat (Cuddihy and Stone 1990, Stone 1985, van Riper and van Riper 1982). Not only are feral pigs major disseminators of alien plant seeds by carrying them internally or on their bodies, but they often carry the seeds into more pristine forests, further degrading the native ecosystem. In East Molokai's wet upland forests, pigs are destroying the habitat of most populations of *Canavalia molokaiensis*, *Cyanea mannii*, and *Melicope reflexa*, both populations of *Clermontia oblongifolia* ssp. *brevipes*, the only known population of *Phyllostegia mannii*, and the single remaining individual of *Hedyotis mannii* (CPC 1991; Dalton 1984; J. Lau, pers. comm., 1990). Pigs also threaten the Kawela gulch population of *Stenogyne bifida* on Molokai and locally degrade the habitat of *Silene lanceolata* on the island of Hawaii (Aplet *et al.* n.d., HPCC 1990c). The only surviving plant of *Pritchardia munroi* in the wild was recently fenced to protect it from pigs and other ungulates (CPC 1991). Therefore, feral pigs are no longer a direct threat to this plant, although they continue to degrade the habitat outside the fenced enclosure, making it unlikely that seedlings will become established there. Eradication efforts in The Nature Conservancy (TNCH) preserves include public hunting; many other areas of East Molokai also have public hunting programs (E. Misaki, pers. comm., 1990). However, feral pigs are invasive animals and often inhabit gulches and areas not frequented by hunters or

management personnel, hiding the control of these animals in remote sites.

Feral sheep (*Ovis aries*) have become firmly established on the island of Hawaii (Tomich 1986) since their introduction almost 200 years ago (Cuddihy and Stone 1990). Like feral goats, sheep roam the upper elevation dry forests of Mauna Kea (above 3,300 ft (1,000 m)), including Pohakuloa Training Area, causing damage similar to that of goats (Stone 1985). Sheep have decimated vast areas of native forest and shrubland on Mauna Kea and continue to do so as a managed game species. Sheep threaten the habitat of *Silene lanceolata* and at least two listed endangered plant species (Cuddihy and Stone 1990, Shaw *et al.* 1990, Stone 1985).

Although not a direct threat to the proposed plant taxa at present, cattle (*Bos taurus*) ranching on Molokai has played a significant role over most of the past 150 years in reducing areas of native vegetation to vast pastures of alien grasses (Cuddihy and Stone 1990, Pekelo 1973, Stone 1985). In 1960 approximately 61 percent of Molokai's land area was devoted to grazing, primarily the lower elevation dry to mesic forests, shrublands, and grasslands of West and central Molokai (Baker 1961). Cattle degraded the habitat by trampling and feeding on vegetation, eventually opening up the ground cover, exposing the soil, and increasing its vulnerability to erosion (Cuddihy and Stone 1990, Lindgren 1908, Pekelo 1973). Red erosional scars resulting from decades of cattle disturbance, exacerbated by other feral ungulate activities, are still evident on West Molokai and upper elevation ridges of East Molokai. Cattle have also facilitated the spread of alien grasses and other plants (Cuddihy and Stone 1990). Because of this alteration of vegetation, natural areas became limited to the upper elevation mesic to wet forests of East Molokai, where the State designated a single protected area: The Molokai Forest Reserve. Most of the proposed taxa are restricted to this forest reserve, which occupies about 30 percent of Molokai's land area (Baker 1961). As the fences separating cattle ranches from the forest reserve began to deteriorate over time, cattle from low elevation pastures were free to enter the forest reserve, further degrading the native forest (Cuddihy and Stone 1990, Pekelo 1973, Pratt 1973).

