

## DEPARTMENT OF THE INTERIOR

## Fish and Wildlife Service

## 50 CFR Part 17

RIN 1018-AB52

**Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for 26 Plants From the Waianae Mountains, Island of Oahu, 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 26 plants: *Abutilon sandwicense* (no common name (NCN)), *Alsinidendron obovatum* (NCN), *Alsinidendron trinerve* (NCN), *Centaurium sebaeoides* ('awiwi), *Chamaesyce celastroides* var. *kaenana* ('akoko), *Chamaesyce kuwaleana* ('akoko), *Cyanea pinnatifida* (haha), *Diellia falcata*, *Dubautia herbstobatae* (na'ena'e), *Gouania meyenii* (NCN), *Hedyotis degeneri* (NCN), *Hedyotis parvula* (NCN), *Hesperomannia arbuscula* (NCN), *Lipochaeta lobaia* var. *leptophylla* (nehe), *Lipochaeta tenuifolia* (nehe), *Lobelia niihauensis* (NCN), *Neraudia angulata* (NCN), *Nototrichium humile* (kulu'i), *Phyllostegia mollis* (NCN), *Sanicula mariversa* (NCN), *Schiedea kaalae* (NCN), *Silene perlmanii* (NCN), *Tetramolopium filiforme* (NCN), *Tetramolopium lepidotum* ssp. *lepidotum* (NCN), *Urera kaalae* (opuhe), and *Viola chamissoniana* ssp. *chamissoniana* (pamakani). These species are known primarily from the Waianae Mountain Range, located on the island of Oahu, Hawaii. Eight of these species have been collected from one or more sites on the islands of Kauai, Molokai, West Maui, Niihau, East Maui, Moku Mano, or the Koolau Mountains on Oahu. The 26 plant species and their habitats have been adversely threatened in various degrees by one or more of the following: Trampling and predation by feral animals (pigs, cattle, goats); habitat degradation and competition for space, light, water, and nutrients by naturalized, alien vegetation; and habitat loss from fires. A few of these species may have been subjected to overcollection, primarily for scientific purposes, and are subject to trampling by human beings along trails. Because of the depauperate number of extant individuals and severely restricted distributions, populations of these species are subject to an increased

likelihood of extinction from stochastic events. A determination that these 26 species are endangered 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 27, 1990. Public hearing requests must be received by November 13, 1990.

**ADDRESSES:** Comments and materials concerning this proposal should be sent to Ernest F. Kosaka, Field Office Supervisor, 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 (308/541-2749 or FTS 551-2749).

**SUPPLEMENTARY INFORMATION:****Background**

*Abutilon sandwicense*, *Alsinidendron obovatum*, *Alsinidendron trinerve*, *Chamaesyce celastroides* var. *kaenana*, *Chamaesyce kuwaleana*, *Cyanea pinnatifida*, *Diellia falcata*, *Dubautia herbstobatae*, *Gouania meyenii*, *Hedyotis degeneri*, *Hedyotis parvula*, *Lipochaeta lobaia* var. *leptophylla*, *Lipochaeta tenuifolia*, *Neraudia angulata*, *Phyllostegia mollis*, *Sanicula mariversa*, *Schiedea kaalae*, *Silene perlmanii*, *Tetramolopium filiforme*, *Tetramolopium lepidotum* ssp. *lepidotum*, *Urera kaalae*, and *Viola chamissoniana* ssp. *chamissoniana* are either endemic to, or have their largest or best known populations in, the Waianae Mountain Range on the western side of the island of Oahu, Hawaii. *Centaurium sebaeoides* is also known from the islands of Kauai, Molokai, and West Maui, and from the Koolau Mountains on Oahu; *Hesperomannia arbuscula* is known from West Maui; *Lobelia niihauensis* is known from Niihau and Kauai; *Nototrichium humile* is known from East Maui; *Chamaesyce kuwaleana* is also known from Moku Mano Island off the coast of Oahu; *Diellia falcata* is known from both the Waianae and Koolau Mountain ranges; *Phyllostegia mollis* is known from Molokai and East Maui as well as the Koolau Mountains of Oahu; and *Tetramolopium lepidotum* ssp. *lepidotum* has been collected on the island of Lanai in the past.

The island of Oahu is formed from the remnants of two large shield volcanoes, the older Waianae volcano on the west

and the younger Koolau volcano on the east. Their original shield volcano shape has been lost as a result of extensive erosion, and today these volcanoes are called "mountains" or "ranges," and consist of long, narrow ridges. The Waianae Mountains were built by eruptions that took place primarily along three rift zones. The two principal rift zones run in a northwestward and south-southeastward direction from the summit, and a lesser one runs to the northeast. The range is approximately 40 miles (mi) (64 kilometers (km)) long. The caldera lies between the north side of Makaha Valley and the head of Nanakuli Valley (MacDonald *et al.* 1983). The Waianae Mountains are in the rain shadow of the parallel Koolau Mountains and except for Mt. Kaala, the highest point on Oahu (4,020 feet (ft) (1,225 meters (m))), receive much less rainfall (Wagner *et al.* 1990). The median annual rainfall for the Waianae Mountains varies from 20 to 75 inches (in) (51 to 191 centimeters (cm)), with only the small summit area of Mt. Kaala receiving the highest amount.

Two of the species, *Chamaesyce celastroides* var. *kaenana* and *Centaurium sebaeoides*, are members of the 'Ilima Shrubland Community of the Coastal Dry Shrublands Vegetation type which occurs on sand dunes and poorly consolidated volcanic soils near shore environments with high exposure to salt-laden winds. Coastal Dry Shrublands occur on all of the islands of the Northwestern Hawaiian Islands and along the coastlines of all of the main islands, extending up to about 1,000 ft (300 m) in elevation. Because of the effects of rain shadows, these communities are most extensively developed on the leeward sides of the higher islands. Annual rainfall is less than 45 in (120 cm), and occurs primarily during the winter months of October to April; much of the vegetation dies back during a prolonged drought that lasts most of the rest of the year (Gagne and Cuddihy 1990).

Lowland Dry Vegetation includes several plant communities and occurs on the leeward sides of all the main Hawaiian islands at an elevation of 15 to 2,000 ft (5 to 610 m). The climate of this vegetation type is distinctly seasonal with hot, dry summers and winter rainfall, usually less than 40 in (100 cm), but ranging up to 80 in (200 cm) annually. The soils range from weathered silty loams to stony clay, and rocky ledges with very shallow soil and recent, little-weathered lava are present (Cuddihy and Stone 1990, Gagne and Cuddihy 1990). The following species proposed herein are members of several

communities of this vegetation type: *Dubautia herbstobatae*, *Lipochaeta lobata* var. *leptophylla*, *Sanicula marivasa*, *Tetramolopium filiforme*, *Chamaesyce kuwaleana*, *Hedyotis parvula*, and *Lobelia niihauensis*.

The remaining 17 species included in this proposed rule are members of the Diverse Mesic Forest Community, one of the lowland Mesic Forest Vegetation community types. These communities occur on most of the main islands between 100 and 5,300 ft (30 to 1,600 m) in elevation. The annual rainfall is 45 to 150 in (120 to 380 cm), falling mostly during the winter months. This community grows on diverse, well-weathered, and well-drained substrates ranging from rocky, shallow, organic muck soils to steep, rocky talus slopes, shallow soil over weathered rock in steep gulches, or deep soil over soft weathered rock and gravelly alluvium. In the Waianae Mountains, this vegetation community is found in sheltered areas and comprises a rich diversity of native plants with no clearly dominant species (Cuddihy and Stone 1990, Gagne and Cuddihy 1990). Four of the 17 taxa that are components of the Diverse Mesic Forest Community grow primarily in the wetter parts of this vegetation type or may cross into a wet forest community: these are *Alsinidendron trinerve*, *Hesperomannia arbuscula*, *Phyllostegia mollis*, and *Schiedea kaalae*.

The land that supports these 26 plant species is owned by the State of Hawaii (including land classified as Department of Hawaiian Homelands, Natural Area Reserve System, Forest Reserve, and City and County of Honolulu land), Federal government, and private parties. Plants on Federal land are located on portions of Schofield Barracks and Makua Military Reservation, both under the jurisdiction of the U.S. Army.

#### Discussion of the 26 Taxa Proposed for Listing

In 1932, Otto Degener (1932a, 1932b) discovered and described what is now called *Abutilon sandwicense*, naming it *Abortopetalum sandwicense* for the Sandwich Islands, an earlier name for the Hawaiian Islands. Degener's new genus, *Abortopetalum*, was based primarily on its spatula-shaped, "abortive" petals. Erling Christophersen (1934) transferred the species to the genus *Abutilon* because none of the characters of the genus *Abortopetalum* made it distinctive from the generally accepted definition of *Abutilon*. In the same publication, Christophersen (1934) described variety *welchii* from Lualualei Valley, but the most recent treatment of the genus (Bates 1990) considers the

differences cited by Christophersen to be within the normal range of variation of the species.

*Abutilon sandwicense*, of the mallow family (Malvaceae), is a shrub that grows to 10 ft (3 m) tall and is covered with short glandular hairs. Leaves are light green, heart-shaped, and 3 to 9 in (8 to 22 cm) long. A single pendulous flower grows from the leaf axil (the point between the leaf and the stem). The flowers have pale, greenish-yellow, hairy, glandular sepals and bright green, often reddish-brown tipped petals up to 2 in (5 cm) long. A greenish-yellow staminal column with about 350 stamens near its tip protrudes from the flower. The fruit is a capsule up to 1 in (2.5 cm) long, which breaks into 8 to 10 parts, each enclosing 3 or more seeds. Seeds are brown, up to 0.1 in (3 millimeters (mm)) long, and slightly hairy. This species is distinguished from others in the genus by the green or reddish-brown tipped petals which extend beyond the sepals (Bates 1990, Degener 1932b, St. John 1981b).

Historically, *Abutilon sandwicense* was known from nearly the entire length of the Waianae Mountains, from Makaleha Valley to Nanakuli Valley (Bates 1990). This species is now known from Kaawa Gulch, Kaimuhole Gulch, Makaha Valley, Makaha-Waianae Kai Ridge, Makaleha Valley, Manuwai Gulch, and Nanakuli Valley on State-owned land (Hawaii Heritage Program (HHP) 1990a1 to 1990a7). The 7 known populations, which extend over a distance of about 5 by 2.5 mi (8 by 4 km), contain an estimated 300 to 400 individuals (HHP 1990a1 to 1990a7). *Abutilon sandwicense* typically grows on steep slopes or gulches in dry to mesic lowland forest at an elevation of 1,000 to 2,000 ft (300 to 600 m) (Bates 1990, HHP 1990a8). Associated species include *Aleurites moluccana* (kukui), *Caesalpinia kavaiensis* (uhiuhi), *Diospyros* (lamo), *Sapindus oahuensis* (aulu), and *Schinus terebinthifolius* (Christmasberry) (HHP 1990a1, 1990a3). The major threats to *Abutilon sandwicense* are competition from alien plant species (Christmasberry, *Clidemia hirta* (Koster's curse), *Melinis minutiflora* (molasses grass), and *Passiflora suberosa* (huehue haole)), fire, and trampling by feral cattle.

Earl Edward Sherff (1951b) first described *Alsinidendron obovatum* based on specimens collected by Charles Noyes Forbes in 1911, choosing a specific epithet describing the shape of the leaves. In the same publication (Sherff 1951b), Degener and Sherff described var. *parvifolium* based on its small leaves. The most recent treatment

of the genus (Wagner *et al.* 1990) does not recognize any varieties in this taxon.

*Alsinidendron obovatum*, a member of the pink family (Caryophyllaceae), is a branching subshrub growing to 3 ft (1 m) tall. The leaves are thick, somewhat fleshy, elliptic shaped, 1.6 to 4.3 in (4 to 11 cm) long, and up to 2.4 in (6 cm) wide, with 3 or 5 large veins. The inflorescence comprises 7 to 12 flowers arranged in a congested cluster. The flowers lack petals, but usually have 5 sepals which are white inside and green or green-veined on the outside (Wagner *et al.* 1990). In fruit, the sepals become fleshy and purple and enclose the capsule, forming a structure similar to a berry in appearance and perhaps attractive to birds, which would aid in dispersal (Carlquist 1980). Seeds are black and about 0.04 in (1 mm) long. This and the following species can be distinguished from other members of the genus by their shrubby habit and fleshy purple sepals surrounding the capsule (Wagner *et al.* 1990).

Historically, *Alsinidendron obovatum* was known from the northern and southern end of the Waianae range (Wagner *et al.* 1990). This species remains in Kapuna and Pahole gulches on State-owned land (HHP 1990b1, 1990b2). The 2 known populations, which are about 0.5 mi (0.8 km) apart, contain about 100 individuals (HHP 1990b1, 1990b2). *Alsinidendron obovatum* typically grows on ridges and slopes in lowland diverse mesic forest dominated by *Acacia koa* (koa) and *Metrosideros polymorpha* ('ohi'a) at an elevation of 1,850 to 2,500 ft (560 to 760 m) (HHP 1990b3, Hawaii Plant Conservation Center (HPCC) 1990a, Wagner *et al.* 1990). Associated species include *Banksia* (ko'oko'olau) and *Syzygium cumini* (Java plum) (HHP 1990b1, 1990b2). The major threats to *Alsinidendron obovatum* are competition from the aggressive alien plant species, molasses grass; habitat degradation by feral pigs; collection or trampling by humans; and the small number of populations.