In the early 1970s, in an effort to keep bovine tuberculosis from entering domestic stock, a total of 375 wild cattle were eradicated from the forest reserve (Pekelo 1973). Because this did not

eliminate tuberculosis, domestic cattle were eradicated from the island between 1985 and 1986. After a mandatory 1-year hiatus, ranches were allowed to reintroduce non-breeding and later breeding animals, such that the cattle population on Molokai is now growing (Molokai Ranch, Ltd. 1988a; J. Lau, pers. comm., 1990). At present, cattle are limited to a large private ranch on West Molokai with over 1,800 animals and small private ranches on East Molokai (Molokai Ranch, Ltd. 1988a to 1988c; E. Misaki, pers. comm., 1990). Cattle are not known to have entered the Molokai Forest Reserve since their reintroduction to the island in 1987 (William Falconer, Maui Department of Agriculture, pers. comm., 1991). However, on West Molokai there are reports of cattle in Moomomi Preserve (HPCC 1990e), where a protective fence is to be erected shortly to protect *Tetramolopium rockii* and other unique native plants (E. Misaki, pers. comm., 1990). Until the fencing is completed, cattle will continue to degrade the habitat of *T. rockii*. The future of cattle and their impact on the native vegetation of Molokai, including the 16 proposed taxa, is uncertain. However, as cattle ranching becomes a more important economic activity on the island, the impact of cattle will likely be increasingly deleterious.

Cattle ranching was the island's primary industry until the 1920, when pineapple cultivation was introduced to boost the then failing economy (Bottenfield 1958). Most of the land used for this form of agriculture had already been altered through decades of extensive ranching activities. However, until the pineapple industry's decline in the 1970's, pineapple cultivation contributed significantly to the high degree of erosion (Cuddihy and Stone 1990, Wagner *et al.* 1985). More recently, economic growth has been based largely on tourism (Plasch 1985). Hotels are being proposed in conjunction with an anticipated increase in the tourist industry. Although development is limited at present to the primary tourist destination of Kaluakoi on Molokai's western end, it is inevitable that development will affect the native vegetation elsewhere on the island. For example, a water diversion plan currently under discussion proposes the extension of a tunnel eastward from Waikolu Stream, now being tapped, to other potential watershed sources such as Pelekunu Valley. Under current methods of tunnel development, construction at the surface level is likely to favor the spread of alien plant species (Alan Holt, TNCH, pers. comm., 1990).

Seven of the 16 taxa being proposed for listing are threatened by competition with 1 or more alien plant species (see Table 1). Noxious alien plants such as *Schinus terebinthifolius* (Christmas berry) have invaded the dry to mesic lowland areas. Introduced to Hawaii before 1911, Christmas berry has had particularly detrimental impacts (Cuddihy and Stone 1990). Its spread is facilitated by the opening of the ground cover and canopy by feral ungulates. This fast-growing tree is considered one of the major alien plant problems affecting the native vegetation of Molokai because it is able to form dense thickets that displace other plants (Cuddihy and Stone 1990; Smith 1985; J. Lau, pers. comm., 1990). It is spreading in Kalaupapa, Waikolu, and throughout Halawa (Kirch and Kelly 1975; Linney, in press; J. Lau, pers. comm., 1990), where it presently threatens the habitat of four of the five populations of *Bidens wiebkei* and may threaten populations of *Brighamia rockii* (HHP 1990b3).

With the introduction of cattle, goats, and deer and the development of organized ranching, the native forests in many parts of the State were converted to vast pastures of alien grasses. Of the alien grasses that have become established on Molokai, *Melinis minutiflora* (molasses grass) is probably the most disruptive to its native dry forests. First introduced as cattle fodder (Bottenfield 1958), then planted for erosion control (Cuddihy and Stone 1990), this alien species quickly spread to dry and mesic forests previously disturbed by ungulates. Molasses grass produces a dense mat capable of smothering plants (Smith 1985), essentially preventing seedling growth and native plant reproduction (Cuddihy and Stone 1990). As a fuel for fire, molasses grass intensifies its heat and carries fire into areas with woody plants (Cuddihy and Stone 1990, Smith 1985). It is able to spread prolifically after a fire and effectively compete with less fire-adapted native plant species, creating a dense stand of alien grass where forests once stood. Molasses grass is becoming a major problem in dry sites along the many leeward ridges of East Molokai. Also affected are the lower portions of Kamakou Preserve and outlying areas to the south (J. Lau, pers. comm. 1990). Here all five populations of *Schiedea lydgatei*, populations of *Canavalia molokaiensis*, and the single known plant of *Hedyotis mannii* are threatened by invading molasses grass (HHP 1990f1, 1990c4; J. Lau, pers. comm., 1990). The southern section of Halawa, containing a population of *Bidens wiebkei*, is also infested (HHP 1990a3).