*Alsinidendron trinerve* was first collected by Louis Charles Adelbert von Chamisso in 1818 or 1823 (Kimura and Nagata 1980). Horace Mann, Jr. (1866) described the genus *Alsinidendron* based on a specimen he collected with William Tufts Brigham. As it is a shrub related to and resembling chickweed, he named it after the Greek for chickweed (*alsine*) and tree (*dendron*). The specific epithet refers to the three-veined leaves. Wilhelm Hillebrand (1888) amended the description of the genus to include information about the floral structures he called "staminodia," although they

currently are believed to more likely represent nectaries or vestigial petals (Wagner *et al.* 1990). Ferdinand Pax and K. Hoffman (1934) transferred the species to *Schiedea*, a course not followed by other botanists who have studied the taxon.

*Alsinidendron trinerve* is very similar in appearance to *A. obovatum* but differs in that it has a more open inflorescence with peduncles more than 0.8 in (2 cm) long, sepals with an acute tip, and usually is found in wet forests above 3,000 ft (900 m) in elevation.

*Alsinidendron obovatum* has a congested inflorescence with peduncles less than 0.8 in (2 cm) long, sepals with a rounded tip, and usually grows in mesic forests 1,800 to 2,600 ft (550 to 800 m) in elevation (Degener 1937a, Wagner *et al.* 1990).

Historically, *Alsinidendron trinerve* was known from the north-central and southern Waianae Mountains. This species is known to be extant on Mt. Kaala and Mt. Kalena on Federally-owned land (HHP 1990c1, 1990c2). The 2 known populations, which are about 1 mi (2 km) apart, contain about 13 individuals (HHP 1990c1, 1990c2). *Alsinidendron trinerve* typically grows on slopes in wet forest or the wetter portions of diverse mesic forest dominated by 'ohi'a and *Ilex anomala* (kawa'u) at an elevation of 3,000 to 4,000 ft (900 to 1,200 m) (HHP 1990c2, Wagner *et al.* 1990). Associated species include *Coprosma ochracea* (pilo), *Gunnera* ('ape'ape), and *Melicope sandwicensis* (alani) (HHP 1990c1). The major threats to *Alsinidendron trinerve* are competition from the aggressive alien plant species, *Rubus argutus* (blackberry); habitat degradation by feral pigs; trampling or collection by humans along trails; and the small number of extant individuals.

On the basis of a collection of specimens by Berthold Carl Seeman of what is now called *Centaurium sebaeoides*, August Grisebach (1853) named a new genus of plants, *Schenkia*, and gave it the specific epithet of *sebaeoides*, indicating its resemblance to a species of *Sebaea*, a genus in the gentian family. The taxon was transferred to the genus *Erythraea* in 1862 by Asa Gray (1862), and later by G. Claridge Druce to the genus *Centaurium* (Druce 1917).

*Centaurium sebaeoides* is the only species of the gentian family (Gentianaceae) native to the Hawaiian Islands. It is an annual herb about 2.4 to 8 in (6 to 20 cm) tall. Leaves are rather fleshy, inversely ovate or elliptic, and 0.3 to 1.8 in (0.7 to 3.2 cm) long by less than 1 in (2 cm) wide. Flowers are

stalkless and are arranged along the stems near their ends. The fused sepals are 0.3 in (8 mm) long and are divided into uneven lobes. The white or pale pink petals are fused into a tube up to 0.4 in (10 mm) long, with lobes up to 0.2 in (4.5 mm) long. The cylindrical capsules are up to 0.4 in (9.5 mm) long and contain numerous tiny brown seeds. This species is distinguished from *C. erythraea*, which is naturalized in Hawaii, by its fleshy leaves and the unbranched arrangement of the flower cluster (Degener 1934, Degener and Degener 1960, Wagner *et al.* 1990).

Historically, *Centaurium sebaeoides* was known from scattered localities on the islands of Kauai, Oahu, Molokai, and Maui (Wagner *et al.* 1990). This species remains in the Awaawapuhi Valley on Kauai, at Kaena on Oahu, near Hoolehua on Molokai, and on West Maui, all on State-owned land (HHP 1990d1, 1990d2, 1990d4, 1990d5). Two known populations, about 4 mi (6 km) apart, remain on Kauai; and one population each exists on the other three islands. These 5 populations contain fewer than an estimated 1,000 individuals (HHP 1990d1, 1990d2, 1990d4, 1990d5; HPCC 1990b). *Centaurium sebaeoides* typically grows in volcanic or clay soils or on cliffs in arid coastal areas below 400 ft (120 m) elevation (HHP 1990d2, Wagner *et al.* 1990). Associated species include ko'oko'olau and *Lipochaeta* (nehe) (HHP 1990d2, 1990d5). The major threats to *Centaurium sebaeoides* are habitat degradation by feral goats and cattle; competition from the alien plant species, *Leucaena leucocephala* (koa haole); trampling by humans on or near trails; and fire. The threats are believed to be similar on Kauai, Oahu, Molokai, and West Maui.

Sherff (1936) described *Euphorbia celastroides* var. *kaenana* based upon a 1911 collection by Forbes, and named it after the geographical area in which Forbes had collected the specimen. He previously had described *E. celastroides* var. *niueensis* based upon a Hillebrand specimen collected in the Niue area of Oahu in the late 1600s (Sherff 1936). The Degeners (Degener and Degener 1959a) and Leon Croizat accepted the elevation of the section *Chamaesyce* to the generic level and published the necessary combinations for the Hawaiian taxa (Croizat 1943; Degener and Croizat 1936a, 1936b, 1937). Further research (Herbst 1971, Percy and Troughton 1975, Perry 1943, Robichaux and Percy 1980) has supported retaining this separation. Daryl L. Koutnik (Koutnik 1987, Koutnik and Huff 1990), the most recent monographer of

the genus in Hawaii, placed variety *niuensis*, which has not been collected since Hillebrand's time, in synonymy under variety *kaenana*.

*Chamaesyce celastroides* var. *kaenana*, a member of the spurge family (Euphorbiaceae), is a low-growing or upright shrub to 5 ft (1.5 m) tall with milky sap. The leaves, which fall off during the dry season, are mostly hairless and are arranged in two opposite rows along the stem; they are 0.8 to 2.6 in (20 to 65 mm) long and 0.3 to 0.8 in (8 to 20 mm) wide, being widest at the tip. Flower clusters (cyathia) are crowded on small side branches and each produce a small, erect capsule. Seeds are small, spherical, and gray or white. This species is distinguished from other members of the genus in the area in which it grows in that it is a woody shrub; the other members of the genus in the area are herbs or small subshrubs (Degener and Degener 1959a, 1959b; Kimura and Nagata 1980; Koutnik 1987; Koutnik and Huft 1990; Sherff 1938).

Historically, *Chamaesyce celastroides* var. *kaenana* was known from the northwestern end of the Waianae Mountains as well as from one collection from the southeastern end of the Koolau Mountains (HHP 1990e4; Koutnik 1987; Koutnik and Huft 1990). This taxon remains only in the vicinity of Kaena Point on State and Federal land (HHP 1990e1 to 1990e3, 1990e5, 1990e6). The 5 known populations, which extend over a distance of about 3 by 1 mi (5 by 1.6 km), contain fewer than 300 individuals (HHP 1990e1 to 1990e3, 1990e5, 1990e6; Joel Lau, Botanist, HHP, Honolulu, pers. comm., 1990).

*Chamaesyce celastroides* var. *kaenana* typically grows in coastal dry shrubland on windward talus slopes at an elevation of 30 to 700 ft (9 to 640 m) (HHP 1990e1, 1990e6, 1990e7; Koutnik and Huft 1990). Associated taxa include *Gossypium tomentosum* (ma'oa), *Jacquemontia ovalifolia* ssp. *sandwicensis* (pa'uohi'iaka), *Santalum freycinetianum* (sandalwood), and *Sida fallax* ('ilima) (HHP 1990e1 to 1990e3, 1990e5). The major threats to *Chamaesyce celastroides* var. *kaenana* are competition from the alien plant species, koa haole; fire; and effects of recreational activities.

Based on a collection by Degener from Mauna Kuwale, Sherff and Degener (Sherff 1949) described *Euphorbia kuwaleana* as a new species. Otto and Isa Degener (1959a) subsequently transferred the species to the genus *Chamaesyce*.

*Chamaesyce kuwaleana*, a member of the spurge family, is an erect shrub 8 to 36 in (20 to 90 cm) tall. The leaves, arranged in two rows along the stem,

are 0.4 to 1 in (11 to 25 mm) long and 0.3 to 0.6 in (8 to 15 mm) wide; they are oval to occasionally circular in outline, and have a whitish waxy coating on the upper surface. Flower clusters (cyathia) are situated singly in the leaf axils, or sometimes at the branch tips. Only immature capsules have been found. This species is distinguished from other species of the genus in its habitat by its stalked, oval to rounded leaves with untoothed margins, and the bent stalk supporting the small capsule (Koutnik 1987, Koutnik and Huft 1990, Sherff 1949).

Historically, *Chamaesyce kuwaleana* was known from the central Waianae Mountains and Moku Manu Island off the eastern coast of Oahu (HHP 1990f1 to 1990f3, Koutnik and Huft 1990). This species is currently known only from Kaaopuu Peak in the Waianae Mountains, primarily on Federal owned land but with some plants extending onto State land (HHP 1990f3, HPCC 1990c). The one known population contains several hundred individuals (HHP 1990f3, 1990f4; HPCC 1990c). *Chamaesyce kuwaleana* typically grows on arid, exposed volcanic cliffs at an elevation of 1,050 ft (320 m) (HHP 1990f3, 1990f4; HPCC 1990c; Koutnik and Huft 1990). Associated species include 'ilima and *Dodonaea viscosa* ('a'ali'i) (HPCC 1990c). The major threats to *Chamaesyce kuwaleana* are competition from the alien plant species, koa haole; fire; and the small number of populations.

*Cyanea pinnatifida* was first collected by Chamisso in 1817 and later named *Lobelia pinnatifida* by him (Chamisso 1833), the specific epithet referring to the lobed leaves. George Don (1834) transferred the species to the genus *Rollandia*, and only two years later Karel Borowag Presl (1836) transferred the species to the genera *Delissea*. In 1943, Franz Elfried Wimmer transferred this species to the genus *Cyanea* (Wimmer 1943). The taxon Degener (1932c) described as *C. selachicauda* is considered conspecific with this species.

*Cyanea pinnatifida*, a member of the bellflower family (Campanulaceae), is a shrub, usually unbranched, growing from 2.6 to 10 ft (0.8 to 3 m) tall. Leaves are 10 to 24 in (25 to 60 cm) long by 6 to 20 in (16 to 50 cm) wide and are deeply cut into 2 to 6 lobes per side. Clusters of 8 to 15 stalked flowers arise from the leaf axils. Sepals are fused to form a tube 0.4 to 0.5 in (10 to 12 mm) long with small triangular lobes at the tips. The petals are greenish-white with purple stripes, and are about 2 in (5 cm) long and 0.2 in (4 to 5 mm) wide. Fruits have not been seen. This species differs from other members of the genus on Oahu by

its leaves, which are deeply cut into two to six lobes per side. The only other member of the genus on Oahu with lobed leaves has 9 to 12 lobes per side (Degener and Greenwell 1952a, Lammers 1990).

Historically, *Cyanea pinnatifida* was known from the central Waianae Mountains (HHP 1990g1, 1990g2; Lammers 1990). This species remains in Kaluaa Gulch on privately-owned land (HHP 1990g1). The one known population contains three individuals (HHP 1990g1). *Cyanea pinnatifida* typically grows on steep, wet, rocky slopes in diverse mesic forest at an elevation of 1,600 to 1,700 ft (490 to 520 m) (HHP 1990g3, Lammers 1990). Associated plants include *Pipturus albidus* (mamaki) and ferns (HHP 1990g3). The major threats to *Cyanea pinnatifida* are competition from the alien plant species, Koster's curse; habitat degradation by feral pigs; collection or trampling by humans on or near trails; and the small number of extant individuals.

William Dunlop Brackenridge discovered *Diellia falcata* during the Wilkes Expedition of 1838 to 1842 and in 1845 described three Hawaiian species, noting that they were similar to members of the genus *Schizoloma* but differed in their interrupted sori or groups of spore producing bodies (Degener and Greenwell 1950a). In 1857 Thomas Moore included *Diellia* in the genus *Schizoloma* (Wagner 1952) and in 1861 transferred *D. falcata* to *Schizoloma* (Moore 1861). William Jackson Hooker and John Gilbert Baker (1883) transferred the species to *Lindsaea*, giving rise to the name *Lindsaya* [sic] (*Diellia*) *falcata*. Degener and Amy B. H. Greenwell (1950a) treated the simple pinnate members of the species as varieties of *Diellia erecta*, resulting in the name *Diellia erecta* var. *falcata*. The most recent interpretations (Lamoureux 1988; Wagner 1952, 1987) again accept the taxon at the specific level.