Other proposed plant taxa found near molasses grass are not presently threatened, because they grow in gulches and wetter areas where the intact ground cover makes invasion by molasses grass difficult.

Prosopis pallida (kiawe), a common deciduous tree found in arid, low-elevation, disturbed sites on Molokai (Smith 1985, Wagner *et al.* 1990), has invaded areas adjacent to the hardened sand dunes of Moomomi Preserve where *Tetramolopium rockii* grows (HHP 1990o1; J. Lau, pers. comm., 1990). Kiawe shades the ground cover and its vast root system dries the substrate by utilizing all available water (Smith 1985). It thus competes with *Tetramolopium rockii* for light, space, and moisture (E. Misaki, pers. comm., 1990).

Of the naturalized species in the melastome family, *Clidemia hirta* (Koster's curse) has become one of the most disruptive invaders of Hawaii's ecosystems (Cuddihy and Stone 1990). First reported from the island of Oahu in 1941, Koster's curse quickly invaded the other Hawaiian islands and now occupies more than 23 sq mi (60 sq km) on East Molokai, primarily in Pelekunu and Wailau valleys (Cuddihy and Stone 1990). This noxious shrub forms a dense understory up to 6 ft (2 m) tall, shading other plants and hindering plant regeneration (Smith 1985). Koster's curse threatens to replace the Wailau-Mapulehu summit ridge population of *Melicope reflexa* (HHP 1990h2; J. Lau, pers. comm., 1991).

Pennisetum setaceum (fountain grass) is a fire-adapted bunch grass that has spread rapidly over bare lava flows and open areas on the island of Hawaii since its introduction in the early 1900s. Fountain grass is particularly detrimental to Hawaii's dry forests because it is able to invade areas once dominated by native plants, where it interferes with plant regeneration, carries fires into areas not usually prone to fires, and increases the likelihood of fires (Cuddihy and Stone 1990, Smith 1985). The *Chamaesyce olowaluana* ('akoko) forests on the island of Hawaii, apparently former habitat of *Silene lanceolata*, have burned repeatedly and are now largely replaced by fountain grass (R. Shaw, pers. comm., 1991). This alien plant is present in the habitat of another population of *Silene lanceolata* on the island of Hawaii, where it is likely to become a more serious problem.

Fire is a major threat to the proposed plant species found in dry to mesic habitats, especially in the lower portions of Kamakou Preserve and adjacent

areas to the south, where populations of *Schiedea lydgatei*, *Silene alexandri*, and *Silene lanceolata* are located (Cuddihy *et al.* 1982; J. Lau, pers. comm., 1990; E. Misaki, pers. comm., 1991). Populations of *Bidens wiebkei* at Halawa and *Tetramolopium rockii* at Moomomi are also threatened by fire (CPC 1991; HHP 1990o1). For reasons previously discussed, the presence of molasses grass greatly enhances the potential and destructiveness of fires. For example, in 1988 a human-caused fire consumed roughly 15 sq mi (38 sq km) of shrubland and forest from the southern coastline of East Molokai to the southwest corner of Kamakou Preserve, about 3.5 mi (5.5 km) inland (E. Misaki, pers. comm., 1990), and may possibly have destroyed four of the five populations of *Schiedea lydgatei*. Molasses grass was the main carrier of that fire (E. Misaki, pers. comm., 1991). Although fires are not frequent at Moomomi, a single fire could burn extensively through dry shrub and grassland and destroy portions of the *Tetramolopium rockii* populations that grow there (E. Misaki, pers. comm., 1990). The dry to mesic habitat of *Pritchardia munroi* is also threatened by fire (CPC 1991, HHP 1990j1).

Natural fires and fires accidentally set by hunters or military ordnance or personnel within Pohakuloa Training Area (PTA) on the island of Hawaii threaten native vegetation on the leeward side of Mauna Kea (Herbst and Fay 1979), including the habitat of three populations of *Silene lanceolata*. Although the habitat of Hawaii Island populations of *S. lanceolata* at Kipuka Alala and Kipuka Kalawamauna has apparently been burned repeatedly, those populations are still present (R. Shaw, pers. comm., 1991). This suggests the possibility that this species may be tolerant to fire. However, fire-adapted grasses already at these sites can exploit newly burned areas more rapidly than woody species (Cuddihy and Stone 1990) (presumably including *S. lanceolata*), resulting in the conversion of native shrubland to land dominated by alien grasses. Fire is therefore at least an indirect and serious threat to this species. In order to protect the Kipuka Kalawamauna population from fires, the U.S. Army has installed firebreaks and now redirects ordnance firing away from that Kipuka. The Army is also developing plans to protect the newly discovered Kipuka Alala population.

Habitat disturbance caused by human activities threatens four of the proposed taxa. Military exercises at PTA on the island of Hawaii may have threatened *Silene lanceolata* in the past. Planned

military maneuvers are now being reevaluated in light of the recent discovery of the Kipuka Alala and Kipuka Kalawamauna populations of that species. Recreational activities such as fishing and camping have drawn people to Moomomi Preserve and the adjacent coastline. The population of *Tetramolopium rockii* on State-owned Hawaiian Home Lands east of Moomomi Preserve is subject to disturbance by vehicles passing along two jeep roads that run through that population (HPCC 1990; E. Misaki, pers. comm., 1990), which represents almost 25 percent of the individuals of that species. Although the human impact on the spray zone population of *T. rockii* on Kalaupapa Peninsula is now minimal, greater impacts may result from the expected increase in visitor use after the residents of Kalaupapa's Hansen's disease settlement live out their lives (Canfield, in press; Greene 1985; United States, National Park Service (NPS) 1986). A population of *Bidens wiebkei* at Makakupaia, representing approximately half the total individuals of that species, grows along a jeep road. Off-road activity would damage a significant portion of that population. One of the three populations of *Stenogyne bifida* is located near a hiking trail at Kawela and has the potential of being trampled or collected (S. Anderson, pers. comm., 1990).

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization is not known to be a factor, but unrestricted collecting for scientific or horticultural purposes or excessive visits by individuals interested in seeing rare plants could result from increased publicity and would seriously impact the 11 taxa whose low numbers make them especially vulnerable to disturbances. Such disturbance could promote erosion and greater ingress of alien plant species.

C. Disease or Predation

No evidence of disease has been reported for the 16 proposed taxa. Rats (*Rattus* spp.) are known to eat the fruits of *Pritchardia munroi* (CPC 1991). Although the incidence of rats in the vicinity of the last remaining wild plant appears to be low, the fence that was erected to protect that plant from foraging animals does not prevent rats from continuing to feed on the fruit (Garnett 1989, HHP 1990j1). A more important threat is that of foraging by goats and other ungulates in the area, which has resulted in there being no successful regeneration of the palm

(CPC 1991, Gerum 1989). There is no direct evidence that rats feed on *Brighamia rockii*, *Clermontia oblongifolia* ssp. *brevipes*, *Cyanea mannii*, or *Cyanea procera*. However, such evidence does exist for related *Clermontia* and *Cyanea* species in similar habitat on other islands (J. Lau, pers. comm., 1990). Because rats are found in remote areas on Molokai, it is likely that predation occurs on these four proposed taxa as well (CPC 1991; HPCC 1990a; J. Lau, pers. comm., 1990).