*Diellia falcata*, in the fern family Polypodiaceae, grown from a rhizome (underground stem), 0.4 to 2 in (1 to 5 cm) long and 0.2 to 0.8 in (0.5 to 2 cm) in diameter, which is covered with small black or maroon scales. Stalks of the fronds are dark brown to pale tan, usually have a dull surface, and are 0.4 to 2.8 in (1 to 7 cm) long. The fronds are long and oval or straight in outline and 8 to 40 in (20 to 100 cm) tall by 1.0 to 3.5 in (2.5 to 9 cm) wide, with 12 to 45 divisions (pinnae) per side. The lower pinnae are small and rounded while pinnae farther up the frond are larger, undivided, and shaped like a sickle or a

long triangle with veins forming a netted textured surface pattern. The sori (groups of the spore-producing bodies) are shaped like short lines 0.04 to 0.1 in (1 to 3 mm) long and are on low projections of the pinna margin. This species is distinguished from others in the genus by the color and texture of its leaf stalk, the venation pattern of its fronds, the color of its scales, its rounded and reduced lower pinnae, and its separate sori arranged on marginal projections (Degener and Greenwell 1950a; Wagner 1952, 1987).

Historically, *Diellia falcata* was known from almost the entire length of the Waianae Mountains, from Manini Gulch to Palehua Iki, as well as from the Koolau Mountains of Oahu, from Kaipapa Valley to Aiea Gulch (IHP 1990h2, 1990h7, 1990h9, 1990h10). This species remains in the Waianae Mountains, from Ekahanui Gulch to Manini Gulch on State and private land (IHP 1990h1, 1990h3, 1990h4, 1990h8 to 1990h8). The 7 known populations, which extend over a distance of about 11 by 2 mi (18 by 3 km), contain an estimated 3,000 individuals (IHP 1990h1, 1990h3 to 1990h8). *Diellia falcata* is a terrestrial fern which typically grows in deep shade or open understory in dryland forest at an elevation of 1,280 to 2,700 ft (390 to 820 m) (IHP 1990h3, 1990h4, 1990h11). Associated species include *Aula*, *Diospyros sandwicensis* (lama), and *Pouteria sandwicensis* ('ala'ala) (IHP 1990h1, 1990h3, 1990h5). The major threats to *Diellia falcata* are habitat degradation by feral goats, pigs, and cattle; competition from alien plant species (Christmasberry, huehue haole, molasses grass, and *Psidium cattleianum* (Strawberry guava)); and fire.

Derral R. Herbst and John K. Obata in 1971 made the first collection of *Dubautia herbstobatae*, which was later described and named to honor its discoverers (Carr 1979). In 1830, Charles Gaudichaud-Beaupre described two closely related Hawaiian genera in the ester family; *Railliardia* has united bracts under the flower head, and *Dubautia* has bracts which are distinct (Gaudichaud-Beaupre 1830). Today, most botanists consider *Railliardia* and *Dubautia* as sections of the genus *Dubautia* (Carr 1990). However, Harold St. John, believing that the separation should be maintained, transferred the species into *Railliardia* (St. John 1981a), a course few botanists follow. The current taxonomic treatment (Carr 1990) recognizes only the genus *Dubautia*.

*Dubautia herbstobatae*, a member of the aster family (Asteraceae), is a small,

spreading shrub to 20 in. (50 cm) tall. The shiny, leathery leaves are oppositely arranged, narrowly elliptic in outline, and 0.8 to 2.2 in. (2 to 5.5 cm) long by 0.1 to 0.4 in. (3 to 11 mm) wide. They usually have one main vein and smooth or nearly smooth margins. There are 5 to 15 heads in an inflorescence, each composed of 4 to 20 yellowish-orange, tubular florets, 0.1 to 0.2 in. (3 to 5 mm) long. The fruit is comprised of a seed with a dry, unopening fruit wall (an achene) covered with silky gray hair. Only 2 species of the genus on Oahu have the outer bracts of the flower heads fused, forming a cup surrounding the florets; of those 2 species, *D. herbstobatae* has 1 large vein showing in each leaf, and the other species has 5 to 11 veins (Carr 1985, 1990).

*Dubautia herbstobatae* is known to be extant in the northern Waianae Mountains, on Ohikilolo and Kamaileunu ridges on State and private land (IHP 1990i1 to 1990i6). No other locations are known for this recently discovered species (Carr 1979, 1982). The 8 known populations, which extend over a distance of about 3 by 0.5 mi (5 by 0.8 km), contain less than 100 individuals (IHP 1990i7). *Dubautia herbstobatae* typically grows on rock outcrops on north-facing ridges in dry shrubland at an elevation of 1,900 to 3,000 ft (580 to 910 m) (Carr 1982, 1990; IHP 1990i1, 1990i6, 1990i7). Associated species include 'ohi'a and *Eragrostis variabilis* (kawelu). The major threats to *Dubautia herbstobatae* are habitat degradation by feral goats and pigs, competition from alien plant species (Christmasberry, koa haole, and molasses grass), fire, visitation and possible trampling by humans, and the small number of individuals.

*Gouania meyenii* was collected by Franz Julius Ferdinand Meyer in 1831 and named *Gouania integrifolia* (Meyen 1834), a name previously used by Jean Baptiste Lamarck in 1789 for another plant (St. John 1988). Ernesto Theoph Steudel (1840) renamed the plant *Gouania meyenii*, the species epithet honoring Meyer. Gerhard Walpers (1843), realizing that Meyer had erred in the use of the specific epithet *integrifolia*, but unaware of Steudel's publication, named the taxon *Gossania orbicularis*, the spelling of the genus name being a printer's error. St. John later described two additional species, *Gouania oliveri* (St. John 1969) and *Gouania gagnei* (St. John 1973), which are currently considered synonyms of *Gouania meyenii* (Wagner et al. 1990).

*Gouania meyenii*, a member of the buckthorn family (Rhamnaceae), is a shrub up to 7 ft (2.2 m) tall. Leaves are

papery in texture, smooth on the upper surface, and with no teeth on the margins. The leaves are oval or broader in outline and 1.2 to 2.8 in. (3 to 7 cm) long by 0.6 to 1.8 in. (1.6 to 4.5 cm) wide. Flowers are possibly functionally unisexual, with male flowers and female flowers on the same plant. They are arranged in clusters originating in the leaf axils. Sepals are 0.06 to 0.1 in. (1.5 to 3 mm) long and white; petals are 0.05 to 0.07 in. (1.2 to 1.8 mm) long and also white. The 2- or 3-winged fruit are 0.4 to 0.8 in. (9 to 18 mm) long. Seeds are brown and 0.2 to 0.3 in. (5 to 7 mm) long. This species is distinguished from the two other Hawaiian species of *Gouania* by its lack of tendrils on the flowering branches, the absence of teeth on the leaves, and the lack or small amount of hair on the fruit (Wagner et al. 1990).

Historically, *Gouania meyenii* was known from central and southern areas of the Waianae Mountains, from Kamaileunu Ridge to Honouliuli (IHP 1990j1, 1990j3; Wagner et al. 1990). This species now found on Kamaileunu Ridge and Makaha-Waianae Kai Ridge on State land (IHP 1990j1, 1990j2, 1990j4, 1990j5). The 4 known populations, which are distributed over about a 1 square mi (2.6 square km) area, contain an estimated 75 individuals (IHP 1990j1, 1990j2, 1990j4, 1990j5). *Gouania meyenii* typically grows on rocky ledges, cliff faces, and ridge tops in dry shrubland at an elevation of 1,900 to 2,700 ft (580 to 820 m) (IHP 1990j1, 1990j6; Wagner et al. 1990). Associated species include 'a'alii, lama, *Lysimachia hillebrandii* (kolokolo kuahiiwi), and *Senna gaudichaudii* (kolomona) (IHP 1990j1, 1990j2, 1990j5; HPCC 1990d). The major threats to *Gouania meyenii* are competition from alien plant species (Christmasberry, molasses grass, and strawberry guava), fire, and the small number of extant populations.

Francis Raymond Fosberg (1943) published *Hedyotis degeneri* based on a specimen collected by Otto Degener, and named it in his honor. Two varieties were recognized, the typical var. *degeneri* and one with narrower leaves (resembling leaves of *Coprosma*), var. *coprosmaefolia* (Fosberg 1943). Hillebrand (1888) had included var. *coprosmaefolia* as a questionable variety of *Kadua foliosa* when he published that name, noting that it might be a distinct species. Today both varieties are recognized (Wagner et al. 1990).

*Hedyotis degeneri*, a member of the coffee family (Rubiaceae), is a prostrate shrub with 4-sided stems and peeling, corky bark. Leaves are quite variable and range from long and thin to heart-shaped, from 0.4 to 1.2 in. (1 to 3 cm) in

length and 0.1 to 0.8 in. (0.3 to 2 cm) in width. Flowers are arranged in groups of 1 to 10 in. clusters at the ends of the stems. Sepals are fused into a tube and flare into 4 or 5 leaflike lobes up to 0.3 in. (8 mm) long. Petals are fused into a trumpet-shaped tube 0.2 to 0.3 in. (6 to 7 mm) long with 4 or 5 lobes up to 0.2 in. (4 mm) long. Capsules are nearly globe-shaped and about 0.2 in. (4 to 5 mm) in diameter. Seeds are angled and almost black. This species can be distinguished from others in the genus on Oahu by its low-growing habit, the peeling corky layers on older stems, and the short, crowded, leafy shoots growing in the leaf axils (Wagner *et al.* 1990).

Historically, *Hedyotis degeneri* was known from Mt. Kaala in the northern Waianae Mountains (Wager *et al.* 1990). This species remains only on Kamaileonu Ridge on State-owned land (HHP 1990kl). The only known population contains about six individuals (Derral Herbst, Botanist, U.S. Fish and Wildlife Service, Honolulu, pers. comm., 1990). *Hedyotis degeneri* typically grows in diverse mesic forest at an elevation of 2,700 ft (820 m) (HHP 1990kl). Associated species include 'ohi'a and *Hedyotis terminalis* (manono) (D. Herbst, pers. comm., 1990). The major threats to *Hedyotis degeneri* are habitat destruction by feral pigs, competition from alien plant species (Christmasberry, molasses grass, and strawberry guava), and the small number of extant individuals.

The first specimen of *Hedyotis parvula* was collected by Heinrich Wawra; Gray (1859) later named the plant *Kadua parvula*, the specific epithet referring to its small size. In 1943, Fosberg transferred the species to the genus *Hedyotis*. He also named a form, *f. sessilis*, which is no longer recognized (Wagner *et al.* 1990).

*Hedyotis parvula*, a member of the coffee family, is a small, many-branched shrub, either upright or sprawling, with stems usually no more than 1 ft (30 cm) in length. Leaves are leathery in texture, overlapping, 0.4 to 1.6 in (1 to 4 cm) long by 0.3 to 0.9 in (7 to 23 mm) wide, and are uniform in size along the stem. Flowers are grouped in small clusters, and when combined with clusters on adjacent stems, give the appearance of a large inflorescence. Sepals are fused into a tube and flare into 4 or 5 lobes 0.04 to 0.16 in (1 to 4 mm) long by 0.04 to 0.08 (1 to 2 mm) wide, often with different sizes on the same plant. The lobes enlarge up to 0.2 in (5.5 mm) long as the fruit matures. The white petals are fused into a funnel-shaped tube 0.3 to 0.4 in (8 to 11 mm) long with 4 or 5

purplish pink-tipped lobes, each about 0.2 in (5 to 6 mm) long. The capsule is almost globe-shaped and about 0.2 in (4 mm) in diameter. Seeds are angled and brown. Its closely spaced overlapping leaves which are uniform in size along the stem separate this species from other members of the genus on Oahu (Degener 1938a, Wagner *et al.* 1990).

Historically, *Hedyotis parvula* was known from the central and southern Waianae Mountains, from Makaleha Valley to Nanakuli Valley (Wagner *et al.* 1990). This species was found on Makaleha Ridge in 1986 and on Makua-Keaau Ridge in 1976, both on State-owned land (HHP 1990L1, 1990L2). *Hedyotis parvula* has not been seen for several years (John Obata, Assistant to Plant Collector, HPCC, pers. comm., 1990). However, because this species inhabits inaccessible cliffs, the chances that it is still extant are very good (D. Herbst, pers. comm., 1990). *Hedyotis parvula* is included here to extend to it the protection of the Act if and when it is rediscovered. *Hedyotis parvula* typically grows on and at the base of cliff faces, rock outcrops, and ledges in dry habitat at an elevation of 2,350 to 2,730 ft (720 to 630 m) (HHP 1990L1, 1990L2; Wagner *et al.* 1990). Associated species include 'a'ali'i, *Canthium odoratum* (alahe'e), and *Plectranthus parviflorus* ('ala'ala wai nui) (HHP 1990L1). The major threats to *Hedyotis parvula* are habitat degradation by feral goats, competition from alien plant species (Christmasberry and molasses grass), and the small population size.

Hillebrand (1888) described *Hesperomannia arbuscula* based on a specimen collected by E. Bishop on Maui, the specific epithet referring to the smaller stature of the plant as compared to the previously described species of the genus, *H. arborescens*. At the same time, Hillebrand also described *H. arborescens* var. *oahuensis*, a taller tree from Oahu, which was later raised to specific status, *H. oahuensis*, by Degener (1938b). Sherwin Carlquist (1957) examined fresh material of both the Maui and Oahu plants and decided a new combination, *H. arbuscula* ssp. *oahuensis*, was in order for Oahu plants, as compared to those on Maui, which he called ssp. *arbuscula*. However, examination of additional specimens showed that there were no valid differences between the taxa (Wagner *et al.* 1990). St. John later published *H. arbuscula* var. *pearsallii* (1978) and *H. mauiensis* (1983), neither of which is now recognized as a valid taxon (Wagner *et al.* 1990).

*Hesperomannia arbuscula*, a member of the aster family (Asteraceae), is a

small shrubby tree, 7 to 11 ft (2 to 3.3 m) tall. Leaves are elliptic, generally 4 to 7 in (10 to 18 cm) long and 2.2 to 4.5 in (5.5 to 11.5 cm) wide, although young leaves can sometimes be larger. Flower heads are erect and arranged in clusters of four or five heads. Each head comprises many yellow to yellowish-brown florets, with a tube of fused petals 0.9 to 1.2 in (2.5 to 3 cm) long and a threadlike style extending beyond them. The fruit is a 0.3 to 0.4 in (0.8 to 1 cm) long achene, crowned by a ring of bristles nearly the same length as the petals. This species can be distinguished from other members of the genus by the erect flower heads and the leaves, usually hairy beneath, which are one to two times as long as wide (Degener 1932d, Wagner *et al.* 1990).

Historically, *Hesperomannia arbuscula* was known from the central and southern Waianae Mountains, from Makaleha to Puu Kanehoa, and from West Maui (HHP 1990ml, 1990m2, 1990m4, 1990m6, 1990m7). This species is currently known to be extant on the Makaha-Waianae Kai Ridge on Oahu and in Iao Valley on West Maui, both on State land (HHP 1990m3, 1990m5, 1990m7). The 2 known populations on Oahu are about 0.6 mi (1 km) apart; and including the third population from West Maui, this species numbers about 50 individuals (HHP 1990m3, 1990m5, 1990m7; HPCC 1990e; J. Lau, pers. comm., 1990). *Hesperomannia arbuscula* typically grows on slopes and ridges in mesic to wet forest dominated by koa and 'ohi'a at an elevation of 1,200 to 3,000 ft (350 to 900 m) (Wagner *et al.* 1990). Associated species include ko'oko'olau, *alyxia oliviformis* (maile), and *Psychotria* (kopiko) (HHP 1990m2, 1990m5). The major threats to *Hesperomannia arbuscula* are habitat degradation by feral pigs, competition from alien plant species (blackberry, Christmasberry, Koster's curse, and strawberry guava), trampling or collection by humans, and the small number of populations.

The earliest collection of *Lipochaeta lobata* var. *leptophylla* was made by Forbes in 1915, from which Degener and Sherff (Sherff 1933) described the taxon, giving it a varietal name that refers to its slender leaves.

*Lipochaeta lobata* var. *leptophylla*, a member of the aster family (Asteraceae), is a low and somewhat woody perennial herb with arched or nearly prostrate stems which may be up to 59 in (150 cm) long. Leaves of this variety are lance-shaped and closely spaced along the stem. Flower heads grow singly or in clusters of 2 or 3, each consisting of bracts (the involucre)

usually 0.2 to 0.3 in (5 to 8 mm) long beneath 8 to 15 yellow ray florets which surround 20 to 65 yellow disk florets. Fruits are achenes which measure 0.1 in (2.5 to 2.7 mm) long by 0.04 to 0.06 in (1.0 to 1.5 mm) wide. They have small wings about 0.2 in (0.4 to 0.5 mm) long. This species is the only one of its genus on Oahu with four-parted disk florets except for a very rare coastal plant. This variety has narrower leaves spaced more closely along the stem than those of *L. lobata* var. *lobata*, the only other variety of this species (Degener and Degener 1957, Gardner 1979, Wagner *et al.* 1990).

Historically, *Lipochaeta lobata* var. *leptophylla* was known from the southern Waianae Mountains, from Kolekole Pass to Lualualei (Wagner *et al.* 1990). This taxon remains on Lualualei-Nanakuli Ridge and at Kolekole Pass on Federal and State land (HHP 1990n1, 1990n3). The 2 known populations, which are about 4.2 mi (6.7 km) apart, contain about 25 to 50 individuals (HHP 1990n1, 1990n3, 1990n5). *Lipochaeta lobata* var. *leptophylla* typically grows in dry shrubland at an elevation of 1,500 to 2,500 ft (460 to 760 m) (HHP 1990n1, 1990n2, 1990n4). Associated species include 'a'alii, 'ala'ala' wai nui, koa haole, and ko'oko'olau (HHP 1990n1). The major threats to *Lipochaeta lobata* var. *leptophylla* are competition from alien plant species (Christmasberry, koa haole, and molasses grass), fire, and the small number of extant individuals.

Gray (1861) described *Lipochaeta tenuifolia* from specimens collected during the U.S. Exploring Expedition in 1840. The species epithet refers to the narrow leaflets of the three-parted, palmately compound leaves.

*Lipochaeta tenuifolia*, a member of the aster family (Asteraceae), is a low growing, somewhat woody perennial herb with short, more or less erect branches. The branches are 10 ft (3 m) long or longer and root along the lower surface. The oppositely arranged leaves are divided into three lobes so deeply that they appear to be six leaves; each lobe is divided to the midrib into fine segments. Flower heads are single or in clusters of two. The involucre bracts are 0.2 to 0.3 in (5 to 7.5 mm) long. Ray florets, on the outer portion of the flower head, are yellow, number 8 to 10 per head, and measure 0.3 to 0.5 in (8 to 11.5 mm) long. Disk florets, in the center of the flower head, are also yellow, number 20 to 30 per head, are 5-parted, and measure about 0.1 in (2.7 to 3 mm) long. The fruits are bumpy achenes with tiny wings, and measure 0.07 to 0.09 in (1.8 to 2.4 mm) long by 0.04 to 0.06 in (1.1

to 1.5 mm) wide. Its five-parted disk florets and its deeply cut, stalkless leaves separate this species from other members of the genus. (Degener and Greenwall 1959b, Gardner 1979, Wagner *et al.* 1990).

*Lipochaeta tenuifolia* occurs in the northern half of the Waianae Mountains, from Kaluakauila Gulch to Kamaileunu Ridge and east to Mt. Kaala on State-owned land (HHP 1990o1 to 1990o7). It has not been found anywhere else (HHP 1990o8). The 7 known populations, which extend over a distance of about 6 by 5 mi (10 by 8 km), contain an estimated 400 to 600 individuals (HHP 1990o1 to 1990o8; HPCC 1990f). *Lipochaeta tenuifolia* typically grows on ridgetops and bluffs in open areas and protected pockets of diverse mesic forest dominated by Christmasberry and 'ohi'a at an elevation of 1,200 to 3,000 ft (370 to 900 m) (HHP 1990o1, 1990o3 to 1990o7; Wagner *et al.* 1990). Associated species include ko'oko'olau, molasses grass, and *Ageratina riparia* (Hamakua pamakani), (HHP 1990o1, 1990o2, 1990o4 to 1990o6; HPCC 1990f). The major threats to *Lipochaeta tenuifolia* are habitat degradation by feral goats and pigs, competition for light, and space from alien plant species (Christmasberry, koa haole, molasses grass, and strawberry guava), and fire.

*Lobelia niihauensis* was described by St. John in 1931, based on a specimen he had collected on the island of Niihau (St. John 1931). Thomas G. Lammers (1990), in his revision of the genus, believed *L. niihauensis* to be conspecific with a Kauai plant previously published by Amos Arthur Heller and named *L. tortuosa* (Heller 1937). When Lammers combined the taxa he was required to use the name *Niihauensis*. Although *tortuosa* is an older name, it had been given to another member of the genus by Carl Ernst Kuntze six years prior to Heller's publication. Other published names which refer to this taxon are: *L. niihauensis* var. *forbesii* (St. John 1939), *L. niihauensis* var. *meridiana* (St. John 1939), *L. tortuosa* f. *glabrata* (Skottsberg 1926), *L. tortuosa* var. *hauensis* (St. John 1937b), and *L. tortuosa* var. *intermedia* (St. John 1939). In 1965, Otto and Isa Degener proposed a new genus to honor F.E. Wimmer, a distinguished student of the lobelia family. They later transferred 19 taxa to the new genus (Degener and Degener 1965). This genus has not been accepted by any other botanical authority. The synonyms resulting from this transfer which can be applied to *L. niihauensis* *Neowimmeria niihauensis* and *N. tortuosa* (Degener and Degener 1965), as well as *N.*

*intermedia*, *N. meridiana*, *N. niihauensis* var. *forbesii*, and *N. tortuosa* var. *glabrata* (Degener and Degener 1974).

*Lobelia niihauensis*, a member of the bellflower family (Campanulaceae), is a low, branched shrub. Each branch ends in a rosette of leaves, which are 2.8 to 5.9 in (7 to 15 cm) long and 0.3 to 0.7 in (0.7 to 1.8 cm) wide. Magenta flowers are clustered at the ends of branches and produced an egg-shaped capsule 0.2 to 0.3 in (6 to 8 mm) long with many small brownish seeds. This species is distinguished from others in the genus by its leaves lacking or nearly lacking leaf stalks, the magenta-colored flowers, the width of the leaf, and length of the flower (Lammers 1990, Rock 1919).

Historically, *Lobelia niihauensis* was known from the Waianae Mountains of Oahu, from Uluhulu Gulch to Nanakuli Valley; from western Kauai, from Limahuli Valley to near the Hanapepe River as well as in the east at Nounou Mountain; and from the island of Niihau (HHP 1990p1, 1990p7, 1990p10, 1990p12, 1990p13, 1990p19). It is now known to be extant only on Kauai and Oahu. On Oahu, this species remains on Kamaileunu Ridge, Makaha-Waianae Kai Ridge, Makua-Keaau Ridge, and in Nanakuli Valley, on State and private land (HHP 1990p2 to 1990p8). On Kauai, this species is found in Waimea Canyon, on Polihale Ridge, and along the Na Pali Coast, on State and private land (HHP 1990p9, 1990p11, 1990p14 to 1990p22). The 19 known populations, which extend over a distance of about 10 by 5 mi (16 by 8 km) on Oahu and 10 by 8 mi (16 by 13 km) on Kauai, contain an estimated 400 to 1,300 individuals (HHP 1990p2 to 1990p8, 1990p11, 1990p14 to 1990p22; J. Lau, pers. comm., 1990; Tim Flynn, Botanist, National Tropical Botanical Garden, Lawai, Kauai, pers. comm., 1990; Steven Perlman, Plant Collector, HPCC, Lawai, Kauai, pers. comm., 1990). *Lobelia niihauensis* typically grows on exposed mesic to dry cliffs at an elevation of 410 to 2,720 ft (125 to 830 m) (HHP 1990p14, Lammers 1990). Associated species include daisy fleabans, kawelu, nche, and *Artemisia* ('ahinahina) (HHP 1990p3, 1990p16, 1990p22). On Oahu, the major threats to *Lobelia niihauensis* are trampling by feral pigs, habitat degradation and predation by feral goats, fire, competition from alien plant species (Christmasberry, koa haole, and molasses grass), and trampling by humans on or along trails. On Kauai, the major threats are habitat degradation and predation by goats and competition from alien plant species.

On the basis of a 1912 collection by Forbes, Richard S. Cowan (1949) described *Neraudia angulata*, choosing the specific epithet in reference to the angled character of the mature calyx of the female flower. He and Degener (Cowan 1949) described var. *dentata*, which is closely sympatric with the nominative variety but is currently recognized as a distinct taxon (Wagner *et al.* 1990).

*Neraudia angulata*, a member of the nettle family (Urticaceae), is an erect shrub to 10 ft (3 m) tall. Leaves are thin and elliptic to oval in outline. They are 2.8 to 5.9 in (7 to 15 cm) long and 1.2 to 2.2 in (3 to 5.5 cm) wide. The upper leaf surface has a few silky hairs, and the lower surface is moderately hairy. Flowers are male or female and grow on different plants. The female flowers produce a dry-walled fruit which is surrounded by fleshy, fused sepals. This species is distinguished from other species in its genus by the conspicuously angled, ridged, fleshy calyx in the female flower (Degener and Greenwell 1950c, 1950d; Wagner *et al.* 1990).

Historically, *Neraudia angulata* was known from almost the entire length of the Waianae Mountains, from Kaluakauila Gulch nearly to Puu Manawahua (HHP 1990q1, 1990q3, 1990q5; Wagner *et al.* 1990). This species remains in Kahanahaiki-Makua Ridge, Kaluakauila Gulch, Makaha-Waianae Kai Ridge, Puu Kanehoa, and Puu Kumakalii (HHP 1990q1, 1990q2, 1990q6 to 1990q8) on Federal, State, and private land (HHP 1990c1, 1990q2, 1990q6 to 1990q8). The 5 known populations, which extend over a distance of about 11 by 1 mi (18 by 1.6 km), are estimated to contain fewer than 15 individuals (HHP 1990q1, 1990q2, 1990q4, 1990q6 to 1990q8, 1990q10). *Neraudia angulata* typically grows on slopes, ledges, or gulches in diverse mesic forest dominated by luma, at an elevation of 1,200 to 2,700 ft (370 to 820 m) (HHP 1990q1, 1990q6 to 1990q10; Wagner *et al.* 1990). Associated species include aulu, Christmasberry, and *Nestegis sandwicensis* (olopua) (HHP 1990q3, 1990q6 to 1990q9). The major threats to *Neraudia angulata* are habitat degradation by feral goats and pigs, competition from alien plant species (Christmasberry, molasses grass, and strawberry guava), fire, and the small number of extant individuals.

Hillebrand (1888) discovered *Nototrichium humile* and named the genus for its "remarkable (Latin, *nota*) hairs (Greek, *tricho*)," that is, its extreme hairiness. The species epithet refers to the plant's low-growing habit.

The species for a time was transferred to the genus *Psilotrichium* (Drake del Castillo 1892). Sherff (1950) recognized three varieties of this species based on leaf shape and size: var. *humile*, var. *parvifolium*, and var. *subrhomboideum*. These varieties were not accepted in the most recent treatment of the genus (Wagner *et al.* 1990).