A goat enclosure experiment on the island of Hawaii demonstrated that *Canavalia hawaiiensis*, a relative of the proposed *Canavalia molokaiensis*, is consumed by goats (St. John 1972). It is possible that goats also eat *C. molokaiensis*. At Moomomi, axis deer graze primarily on introduced plants inland of the dunes (Bruegmann 1986), but they are also likely to consume *Tetramolopium rockii* where it is the dominant ground cover. While there is no direct evidence of predation by ungulates on any of the proposed taxa, they are not known to be unpalatable to goats, deer, or cattle. Predation is therefore a probable threat at sites where those animals have been reported potentially affecting 10 of the taxa: *Bidens wiebkei*, *Brighamia rockii*, *Canavalia molokaiensis*, *Hibiscus arnotianus* ssp. *immaculatus*, *Melicope reflexa*, *Pritchardia munroi*, *Silene alexandri*, *Silene lanceolata*, *Stenogyne bifida*, and *Tetramolopium rockii*.

D. The Inadequacy of Existing Regulatory Mechanisms

All 16 proposed taxa have populations located on privately-owned land. Nine taxa are found exclusively on private land. Of the remaining taxa, six also occur on State land (including one species located on the boundary between State and private land) and one occurs on Federal land. There are no State laws or existing regulatory mechanisms at the present time to protect or prevent further decline of these plants on private land. However, Federal listing would automatically invoke listing under Hawaii State law, which prohibits taking and encourages conservation by State Government agencies. State regulations prohibit the removal, destruction, or damage of plants found on State lands. However, the regulations are difficult to enforce because of limited personnel.

Hawaii's Endangered Species Act (HRS, Sect. 195D-4(a)) states, "Any species of aquatic life, wildlife, or land plant that has been determined to be an endangered species pursuant to the Endangered Species Act (of 1973) shall be deemed to be an endangered species

under the provisions of this chapter and any indigenous species of aquatic life, wildlife, or land plant that has been determined to be a threatened species pursuant to the Endangered Species Act shall be deemed to be a threatened species under the provisions of this chapter." Further, the State may enter into agreements with Federal agencies to administer and manage any area required for the conservation, management, enhancement, or protection of endangered species (HRS, Section 195D-5(c)). Funds for these activities could be made available under section 6 of the Federal Act (State Cooperative Agreements). Listing of these 16 plant taxa would therefore reinforce and supplement the protection available under State law. The Act would also offer additional protection to these 16 taxa because if they were to be listed as endangered or threatened, it would be a violation of the Act for any person to remove, cut, dig up, damage, or destroy any such plant in an area not under Federal jurisdiction in knowing violation of State law or regulation or in the course of any violation of a State criminal trespass law.

E. Other Natural or Manmade Factors Affecting its Continued Existence

The small number of populations and of individual plants of many of these taxa increases the potential for extinction from stochastic events. The limited gene pool may depress reproductive vigor, or a single human-caused or natural environmental disturbance could destroy a significant percentage of the individuals or the only known extant population. For example, 6 of the taxa are known from a single population: *Clermontia oblongifolia* ssp. *brevipes* and *Pritchardia munroi* (each reduced to a single remaining plant); *Cyanea procera* and *Hedyotis mannii* (each numbering only 2 plants); *Phyllostegia mannii* (4 plants); and *Silene alexandri* (fewer than 10 plants). All of the 16 proposed taxa are known from 7 or fewer populations, 11 of them from fewer than 5 populations. Eleven of the proposed taxa are estimated to number no more than 100 known individuals (see Table 1.). Approximately 22 plants of *Pritchardia munroi* are in cultivation in various arboreta and institutions throughout the world (Gerum 1989). However, little is known about the genetics of this species and it is unclear whether hybridization with other species occurs, resulting in the questionable species integrity of the cultivated plants. It is not clear whether selfing or outcrossing (outbreeding) occurs or whether the second generation

seeds are viable (Derral Herbst, U.S. Fish and Wildlife Service, pers. comm., 1990).