*Nototrichium humile*, a member of the amaranth family (Amaranthaceae), is an upright to trailing shrub with branched stems to 5 ft (1.5 m) long. Stems and young leaves are covered with short hairs. Leaves are oppositely arranged, oval to oblong in outline, 1.2 to 3.5 in (3 to 9 cm) long, and 0.8 to 2.0 in (2 to 5 cm) wide. Stalkless flowers are arranged in a spike 1.2 to 5.5 in (3 to 14 cm) long and are at the ends of the stem. Membranous bracts grow below each flower. Two of the bracts and the sepals fall off with the mature fruit, which is 0.08 in (2 mm) long. This species is distinguished from the only other species in the genus by its inflorescence, a slender spike 0.2 in (4 mm) in diameter, or less, which is covered with short hair (Degener and Greenwell 1952a, 1956a; Sherff 1951a; Wagner *et al.* 1990).

Historically, *Nototrichium humile* was known from the entire length of the Waianae Mountains, from near Kaena Point to Nanakuli Valley, and from Lualailua Hills on East Maui (HHP 1990r3, 1990r6, 1990r9, Wagner *et al.* 1990). This species is extant on Oahu in Kahanahaiki Valley, Kealia, Makaha-Waianae Kai Ridge, Makua Valley, Nanakuli Valley, Pahole Gulch, and Waianae Kai on State and private land (HHP 1990r1, 1990r2, 1990r4, 1990r5, 1990r7 to 1990r12). It is also extant in Maui's Lualailua Hills on State land (HHP 1990r3). Ten of the 11 known populations extend over a distance of about 13 by 2 mi (22 by 3 km) in the Waianae Mountains, and, together with the Maui population, total an estimated 1,500 to 3,000 individuals (HHP 1990r1 to 1990r5, 1990r7 to 1990r12; J. Lau, pers. comm., 1990). *Nototrichium humile* typically grows at an elevation of 200 to 2,300 ft (60 to 700 m), on cliff faces, gulches, or steep slopes in remnants of open dry forests often dominated by aulu or luma (HHP 1990r2, 1990r5, 1990r7 to 1990r9, 1990r11, 1990r12; Wagner *et al.* 1990). Associated species include Christmasberry, kukui, and olopuu (HHP 1990r1, 1990r2, 1990r7 to 1990r9, 1990r11, 1990r13). On both Oahu and East Maui, the major threats to *Nototrichium humile* are habitat degradation by feral goats, pigs, and cattle; competition from alien plant species (Christmasberry, koa haole, molasses grass, and strawberry guava); and fire.

Soon after erecting the genus *Phyllostegia*, George Bentham (1831) described *Phyllostegia mollis* in reference to its soft pubescence. Other published names referring to this taxon are *P. parviflora* var. *mollis* (Gray 1861), *P. haliakalae* (Wawra 1872), *P. honoluluensis* (Wawra 1872), and *P. parviflora* var. *honoluluensis* (Sherff 1934c). Sherff's concept of *P. mollis* was broader than that accepted in the most recent treatment of the genus (Wagner *et al.* 1990), and many varieties he described are now referred to other species: var. *skottsbergii* (Sherff 1939), var. *fagerlundii* (Sherff 1949), and var. *hochreutineri* (Sherff 1953) are now included in *P. electra* (Forbes 1916); var. *glabrescens* (Sherff 1952) in *P. stachyoides* (Gray 1861); var. *micrantha* (Sherff 1934a) in *P. imminuta* (St. John 1976); and var. *lydgatei* (Sherff 1934a) in *P. parviflora* (Bentham 1831). Fosberg (1942) described *P. mollis* var. *resinosa* based on a specimen of *P. electra*. Most recently, St. John (1987a) published many species, varieties, and combinations in *Phyllostegia*, however, most botanists do not recognize this treatment (Wagner *et al.* 1990).

*Phyllostegia mollis*, a member of the mint family (Lamiaceae), grows as a nearly erect, densely hairy, nonaromatic, perennial herb. Leaves are oval in outline with rounded teeth and usually are 3.9 to 9.4 in (10 to 24 cm) long and 1.3 to 2.8 in (3.3 to 7 cm) wide. Flowers, usually in groups of 6, are spaced along a stem 3.1 to 6.7 in (8 to 17 cm) long; there are 2 shorter flowering stems directly below the main stem. The flowers have fused sepals which are 0.1 to 0.2 in (3 to 4 mm) long and white petals 0.3 to 0.5 in (8.5 to 12 mm) long fused into a tube and flaring into a smaller upper and a larger lower lip. Fruits are fleshy, dark green to black nutlets about 0.1 in (2 to 3 mm) long. A suite of technical characters concerning the kind and amount of hair, the number of flowers in a cluster, and details of the various plant parts separate this species from other members of the genus (Degener 1935, Sherff 1935b, Wagner *et al.* 1990).

Historically, *Phyllostegia mollis* was known from the central and southern Waianae Mountains, from Mt. Kaala to Honouliuli, and from Makiki in the Koolau Mountains of Oahu (HHP 1990s3 to 1990s5, Wagner *et al.* 1990). It also was known from Molokai and East Maui (HHP 1990s6, 1990s7; Wagner *et al.* 1990). This species remains only in Kaluaa Gulch and on Puu Kaua in the Waianae Mountains on Federal and private land (HHP 1990s1; J. Lau, pers. comm., 1990). The 2 known populations,



which are 1.3 mi (2 km) apart, are estimated to contain less than 50 individuals (HHP 1990s1; J. Lau, pers. comm., 1990). *Phyllostegia mollis* typically grows on steep slopes and in gulches in diverse mesic to wet forest at an elevation of 1,500 to 2,800 ft (450 to 860 m) (Wagner *et al* 1990). Associated plants include ferns, kopiko, *Pisonia* (papala kepau), and *Rubus* (raspberry) (HHP 1990s1, 1990s2, 1990s5). The major threats to *Phyllostegia mollis* are competition from the alien plant species, Christmasberry, and the small number of extant populations.

*Sanicula mariversa* was discovered by Kenneth M. Nagata in 1981, who later described the species in a publication with Samuel M. Gon, III (Nagata and Gon 1987). The specific epithet refers to the plant's habitat which is on a ridge overlooking the sea.

*Sanicula mariversa*, a member of the parsley family (Apiaceae), is an upright herb, 16 to 28 in (40 to 70 cm) tall which produces a single branched stem from a sturdy base (caudex) growing just beneath the surface of the soil. There are many heart- to kidney-shaped, leathery, 3- to 5-lobed leaves, 5 to 9 in (13 to 23 cm) wide, growing from the base of the plant. Leaves on the stem become smaller and more deeply lobed the closer they are to the tip of the stem. Flowers are arranged in 1 to 4 more or less flat-topped clusters; each cluster comprises 10 to 20 flowers and is located at the end of the stem or in the leaf axils. Each flower cluster has 8 to 12 bracts beneath it and comprises both male and hermaphroditic flowers. There are 5 nearly circular, fused, toothed, yellow petals, each 0.04 in (1 mm) wide. The egg-shaped fruit is about 0.2 in (4 to 6 mm) long by about 0.1 in (3 to 4 mm) wide, covered with hooked prickles, and separates into 2 single-seeded parts. The larger size of the plant and basal leaves, the color of the flower petals, and the hooked prickles on the fruit separate this species from others of the genus in Hawaii (Constance and Affolter 1990, Nagata and Gon 1987).

Historically, *Sanicula mariversa* was known from the central Waianae Mountains, from Makau-Keaau Ridge to Kaluaa-Lualualei Summit Ridge (HHP 1990t1 to 1990t3). This species is now extant only at Makau-Keaau Ridge on State-owned land (HHP 1990t1, 1990t3). The 2 known populations, which are about 0.4 mi (0.6 km) apart, contain fewer than 100 individuals (HHP 1990t1, 1990t3; J. Lau, pers. comm., 1990). *Sanicula mariversa* typically grows on well-drained, dry slopes at an elevation of 2,500 to 2,800 ft (750 to 850 m) (HHP 1990t4, Wagner *et al* 1990). Associated

species include *Hamakua pamakani*, kawelu, and 'ohi'a (HHP 1990t1, 1990t4; HPCCC 1990g). The major threats to *Sanicula mariversa* are habitat degradation by feral goats, fire, competition from alien plant species (Christmasberry and molasses grass), trampling by humans on or near trails, and the small number of populations.

In 1873 Wawra described *Schiedea kaalae* based upon a specimen he had collected three years earlier. The specific epithet refers to the geographical range of the plant, which is on the slopes of Mt. Kaala on Oahu. Sherff (1943) later recognized an additional variety, var. *acutifolia*, based upon a minor difference in the leaf. This variety is no longer accepted (Wagner *et al* 1990).

*Schiedea kaalae*, a member of the pink family (Caryophyllaceae), has a short woody caudex less than 8 in (20 cm) long. The thick, single-veined leaves are bunched at the top of the stem; they are long and elliptic or broader toward the tip and can reach a length of 9.4 in (24 cm) and a width of 2.4 in (6 cm). Flowers are in an open, much branched inflorescence (panicle) usually 8 to 16 in (20 to 40 cm) long. The flowers lack petals, but have purple bracts and sepals, which are 0.1 to 0.2 in (3 to 4 mm) long. Stamens and nectaries each number 5 and are about 0.2 in (4 to 5 mm) long. Capsules are about 0.2 in (4 mm) long, and seeds are dark grayish brown and about 0.04 in (1 mm) long. This species can be distinguished from other members of its genus by its very short stems and its thick leaves with one conspicuous vein (Degener 1938c, Degener and Degener 1958, Sherff 1945, Wagner *et al* 1990).

Historically, *Schiedea kaalae* was known from the north-central and south-central Waianae Mountains and the northern Koolau Mountains of Oahu (HHP 1990u2, 1990u4, 1990u5, 1990u7). This species remains at Huliwai, Makaleha, Mokuleia, Pahole Gulch, and Puu Hapapa in the Waianae Mountains and at Kaipapau and Punaluu in the Koolau Mountains (HHP 1990u1 to 1990u7, Wagner *et al* 1990). The 5 known populations in the Waianae Mountains, which are distributed over a distance of about 10 by 1 mi (16 by 1.6 km), and the 2 known populations in the Koolau Mountains, which are about 3 mi (5 km) apart, contain fewer than 100 individuals (HHP 1990u1 to 1990u7; J. Lau, pers. comm., 1990). *Schiedea kaalae* typically grows on steep slopes and shaded sites in diverse mesic forest at an elevation of 700 to 2,600 ft (210 to 790 m) (HHP 1990u6, 1990u7). Associated species include kukui, *Athyrium*

*sandwicensis*, *Delissea subcordata*, and *Pisonia umbellifera* (papala kepau) (HHP 1990u2 to 1990u5, 1990u7; HPCCC 1990h). The major threats to *Schiedea kaalae* are habitat degradation by feral pigs and goats, competition from alien plant species (Christmasberry, huehue haole, Koster's curse, molasses grass, and *Myrica faya* (firetree)), fire, and the small number of extant individuals.

Steven Perlman and John Obata discovered *Silene perlmanii* in 1987. It was described by Warren L. Wagner, D.R. Herbst, and S.H. Sohmer (1989), and named in honor of one of its discoverers.

*Silene perlmanii*, a member of the pink family (Caryophyllaceae), is a perennial plant with stems that are woody at the base. It usually is much branched from the base and often forms clumps. Stems are 12 to 20 in (30 to 50 cm) long, and leaves are in the shape of narrow ellipses 2 to 4 in (5 to 10.5 cm) long and 0.3 to 0.6 in (7 to 16 mm) wide. A few flowers are arranged in clusters at the ends of stems. Each flower has fused sepals 0.9 to 1.2 in (22 to 30 mm) long with 5 lobes and white, deeply notched petals 0.3 to 0.4 in (8 to 10 mm) long. Mature capsules have not been seen. It is the only species of the genus on Oahu and can be distinguished from other *Silene* species by its white petals and a calyx which is more than 0.7 in (19 mm) long and densely covered with short hairs (Wagner *et al* 1990).

*Silene perlmanii* is known from the southern Waianae Mountains, between Palikea and Pohakea Pass on privately owned land (HHP 1990v1; Wagner *et al* 1990). No other localities are known for this recently discovered species (HHP 1990v2). The 1 known population contains 10 to 20 individuals (J. Lau, pers. comm., 1990). *Silene perlmanii* typically grows on cliff faces in diverse mesic forest at an elevation of 2,600 ft (790 m) (Wagner *et al* 1990). Associated species include *Plantago princeps* (laukahi kuahiwi) (HHP 1990v1). The major threats to *Silene perlmanii* are competition from alien plant species (Christmasberry, firetree, and molasses grass), and the small number of extant individuals.

*Tetramolopium filiforme* was collected by Hillebrand in 1869 and described by Sherff (1934b) in his monograph of the genus. Sherff named the species *filiforme* because of its very narrow leaves. In the same monograph, Sherff (1934b) described *Tetramolopium polyphyllum* based upon a plant collected by Wawra in 1870 during the Austrian East Asian Exploring Expedition. In a recent revision of the genus, Timothy K. Lowrey (1988, 1990)

recognized *T. polyphyllum* as a variety of *T. filiforme*.

*Tetramolopium filiforme*, a member of the aster family (Asteraceae), is a dwarf shrub from 2 to 6 in (5 to 15 cm) tall with complexly branched stems. Leaves are much longer than wide, from 0.4 to 0.8 in (1 to 2 cm) long and 0.02 to 0.05 in (0.4 to 1.2 mm) wide. Flower heads are single or grouped in clusters of 2 to 4, each having a bell-shaped involucre 0.2 in (4 to 5 mm) high and 0.3 to 0.4 in (7 to 10 mm) in diameter. There are 35 to 52 white or pale lavender petals (ray florets) in a single circle at the edge of the head, each 0.1 to 0.2 in (3 to 4 mm) long. There are 18 to 30 maroon (rarely yellow) disk florets in the center of each head. The ray florets are female, while the disk florets function as male flowers. Fruits are achenes, less than 0.1 in (3 mm) long and up to 0.04 in (1 mm) wide. This species is distinguished from the other extant species on Oahu by its separate male and female flowers both on the same plant, and its inflorescence of one to four heads (Lowrey 1986, Sherff 1935a).

Historically, *Tetramolopium filiforme* was known from the northern Waianae Mountains, from Ohikilolo Ridge, Keaau Valley, and Makaha Valley (HHP 1990w5 to 1990w7, Lowrey 1990). This species remains on in Keaau Valley and on Ohikilolo Ridge on State land (HHP 1990w1 to 1990w4, 1990w7; Lowrey 1990). The 5 known populations, which are distributed over a distance of about 1.4 by 0.5 mi (2.3 by 0.8 km), are estimated to contain fewer than 500 individuals (HHP 1990w1 to 1990w4, 1990w8).

*Tetramolopium filiforme* typically grows on dry cliff faces and ridges at an elevation of 1,100 to 3,000 ft (340 to 900 m) (HHP 1990w2, 1990w7). Associated species include 'a'ali'i, *Artemisia australis* ('ahinahina), and *Schiedea mannii* (HHP 1990w2, 1990w4, 1990w7). The major threats to *Tetramolopium filiforme* are habitat degradation by feral goats, competition from alien plant species (Christmasberry, koa haole, molasses grass, and *Erigeron karvinskianus* (daisy fleabane)), fire, and trampling or collection by humans on or near trails.

*Tetramolopium lepidotum* ssp. *lepidotum* was described by Sherff (1934b) in his monograph of the genus. Other names which have been applied to this taxon are *Erigeron lepidotus* (Lessing 1831), *E. pauciflorus* (Hooker and Arnott 1830-1941), *E. tennerrimus* var. *lepidotus* (Drake del Castillo 1888), *T. chamissonis* var. *luxurians* (Hillebrand 1888), *T. lepidotum* var. *luxurians* (Sherff 1934b), and *Vittadinia chamissonis* (Gray 1881).

*Tetramolopium lepidotum* ssp. *lepidotum*, a member of the aster family (Asteraceae), is an erect shrub 4.7 to 14 in (12 to 36 cm) tall, branching near the ends of the stems. Leaves of this taxon are lance-shaped, wider at the leaf tip, and measure 1.0 to 1.8 in (25 to 45 mm) long and 0.04 to 0.3 in (1 to 7 mm) wide. Flower heads are arranged in groups of 6 to 12. The involucre is bell-shaped and less than 0.2 in (4 mm) high. Florets are either female or bisexual, with both occurring on the same plant. There are 21 to 40 white to pinkish-lavender ray florets 0.04 to 0.08 in (1 to 2 mm) long on the periphery of each head. In the center of each head there are 4 to 11 maroon to pale salmon disk florets. The fruits are achenes, 0.06 to 0.1 in (1.6 to 2.5 mm) long and 0.02 to 0.03 in (0.5 to 0.8 mm) wide. This species can be distinguished from the other extant species on Oahu by its hermaphroditic disk flowers and its inflorescence of 6 to 12 heads (Degener 1937b; Lowrey 1986, 1990; Sherff 1935a).

Historically, *Tetramolopium lepidotum* ssp. *lepidotum* was known from nearly the entire length of the Waianae Mountains, from Makua Valley to Kaaikukae Ridge, as well as from the island of Lanai (HHP 1990x1, 1990x3, 1990x5; Lowrey 1990). This taxon remains in the Waianae Mountains on Mauna Kapu and Puu Kaa on Federal and private land (HHP 1990x1 to 1990x3). The 3 known populations, which extend over a distance of about 2.5 mi (4 km), are estimated to contain fewer than 100 individuals (HHP 1990x1 to 1990x3, 1990x6). *Tetramolopium lepidotum* ssp. *lepidotum* typically grows on grassy ridgetops, slopes, or west-facing cliffs in mesic forest at an elevation of 1,200 to 3,100 ft (370 to 940 m) (HHP 1990x2, 1990x4; Lowrey 1990). Associated species include daisy fleabane, firetree, ko'oko'oi'au, and 'ohi'a (HHP 1990x1, 1990x2; HPCC 1990j). The major threats to *Tetramolopium lepidotum* ssp. *lepidotum* are competition from alien plant species (Christmasberry, daisy fleabane, firetree, and molasses grass), trampling or collection by humans on or along trails, and the small number of populations.

*Urera Kaalae* was first collected by Chamisso in the early 1800s, and later rediscovered and described by Wawra (1874). The specific epithet refers to the geographical range of the species.

*Urera kaalae*, a member of the nettle family (Urticaceae), is a small tree or shrub 10 to 23 ft (3 to 7 m) tall. The sap of the plant becomes greenish black when exposed to air. Leaves are pale green, thin and membranous, heart-

shaped, 4 to 11 in (10 to 27 cm) long by 2 to 5 in (5 to 13 cm) wide, with 3 main veins and toothed margins. Flowers are either male or female and may grow on the same or different plants. They are arranged in three-branched inflorescences. Sepals of male flowers are fused into rather globe-shaped structures about 0.06 in (1.5 mm) long. Sepals of female flowers are less than 0.04 in (1 mm) long, and the inner pair becomes slightly fleshy to enclose the achene along about half of its 0.04 in (1 mm) length (Degener 1936, Wagner *et al.* 1990). This species can be distinguished from the other Hawaiian species of the genus by its heart-shaped leaves.

Historically, *Urera kaalae* was known from the central to southern windward Waianae Mountains, from Waianae Uka to Kupehau Gulch (HHP 1990y3, 1990y4; Wagner *et al.* 1990). This species now occurs only in Ekehanui and Kaluaa gulches on privately owned land (HHP 1990y1, 1990y2, 1990y6). The 3 known populations, which are sparsely distributed over a distance of about 2 by 0.1 mi (3 by 0.2 km), contain no more than 19 individuals (HHP 1990y6; HPCC 1990j; S. Perlman, pers. comm., 1990). *Urera kaalae* typically grows on slopes and in gulches in diverse mesic forest dominated by papala kepau at an elevation of 980 to 2,700 ft (300 to 820 m) (HHP 1990y5; Wagner *et al.* 1990). Associated species include huehue haole, mamaki, and *Psidium guajava* (guava) (HHP 1990y8; HPCC 1990j). The major threats to *Urera kaalae* are habitat degradation by feral pigs, competition from alien plant species (Christmasberry, daisy fleabane, firetree, huehue haole, molasses grass, and strawberry guava), fire, and the small number of extant individuals.

First collected in 1817 by Johann Friedrich Eschscholz, surgeon on a Russian world exploring expedition, *Viola chamissoniana* was named by Gingins (1826) in honor of Chamisso, the botanist on the expedition. The name *V. chamissoniana* as used by Hillebrand (1888) included the taxon presently known as *v. chamissoniana* ssp. *trachelifolia*; his *V. helioscopia* is now referred to as ssp. *chamissoniana* (Wagner *et al.* 1990).

*Viola chamissoniana* ssp. *chamissoniana*, a member of the violet family (Violaceae), is a branched shrub up to 3 ft (90 cm) tall. The toothed leaves, usually clustered at branch tips, are triangular-oval to heart-shaped in outline and measure about 0.8 to 1.6 in (2 to 4 cm) long. Each flowering stalk produces 1 or 2 flowers with 5 sepals which are 0.2 to 0.4 in (5 to 9 mm) long and 5 white, purple-tinged petals which

are 0.4 to 0.9 in (10 to 23 mm) long. Capsules are usually 0.5 to 0.7 in (12 to 17 mm) long and contain dark brown to almost black seeds which are about 0.1 in (1.8 to 2.3 mm) long. This subspecies can be distinguished from the other members of the genus in the Waianae Mountains by the small size of its leaves (Degener and Greenwell 1952c, 1956b; St. John 1989; Wagner *et al.* 1990).

Historically, *Viola chamissoniana* ssp. *chamissoniana* was known from the center and southern Waianae Mountains, from Makaleha Valley to Kaaikukui (HHP 1990z1, 1990z5). This taxon now occurs on Kamaileane Ridge, Puu Hapapa, and Puu Kumakalii on Federal and State land (HHP 1990z2 to 1990z4), the 3 known populations, which extend over a distance of about 4.4 by 0.2 mi (7.0 by 0.3 km), contain about 16 individuals (HHP 1990z2 to 1990z4). *Viola chamissoniana* ssp. *chamissoniana* typically grows on dry cliffs in mesic shrubland at an elevation of 2,300 to 3,040 ft (700 to 1,000 m) (HHP 1990z1, 1990z2). Associated species include 'ahinahina, ko'oko'olea, and 'ohi'a (HHP 1990z1 to 1990z4). The major threats to *Viola chamissoniana* ssp. *chamissoniana* are habitat degradation by feral goats; competition from the alien plant species, Christmasberry and melasses grass; and the small number of extant individuals.

#### 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, *Abutilon sandwicense* (as *Abutilon sandwicense* var. *sandwicense*), *Alsinidendron obovatum*, *Alsinidendron trinerve*, *Chamaesyce celestroides* var. *kaenana* (as *Euphorbia celestroides* var. *kaenana*), *Cyanea pinnatifida* (as *Bulsondia pinnatifida*), *Diellia falcata*, *Hedyotis degeneria*, *Hedyotis parvula*, *Hesperomannia arbuscula*, *Lipochaeta lobata* var. *leptophylla*, *Lobelia*

*niihauensis*, *Nerudia arguata*, *Nototrichium humile*, *Phyllostegia mollis*, *Schiedea kaalae*, *Tetramolopium lepidotum* ssp. *lepidotum* (as *Tetramolopium lepidotum* var. *lepidotum*), *Urera kaalae*, and *Viola chamissoniana* ssp. *chamissoniana* (as *Viola chamissoniana*) were considered to be endangered, *Lipochaeta tenuifolia* was considered to be threatened, and *Gouania meyenii* as well as *Tetramolopium filiforme* were considered to be extinct. Only 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 18, 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 18 taxa considered to be endangered, plus *Gouania meyenii* and *Tetramolopium filiforme* (both thought to be extinct). *Lipochaeta tenuifolia* was not included in the proposed rule. 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 18, 1976, proposal that had not been made final, along with four other proposals that had expired. The Service published an updated notice of review for plants on December 15, 1980 (45 FR 82479), September 27, 1985 (50 FR 39525), and February, 1990 (55 FR 6185). In these notices, 19 of the taxa

that had been in the 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. In the 1980 and 1985 notices, *Gouania meyenii* was included in Category 3A, meaning that the Service believed that the species was extinct. *Gouania meyenii* was included in Category 1 in the 1990 notice after a taxonomic revision combined *G. meyenii* with two other Category 1 species (*G. gagei* and *G. oliveri*). *Dubautia herbstobatae* was included on the 1980 and subsequent notices as a Category 1 species after it was described by Carr in 1979. The 1990 notice also included *Centaurium sebaeoides*, *Chamaesyce kuwaleana*, *Sanicula morivera*, and *Silene perlmanii* as Category 1 species.

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 species 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 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, and 1989. Publication of the present proposal constitutes the final 1-year finding for these species.

#### 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 26 taxa are summarized in Table 1.

TABLE 1.—SUMMARY OF THREATS

Species	Feral animal activity			Alien plants	Fire	Human impacts	Limited numbers <sup>1</sup>
	Pigs	Cattle	Goats				
<i>Abutilon sandwicense</i> .....		X		X	X		
<i>Alsinidendron obovatum</i> .....	X			X		X	X
<i>Alsinidendron trinerve</i> .....	X			X		X	X
<i>Centaurium sebaeoides</i> .....		X	X	X	X	X	
<i>Chamaesyce celestroides</i> var. <i>kaenana</i> .....				X	X	X	

TABLE 1.—SUMMARY OF THREATS—Continued

Species	Feral animal activity			Alien plants	Fire	Human impacts	Limited numbers <sup>1</sup>
	Pigs	Cattle	Goats				
<i>Chamaesyce Kuwaleana</i> .....				X	X		X
<i>Cyanea pinnatifida</i> .....	X			X		X	X
<i>Diellia falcata</i> .....	X	X	X	X	X		
<i>Dubautia herbstobatae</i> .....	X		X	X	X	X	X
<i>Gouania meyenii</i> .....				X	X		X
<i>Hedyotis degeneri</i> .....	X			X			X
<i>Hedyotis parvula</i> .....			X	X			X
<i>Hesperomannia arbuscula</i> .....	X			X		X	X
<i>Lipochaeta lobata</i> var. <i>leptophylla</i> .....				X	X		X
<i>Lipochaeta tenuifolia</i> .....	X		X	X	X		
<i>Lobelia niihauensis</i> .....	X		X	X	X	X	
<i>Neraudia angulata</i> .....	X		X	X	X		X
<i>Nototrichum humile</i> .....	X	X	X	X	X		
<i>Phyllostegia mollis</i> .....				X			X
<i>Sanicula mariversa</i> .....			X	X	X	X	X
<i>Schiedea kaalae</i> .....	X		X	X	X		X
<i>Silene perlmanii</i> .....				X			X
<i>Tetramolopium filiforme</i> .....			X	X	X	X	
<i>Tetramolopium lepidotum</i> ssp. <i>lepidotum</i> .....				X		X	X
<i>Urera kaalae</i> .....	X			X	X		X
<i>Viola chamissoniana</i> ssp. <i>chamissoniana</i> .....			X	X			X

<sup>1</sup> No more than 100 individuals and/or fewer than 5 populations.