The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by these taxa in determining to propose this rule. Based on this evaluation, the preferred action is to list 15 taxa, *Bidens weibkei*, *Brighamia rockii*, *Canavalia molokaiensis*, *Clermontia oblongifolia* ssp. *brevipes*, *Cyanea mannii*, *Cyanea procera*, *Hedyotis mannii*, *Hibiscus arnottianus* ssp. *immaculatus*, *Melicope reflexa*, *Phyllostegia mannii*, *Pritchardia munroi*, *Schiedea lydgatei*, *Silene alexandri*, *Silene lanceolata*, and *Stenogyne bifida*, as endangered and the species *Tetramolopium rockii* as threatened.

All of the taxa proposed for listing as endangered are known from 7 or fewer populations, and 11 taxa are estimated to number fewer than 100 individuals. The 15 taxa are threatened by 1 or more of the following: Habitat degradation and/or predation by deer, feral goats, pigs, sheep, and cattle; competition from alien plants; fire; recreational activities; and military training exercises. Small population size makes these taxa particularly vulnerable to extinction from stochastic events. Because these 15 taxa are in danger of extinction throughout all or a significant portion of their ranges, they fit the definition of endangered as defined in the Act.

Although all populations of *Tetramolopium rockii* are threatened to some degree by competition with alien plants, habitat destruction and predation by feral animals, fire, and/or human activities, the relatively large number of existing individuals of *T. rockii* reduces the likelihood that this species will become extinct in the near future. Because the threats facing *T. rockii* are limited at present, this species is not now in immediate danger of extinction throughout all or a significant portion of its range. However, *T. rockii* is likely to become endangered in the foreseeable future if the threats are not curbed. As a result, *Tetramolopium rockii* fits the definition of a threatened species as defined in the Act.

Critical habitat is not being proposed for the 16 taxa included in this rule, for reasons discussed in the "Critical Habitat" section of this proposal.

Critical Habitat

Section 4(a)(3) of the Act, as amended, requires that to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time a species is determined to be endangered or threatened. The Service finds that

designation of critical habitat is not presently prudent for these taxa. Such a determination would result in no known benefit to the taxa. Eleven of the taxa have extremely low total populations and face anthropogenic threats (see Factor B in "Summary of Factors Affecting the Species"). The publication of precise maps and descriptions of critical habitat in the Federal Register and local newspapers as required in a proposal for critical habitat would increase the degree of threat to these plants from take or vandalism and, therefore, could contribute to their decline and increase enforcement problems. The listing of these taxa as either endangered or threatened publicizes the rarity of the plants and, thus, can make these plants attractive to researchers, curiosity seekers, or collectors of rare plants. All involved parties and the major landowners have been notified of the general location and importance of protecting the habitat of these taxa. Protection of the habitat of the taxa will be addressed through the recovery process and through the section 7 consultation process.

There are two known Federal activities within the currently known habitats of these plants. Three populations of *Silene lanceolata* are known from the Pohakuloa Training Area (PTA) on the Island of Hawaii: One population, which has not been seen for over 40 years, was located in the northern part of PTA; another population is in the Kipuka Kalawamauna Endangered Plants Habitat, an area of PTA cooperatively designated by the U.S. Army, the U.S. Fish and Wildlife Service, the Hawaii Department of Fish and Wildlife, and the Hawaii Department of Land and Natural Resources; and the third population is in Kipuka Alaka. Existing firebreaks and redirection of ordnance firing away from Kipuka Kalawamanua will help protect that population, and the Army is now developing plans to protect the newly discovered Kipuka Alaka population. Three of the seven populations of *Canavalia molokaiensis* and one of the four populations of *Tetramolopium rockii* are found in Kalaupapa National Historical Park. Although the State of Hawaii owns the land where these populations are found, the National Park Service leases and manages the area. Federal laws protect all plants in the park from damage or removal. The involved Federal agencies are aware of the presence and location of these species, and any Federal activities that may affect the continued existence of these plants will be addressed through the section 7 consultation process. Therefore, the