These factors and their application to *Abutilon sandwicense* (Degener) Christoph. (NCN), *Alsinidendron obovatum* Sherff (NCN), *Alsinidendron trinerve* H. Mann (NCN), *Centaurium sebaeoides* (Griseb.) Druce ('awiwi), *Chamaesyce celastroides* (Boiss.) Criezat var. *kaenana* (Sherff) Degener and I. Degener ('akoko), *Chamaesyce kuwaleana* (Degener and Sherff) Degener and I. Degener (NCN), *Cyanea pinnatifida* (Cham.) F. Wimmer (haha), *Diellia falcata* Brack. (NCN), *Dubautia herbstobatae* G. Carr (na'ena'e), *Gouania meyenii* Steud. (NCN), *Hedyotis degeneri* Fosb. (NCN), *Hedyotis parvula* (A. Gray) Fosb. (NCN), *Hesperomannia arbuscula* Hilleb. (NCN), *Lipochaeta lobata* (Gaud.) DC var. *leptophylla* Degener and Sherff (nehe), *Lipochaeta tenuifolia* A. Gray (nehe), *Lobelia niihauensis* St. John (NCN), *Neraudia angulata* R. Cowan (NCN), *Nototrichum humile* Hilleb. (kulu'i), *Phyllostegia mollis* Benth. (NCN), *Sanicula mariversa* Nagata and Gon (NCN), *Schiedea kaalae* Wawra (NCN), *Silene perlmanii* W.L. Wagner, Herbst, and Sohmer (NCN), *Tetramolopium filiforme* Sherff (NCN), *Tetramolopium lepidotum* (Less.) Sherff ssp. *lepidotum* (A. Gray) Lowrey (NCN), *Urera kaalae* Wawra (opuhe), and *Viola chamissoniana* Ging. ssp. *chamissoniana* (pamakan!) are as follows:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. The native vegetation of the Waianae Mountains and adjacent areas has undergone extreme alterations because of past and present land management practices,

including deliberate alien plant and animal introductions, agricultural development, and military use (Frierson 1973, Wagner *et al.* 1985). Degradation of habitat by feral animals and competition with alien plants are considered the greatest present threats to the 26 species being proposed.

Feral pigs (*Sus scrofa*) have been in the Waianae Mountains for about 150 years and are known to be one of the major current modifiers of forest habitats (Stone 1985). Pigs damage the native vegetation by rooting and trampling the forest floor and encourage the expansion of alien plants that are better able to exploit the newly tilled soils than are native species (Stone 1985). Pigs also disseminate alien species through their feces and on their bodies, accelerating the spread of alien plant species within the native forest. Present throughout the Waianae Mountains in low numbers, feral pigs pose a significant threat to the native flora (HHP 1987a, 1987b; J. Lau, pers. comm., 1990). For example, digging was noted in the wet summit forests within honouliuli in the southern Waianae Mountains where two of the proposed plant species (*Cyanea pinnatifida* and *Urera kaalae*) are restricted (HHP 1987a). In Pahole Gulch in the northwestern Waianae Mountains, a population of pigs, which are thriving as the result of insufficient hunting pressure, threatens at least two of the proposed plant species, *Alsinidendron trinerve* and *Schiedea kaalae* (Nagata 1980). Of the 26 plant species, 13 are threatened or already have sustained loss of individual plants or habitat as the result of feral pig activity (see Table

1) (HHP 1990b3, 1990i7, 1990p23, 1990u2; HPCC 1990e, 1990j; Nagata 1980; J. Lau and S. Perlman, pers. comms., 1990).

Although feral cattle (*Bos taurus*) were eliminated from Oahu by the mid-1900s (Stone 1985), the effects of cattle ranching have left an indelible scar on the native low to mid-elevation forests of the Waianae Mountains. Much of the forest between 700 and 1,800 ft (210 and 550 m) in elevation has been destroyed by cattle and feral goats (*Capra hircus*) (Cuddihy and Stone 1990), effectively restricting the native vegetation to higher elevations (Nagata 1980). Cattle ranching still continues in the Mokuleia area on the west side of the Waianae Mountains. Taking advantage of the natural barrier of its slopes, ranchers have not installed adequate fences to contain the cattle. Some cattle escape into the upland forest (J. Lau, pers. comm., 1990) where they consume native vegetation, trample roots and seedlings, accelerate erosion, and promote the invasion of alien plants (Scott *et al.* 1986). Species such as *Abutilon sandwicense*, *Diellia falcata*, and *Nototrichum humile* have been detrimentally affected by the activities of cattle (J. Lau, pers. comm., 1990). Cattle grazing also is considered a threat to the population of *Centaurium sebaeoides* on Maui (HHP 1990d5).

Goats have been on Oahu for the past 170 years. Because of their commercial value in the 1820's, goats were allowed to proliferate throughout the Waianae Mountains without the confines of fences (Culliney 1986). As the result of their agility, goats were able to reach more remote areas than pigs or cattle.

Goats (and cattle) are responsible for the destruction of most of the lower elevation dryland forests of Oahu (Stone 1985). The impact of feral goats on the native vegetation is similar to that described above for cattle (Scott *et al.* 1986). Successful control efforts decreased the goat population significantly by 1905 (Gill *et al.* 1989). Although their estimated current numbers are low, there continues to be a problem of trampling and grazing by goats in areas where 12 of the 28 plant taxa now occur (Culliney 1988). Erosion is a serious direct effect of grazing and trampling by feral goats. Through their activities, goats remove the ground cover, exposing the soil to erosional actions, thereby further degrading the habitat (J. Lau, pers. comm., 1990). Encroaching urbanization and hunting pressure tend to restrict goats to the drier upper slopes of the Waianae Mountains (Tomich 1986). The dry to mesic habitat of *Diellia falcata*, *Dubautia herbstobatae*, *Hedyotis parvula*, *Lipochaeta tenuifolia*, *Lobelia niihauensis*, *Neraudia angulata*, *Nototrichium humile*, *Sanicula mariversa*, *Schiedea kaalae*, *Tetramolopium filiforme*, and *Viola chamissoniana* ssp. *chamissoniana* in the Waianae Mountains is being heavily degraded by these animals (HHP 1990i1, 1990o1, 1990p4, 1990q4, 1990r2, 1990u2, 1990w1, 1990z6; J. Lau, pers. comm., 1990). A population of *Centaurium sebaeoides* in similar habitat on West Maui was recently destroyed by goats (HHP 1990d3).

Habitat degradation by goats, cattle, or pigs is a likely threat to the populations of these plant taxa whose distributions extend beyond the Waianae Mountains to elsewhere on Oahu, Kauai, Molokai, or Maui (*Centaurium sebaeoides*, *Chamaesyce celastroides* var. *kaenana*, *Chamaesyce kuwaleana*, *Hesperomannia arbuscula*, *Lobelia niihauensis*, *Nototrichium humile*, and *Schiedea kaalae*). The adverse impacts of these animals on these seven proposed plant taxa is similar to the effects observed in the Waianae Mountains.

All of the 28 Waianae plant species being proposed for listing are threatened by competition from one or more alien plant species. *Schinus terebinthifolius* (Christmasberry), an aggressive tree introduced to Hawaii before 1911 as an ornamental, has had particularly detrimental impacts (Cuddihy and Stone 1990). This fast-growing alien plant is able to form dense thickets, displacing other plants; it also may release a chemical that inhibits the growth of other species (Smith 1985). As early as

the 1940s, Christmasberry had invaded the dry slopes of Oahu; it is now replacing the native vegetation of much of the southern Waianae Mountains (Cuddihy and Stone 1990). Christmasberry is gradually invading other areas of the Waianae Mountains as well, and now is found on nearly all the other Hawaiian Islands; it now threatens to occupy the habitat of 20 of the 28 plant species being proposed (HHP 1990a1, 1990o5, 1990q2, 1990r14, 1990t4, 1990z6; HPCC 1990d; J. Lau, pers. comm., 1990).

The native vegetation of the leeward ridges of the Waianae Mountains, especially Ohikilolo, Kamaileuna, and Kumaipo ridges, is being replaced by *Melinis minutiflora* (molasses grass), another aggressive alien plant species. This species and Christmasberry are considered the two most serious alien plant problems in these areas (J. Lau, pers. comm., 1990). Molasses grass ranges from the dry lowlands to the lower wet forests, especially in open areas with sparse vegetation and is distributed on the other islands as well. This fire-adapted grass produces a dense mat capable of smothering plants, provides fuel for fires, and carries fires into areas with native woody plants (Cuddihy and Stone 1990). Because most native forest species are not fire-adapted, molasses grass is able to exploit freshly burned areas (J. Lau, pers. comm., 1990). Populations of 19 of the 28 proposed taxa located on leeward slopes and ridges are most vulnerable to molasses grass (J. Lau, pers. comm., 1990).

*Myrica faya* (firetree), a species that was introduced before 1900 as an ornamental or for firewood, inhabits dry to mesic habitats on most of the Hawaiian Islands (Cuddihy and Stone 1990). The Territory of Hawaii planted firetree in the Waianae Mountains in the 1920s for reforestation. It now forms a dense stand near Palikea in the Honouliuli Forest Reserve and has spread approximately two mi (three km) to the north (Whiteaker and Gardner 1985) where it poses a threat to the habitat of *Schiedea kaalae*, *Silene perlmanii*, *Tetramolopium lepidotum* ssp. *lepidotum*, and *Urera kaalae*. The impact of this noxious tree is serious because, given suitable habitat, firetree can form a dense closed canopy to the exclusion or detriment of other plants. This plant also produces nitrogen, making it adaptable to habitats with low nitrogen soils and an excellent competitor with native plants that have evolved in low nitrogen conditions (Cuddihy and Stone 1990).

*Psidium cattleianum* (strawberry guava), a pervasive alien tree in the

southern Waianae Mountains, is distributed mainly by feral pigs and fruit-eating birds (Smith 1985). It also is found on the other Hawaiian Islands. Like Christmasberry and firetree, strawberry guava is capable of forming dense stands to the exclusion of other plant species (Cuddihy and Stone 1990). Populations of *Diellia falcata*, *Couania meyenii*, *Hedyotis degeneri*, *Hesperomannia arbuscula*, *Lipochaeta tenuifolia*, *Neraudia angulata*, *Nototrichium humile*, and *Urera kaalae* are immediately threatened by competition with this alien plant (HPCC 1990e; Obata 1986; J. Lau, pers. comm., 1990).

*Leucaena leucocephala* (koa haole) is an alien tree usually seen in disturbed lowland areas on the Hawaiian Islands. Originally introduced as fodder (Smith 1989), it is now widely distributed in dry and mesic forests that are the habitat for *Centaurium sebaeoides*, *Chamaesyce celastroides* var. *kaenana*, *Chamaesyce kuwaleana*, *Dubautia herbstobatae*, *Lipochaeta lobata* var. *leptophylla*, *Lipochaeta tenuifolia*, *Lobelia niihauensis*, *Nototrichium humile*, and *Tetramolopium filiforme* (J. Lau, pers. comm., 1990). Like firetree, koa haole is an aggressive competitor that produces its own nitrogen.

*Glidemia hirta* (Koster's curse), a noxious shrub first cultivated in Wahiawa on Oahu, spread to the Koolau Mountains in the early 1960s, where it is now rapidly displacing native vegetation. Koster's curse spread to the Waianae Mountains around 1970 and is now widespread throughout Honouliuli (Cuddihy and Stone 1990, Culliney 1988). It has recently spread to other Hawaiian Islands (Cuddihy and Stone 1990). This species forms a dense understory, shading other plants and hindering plant regeneration (HHP 1987a). At present, Koster's curse threatens to replace four of the proposed plant species (*Abutilon sandwicense*, *Cyanea pinnatifida*, and *Hesperomannia arbuscula*) in the Waianae Mountains, and *Schiedea kaalae* in the Koolau Mountains (HHP 1990a1; J. Lau and S. Perlman, pers. comms., 1990).

*Rubus argutus* (blackberry), recognized as a noxious weed by the Hawaii State Department of Agriculture (Cuddihy and Stone 1990), poses a serious threat to *Alsinidendron trinerve* and *Hesperomannia arbuscula* (HHP 1990c1; HPCC 1990e; Paul Higashino, Maui Preserves Naturalist, The Nature Conservancy of Hawaii, pers. comm., 1990). Blackberry occurs in the Waianae Mountains between 3,300 and 7,500 ft (1,000 and 2,300 m) in elevation, where it

forms impenetrable thickets in disturbed areas (Smith 1985). Its distribution includes the other Hawaiian Islands.

*Passiflora suberosa* (huehue haole), a vine that smothers small plants in the subcanopy of dryland habitats (Smith 1985) on Oahu, Maui, and Hawaii, poses an immediate threat to several of the proposed plant species. There are major infestations in the Waianae Mountains and it is a probable threat to all extant populations of *Urera koala* and to some populations of *Abutilon sandwicense* and *Diellia falcata* (HPCC 1990; J. Lau, pers. comm., 1990).