Service finds that designation of critical habitat for these taxa is not prudent at this time, because such designation would increase the degree of threat from vandalism, collecting, or other human activities and because it would be unlikely to aid in the conservation of these taxa.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Endangered Species Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain activities. Recognition through listing encourages and results in conservation actions by Federal, State, and private agencies, groups, and individuals. The Endangered Species Act provides for possible land acquisition and cooperation with the State and requires that recovery actions be carried out for all listed species. The protection required of Federal agencies and the prohibitions against certain activities involving listed plants are discussed, in part, below.

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer informally with the Service on any action that is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Some populations of two species, *Canavalia molokaiensis* and *Tetramolopium rockii*, are located in Kalaupapa National Historical Park. Laws relating to national parks prohibit damage or removal of any plants growing in the parks. Most of the known individuals of *Silene lanceolata* are located within Pohakuloa Training Area on the Island of Hawaii. Firebreaks and redirection of firing exercises away from the listed plant species at Kipuka

Kalawamauna will help protect the population of *Silene lanceolata* at that kipuka. Military activities planned near the Kipuka Alala population are now being reevaluated in the light of that population's discovery. There are no other known Federal activities that occur within the present known habitat of these 16 plant taxa.

The Act and its implementing regulations found at 50 CFR 17.61, 17.62, and 17.63 for endangered species and 17.71 and 17.72 for threatened species set forth a series of general trade prohibitions and exceptions that apply to all endangered and threatened plant species. With respect to the 16 plant taxa from the island of Molokai, all trade prohibitions of section 9(a)(2) of the Act, implemented by 50 CFR 17.61 and 17.71, would apply. These prohibitions, in part, make it illegal with respect to any endangered or threatened plant for any person subject to the jurisdiction of the United States to import or export; transport in interstate or foreign commerce in the course of a commercial activity; sell or offer for sale these species in interstate or foreign commerce; or to remove and reduce to possession any such species from areas under Federal jurisdiction; maliciously damage or destroy any such species on any area under Federal jurisdiction; or remove, cut, dig up, damage, or destroy any such species on any other area in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law. Seeds from cultivated specimens of threatened plant species are exempt from these prohibitions provided that a statement of "cultivated origin" appears on their containers. Certain exceptions apply to agents of the Service and State conservation agencies. The Act and 50 CFR 17.62, 17.63, and 17.72 also provide for the issuance of permits to carry out otherwise prohibited activities involving endangered and threatened plant species under certain circumstances.

It is anticipated that few trade permits would ever be sought or issued because the species are not common in cultivation nor in the wild. Requests for copies of the regulations on plants and

inquiries regarding them may be addressed to the Office of Management Authority, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, room 432, Arlington, Virginia 22203-3507 (703/358-2104 or FTS 921-2104; FAX 703/358-2281).

Public Comments Solicited

The Service intends that any final action resulting from this proposal will be as accurate and as effective as possible. Therefore, comments or suggestions from the public, other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule are hereby solicited. Comments particularly are sought concerning:

- (1) Biological, commercial trade, or other relevant data concerning any threat (or lack thereof) to these species;
- (2) The location of any additional populations of these species and the reasons why any habitat should or should not be determined to be critical habitat as provided by section 4 of the Act;
- (3) Additional information concerning the range, distribution, and population size of these species; and
- (4) Current or planned activities in the subject area and their possible impacts on these species.

The final decision on this proposal will take into consideration the comments and any additional information received by the Service, and such communications may lead to a final regulation that differs from this proposal.

The Endangered Species Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days of the date of publication of the proposal. Such requests must be made in writing and addressed to the Field Supervisor (see **ADDRESSES** section).

National Environmental Policy Act

The Fish and Wildlife Service has determined that an Environmental Assessment or Environmental Impact Statement, as defined under the authority of the National Environmental

Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. A notice outlining the Service's reasons for this determination was published in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited herein is available upon request from the Pacific Islands Office (see **ADDRESSES** section).

Author

The primary authors of this proposed rule are Joan M. Yoshioka, Z.E. Ellshoff, Joan E. Canfield, and Derral R. Herbst, Fish and Wildlife Enhancement, Pacific Islands Office, U.S. Fish and Wildlife Service, 300 Ala Moana Boulevard, room 6307, P.O. Box 50167, Honolulu, Hawaii 96850 (808/541-2749 or FTS 551-2749). Substantial data were also generously contributed by Joel Q.C. Lau of the Hawaii Heritage Program.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, and Transportation.

Proposed Regulations Promulgation

PART 17—[AMENDED]

Accordingly, it is hereby proposed to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361-1407; 16 U.S.C. 1531-1544; 16 U.S.C. 4201-4245; Pub. L. 99-625, 100 Stat. 3500; unless otherwise noted.

2. It is proposed to amend § 17.12(h) by adding the following, in alphabetical order under the families indicated, to the List of Endangered and Threatened Plants:

§ 17.12 Endangered and threatened plants.

* * * * *
(h) * * *

Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
Arecaceae—Palm family:						
<i>Pritchardia munroi</i>	loulu	U.S.A. (HI)	E		NA	NA
Asteraceae—Aster family:						
<i>Bidens wiewbkei</i>	ko'oko'olau	U.S.A. (HI)	E		NA	NA

Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
<i>Tetramolopium rockii</i>	None	U.S.A. (HI)	T		NA	NA
Campanulaceae—Bellflower family:						
<i>Brighamia rockii</i>	pua 'ala	U.S.A. (HI)	E		NA	NA
<i>Clermontia oblongifolap. brevipes.</i>	'oha wai	U.S.A. (HI)	E		NA	NA
<i>Cyanea mannii</i>	haha	U.S.A. (HI)	E		NA	NA
<i>Cyanea procere</i>	haha	U.S.A. (HI)	E		NA	NA
Caryophyllaceae—Pink family:						
<i>Schiedea lydgatei</i>	None	U.S.A. (HI)	E		NA	NA
<i>Silene alexandri</i>	None	U.S.A. (HI)	E		NA	NA
<i>Silene lanceolata</i>	None	U.S.A. (HI)	E		NA	NA
Fabaceae—Pea family:						
<i>Canavalia motokaiensis</i>	'awikwiki	U.S.A. (HI)	E		NA	NA
Lamiaceae—Mint family:						
<i>Phyllostegia mannii</i>	None	U.S.A. (HI)	E		NA	NA
<i>Stenogyne bifida</i>	None	U.S.A. (HI)	E		NA	NA
Malvaceae—Mallow family:						
<i>Hibiscus amottianus ssp. immaculatus.</i>	koki'o ke'oke'o	U.S.A. (HI)	E		NA	NA
Rubiaceae—Coffee family:						
<i>Hedyotis mannii</i>	pilo	U.S.A. (HI)	E		NA	NA
Rutaceae—Citrus family:						
<i>Melicope reflexa</i>	alani	U.S.A. (HI)	E		NA	NA

Dated: August 26, 1991.

Richard N. Smith.

Acting Director, Fish and Wildlife Service.

[FR Doc. 91-22695 Filed 9-19-91; 8:45 am]

BILLING CODE 4310-55-M