*Erigeron karvinskianus* (daisy fleabane) is another low-growing alien species that smothers native plants, particularly on cliffs and is found on most of the Hawaiian Islands. This species threatens *Cyanea pinnatifida*, *Lobelia niihauensis*, *Tetramolopium filiforme*, and *Tetramolopium lepidotum* ssp. *lepidotum* (S. Perlman, pers. comm., 1990).

Fire threatens 16 of the 26 proposed species, particularly those located upslope from Makua Military Reservation and Schofield Barracks, where current firing exercises could unintentionally ignite fires. Within a 14-month period in 1989 and 1990, for example, a total of 10 fires resulted from firing activities in the Makua Military Reservation. Of these, eight occurred outside of the firebreak installed by the Army (Colonel William Chastain, Commanding Officer, U.S. Army Support Command, Fort Shafter, Hawaii, in *lit.*, 1989a, 1989b, 1990a, 1990b). A 300 acre (120 hectare) fire in July 1989 may have consumed a population of *Neraudia angulata*, and came within 0.25 mi (0.4 km) of a population of *Nototrichium humile*. Although most fires have been contained within 0.02 acres (0.01 hectares), the July 1989 fire is evidence of the potential for escape into the fire-prone habitat of 16 of the proposed species (*Abutilon sandwicense*, *Centaurium sebaeoides*, *Chamaesyce celastroides* var. *kaenana*, *Chamaesyce kuwaleana*, *Diellia falcata*, *Dubautia herbstobatae*, *Gouania meyenii*, *Lipochaeta lobata* var. *leptophylla*, *Lipochaeta tenuifolia*, *Lobelia niihauensis*, *Neraudia angulata*, *Nototrichium humile*, *Sanicula mariversoni*, *Schiedea koala*, *Tetramolopium filiforme*, and *Urera koala*) (Carr 1982; HHP 1990d, 1990f, 1990g, 1990p23, 1990q4, 1990r14, 1990u2, 1990w6, 1990w8; HPCC 1990d; St. John 1981b; Sam Gon, Ecologist, HHP, Honolulu, pers. comm., 1990; J. Lau, pers. comm., 1990).

*B. Overutilization for commercial, recreational, scientific, or educational purposes.* Illegal 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 several of these species. *Alsinidendron obovatum*, *Alsinidendron trinerve*, *Centaurium sebaeoides*, *Chamaesyce celastroides* var. *kaenana*, *Cyanea pinnatifida*, *Dubautia herbstobatae*, *Hesperomannia arbuscula*, *Lobelia niihauensis*, *Sanicula mariversoni*, *Tetramolopium filiforme*, and *Tetramolopium lepidotum* ssp. *lepidotum* are located on or near trails or roads and have the potential of being collected or trampled (HHP 1990b3, 1990x6; Nagata 1980; D. Herbst, J. Lau, and S. Perlman, pers. comms., 1990). For these seven species, disturbance from trampling during recreational use (hiking, for example) could promote erosion and greater ingress by competing alien species.

*C. Disease or predation.* *Xylosandrus compactus* (black twig borer) has been cited as a possible threat to the extant populations of *Urera koala* (St. John 1981b). The black twig borer burrows into the branches and introduces a pathogenic fungus, pruning the host severely, often killing branches or whole plants (Hara and Beardsley 1979, Howarth 1985). No other evidence of disease is known for any of the species to be proposed.

Predation of *Lobelia niihauensis* by goats has been observed in the Makua area of the Waianae Mountains (HHP 1990p4). While there is no direct evidence of predation on the other 25 proposed species, none of them are known to be unpalatable to goats or cattle. Predation is therefore a probable threat at sites where those animals have been reported, potentially affecting 11 of the proposed species (*Centaurium sebaeoides*, *Diellia falcata*, *Dubautia herbstobatae*, *Hedyotis parvula*, *Lipochaeta tenuifolia*, *Neraudia angulata*, *Nototrichium humile*, *Sanicula mariversoni*, *Schiedea koala*, *Tetramolopium filiforme*, and *Vicia chamissoniana* ssp. *chamissoniana*) (HHP 1990d3, 1990q2, 1990r1, 1990r2, 1990u2; St. John 1981b; J. Lau, pers. comm., 1990). The restriction of most of the populations of *Lobelia niihauensis* on both Oahu and Kauai to virtually inaccessible cliffs suggests that goat predation may have eliminated that species from more accessible locations, as is the case for other rare plants of Kauai's Na Pali Coast (Corn *et al.* 1979). Similar restriction of populations of other proposed species to inaccessible cliffs in the Waianae Mountains suggests that goats have played a parallel role in limiting the distribution

of those species (J. Lau, pers. comm., 1990).

Although predation of fruits and seeds by rodents has been cited as a probable threat to *Abutilon sandwicense* and *Schiedea koala* (Center for Plant Conservation 1990; Wagner *et al.* 1985), those reports have not been confirmed.

*D. The inadequacy of existing regulatory mechanisms.* Of the 26 proposed species, a total of 12 have populations located on private land, 17 on State (including City and County) land, and 6 on Federal land. While 13 of the species occur in more than 1 of those 3 ownership categories, the other 13 species are restricted to a single category: 5 species are found only on private land, 7 species only on State land, and 1 species only Federal land. There are no State laws or existing regulatory mechanisms at the present time to protect or prevent further decline of these species on private land. However, Federal listing would automatically invoke listing under Hawaii State law, which prohibits raking 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 wildlife or wild 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. \* \* \* 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 (Sect. 195D-5(c)). Funds for these activities could be made available under section 6 of the Federal Act (State Cooperative Agreements). Listing of these 26 plant taxa would therefore reinforce and supplement the protection available to the species under State law. The Federal Act also would offer additional protection to these 26 species because if they were to be listed as endangered, it would be a violation of the Act for any person to remove, cut, dig up, damage, or destroy an endangered 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 all of these species increases the potential for extinction from stochastic events. The limited gene pool may depress reproductive vigor, or a single man-caused or natural environmental disturbance could destroy a significant percentage of the individuals (or the only known extant population) of these species. For example, 4 of the species are known from a single population: *Cyanea pinnatifida* (totalling 3 known plants), *Hedyotis degeneri* (6 plants), *Silene perlmanii* (10 to 20 plants), and *Chamaesyce kuwaleana* (several hundred plants) (HIP 1990f3, 1990g1, 1990k1, 1990v2). Fifteen of the 26 proposed species are known from fewer than 5 populations. And 17 of the proposed species are estimated to number no more than 100 known individuals.

The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by these species in determining to propose this rule. Based on this evaluation, the preferred action is to list these 26 plant species as endangered. Eighteen of these species either number no more than about 100 individuals or are known from fewer than 5 populations. The 26 species are threatened by one or more of the following: habitat degradation by feral pigs, cattle, and goats; competition from alien plants; fire; overcollection, mainly for scientific purposes; and trampling by humans along trails. Small population size makes these species particularly vulnerable to extinction from stochastic events. Given these circumstances, the determination of endangered status for these 26 species seems warranted. Critical habitat is not being proposed for these species 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 propose critical habitat at the time a species is proposed to be endangered or threatened. The Service finds that designation of critical habitat is not presently prudent for these species. Such a determination would result in no known benefit to the species. The publication of descriptions and maps required in a proposal for critical habitat would increase the degree of threat to these plants from possible take or vandalism and, therefore, could contribute to their decline and increase enforcement problems. The listing of species 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 location and importance of protecting the habitat of these species. Protection of the species' habitat will be addressed through the recovery process and through the section 7 consultation process. The only known Federal activity within the currently known habitat of these plants involves the use of portions of the Makua Military Reservation and Schofield Barracks as military buffer zones adjacent to impact areas used as ordnance training sites by the Army. Firebreaks have been constructed between the impact area and the buffer zone on the Makua Military Reservation to minimize potential impacts from any fires that may be generated during the ordnance training exercises (Herve Messier, Environmental Protection Specialist, U.S. Army Support Command, Ft. Shafter, Hawaii, pers. comm., 1990). As there is no direct use of the area by the military and the zoning prevents human entry onto military land, it is unlikely that such continued classification of the area would threaten the existence of these plants. Therefore, the Service finds that designation of critical habitat for these species 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 is unlikely to aid in the conservation of these species.

#### 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) 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 of these plant taxa are located on the Makua Military Reservation and Schofield Barracks, both under the jurisdiction of the U.S. Army. The military uses portions of both these areas for ordnance training of its troops and provides a buffer zone adjacent to the impact areas. Entry into the buffer area is forbidden to prevent injury from stray or unexploded shells or other devices (H. Messier, pers. comm., 1990). Virtually all of the proposed plants that occur on Army land are present only in the buffer zones and, therefore, are not directly affected by military activities. The Army has constructed firebreaks on the Makua Military Reservation to minimize damage from unintentional fires that occasionally result from stray bullets (H. Messier, pers. comm., 1990). There are no other known Federal activities that occur within the present known habitat of these 26 plant species.

The Act and its implementing regulations found at 50 CFR 17.61, 17.62, and 17.63 set forth a series of general trade prohibitions and exceptions that apply to all endangered plants. With respect to the 26 plant species from the Waianae Mountains, all trade prohibitions of section 9(a)(2) of the Act, implemented by 50 CFR 17.61, would apply. These prohibitions, in part, would make it illegal with respect to any endangered 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; maliciously damage or destroy any such species on any area under Federal jurisdiction; or remove, cut, dig up, damage or destroy any such

endangered plant 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. Certain exceptions apply to agents of the Service and State conservation agencies. The Act and 50 CFR 17.82 and 17.83 also provide for the issuance of permits to carry out otherwise prohibited activities involving endangered 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 or 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 5 of this 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 of 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 Honolulu Field Office (See ADDRESSES above).

**Author**

The primary authors of this proposed rule are Z.E. Ellshoff, Joan M. Yoshioka, Joan E. Canfield, Derral R. Herbst, and Patricia C. Welton, 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 (208/541-2749 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**

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:

**PART 17—[AMENDED]**

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.**

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(h) \* \* \*

Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
Amaranthaceae—Amaranth family:						
<i>Nototrichium humile</i>	kuku i	U.S.A. (HI)	E		NA	NA
Apiaceae—Parsley family:						
<i>Sanicula maritima</i>	None	U.S.A. (HI)	E		NA	NA
Aspleniaceae—Spleenwort family:						
<i>Diella fatcsta</i>	None	U.S.A. (HI)	E		NA	NA
Asteraceae—Aster family:						
<i>Dubautia herbstobatae</i>	na'ena'e	U.S.A. (HI)	E		NA	NA
<i>Hesperomannia arbuscula</i>	None	U.S.A. (HI)	E		NA	NA
<i>Lipochaeta lobata</i> var. <i>leptophylla</i>	nehe	U.S.A. (HI)	E		NA	NA
<i>Lipochaeta tenuifolia</i>	nehe	U.S.A. (HI)	E		NA	NA



Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
<i>Tetramolopium filiforme</i>	None	U.S.A. (HI)	E		NA	NA
<i>Tetramolopium leptodum</i> var. <i>lepidotum</i>	None	U.S.A. (HI)	E		NA	NA
Campanulaceae—Bellflower family:						
<i>Cyanea pinnatifida</i>	haha	U.S.A. (HI)	E		NA	NA
<i>Lobelia nīhauensis</i>	None	U.S.A. (HI)	E		NA	NA
Caryophyllaceae—Pink family:						
<i>Alsiniidendron obovatum</i>	None	U.S.A. (HI)	E		NA	NA
<i>Alsiniidendron trinerve</i>	None	U.S.A. (HI)	E		NA	NA
<i>Schiedea kaalae</i>	None	U.S.A. (HI)	E		NA	NA
<i>Siene perlmanni</i>	None	U.S.A. (HI)	E		NA	NA
Euphorbiaceae—Spurge family:						
<i>Chamaesyce celastroides</i> var. <i>kaenana</i>	'akoko	U.S.A. (HI)	E		NA	NA
<i>Chamaesyce kuwaleana</i>	'akoko	U.S.A. (HI)	E		NA	NA
Gentianaceae—Gentian family:						
<i>Centaurium seabaeoides</i>	'awiwi	U.S.A. (HI)	E		NA	NA
Lamiaceae—Mint family:						
<i>Phyllostegia mollis</i>	None	U.S.A. (HI)	E		NA	NA
Malvaceae—Mallow family:						
<i>Abutilon sandwicense</i>	None	U.S.A. (HI)	E		NA	NA
Rhamnaceae—Buckthorn family:						
<i>Gouania meyerii</i>	None	U.S.A. (HI)	E		NA	NA
Rubiaceae—Coffee family:						
<i>Hedyotis degeneri</i>	None	U.S.A. (HI)	E		NA	NA
<i>Hedyotis parvula</i>	None	U.S.A. (HI)	E		NA	NA
Urticaceae—Nettle family:						
<i>Neraudia angulata</i>	None	U.S.A. (HI)	E		NA	NA
<i>Urera kaalae</i>	opuhe	U.S.A. (HI)	E		NA	NA
Violaceae—Violet family:						
<i>Viola chamissoniana</i> ssp. <i>chamissoniana</i>	pamakani	U.S.A. (HI)	E		NA	NA

Dated: September 24, 1990.

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[FR Doc. 90-22936 Filed 9-27-90; 8:45 am]

BILLING CODE 4310-55-M