

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Munroidendron racemosum* (no common name)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2008. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 70 species in Idaho, Montana, Oregon, Washington, and the Pacific Islands. Federal Register 73(83):23264-23266.

Lead Region/Field Office:

Region 1/Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii

Name of Reviewer(s):

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Marilet A. Zablan, Pacific Islands Fish and Wildlife Office, Assistant Field Supervisor for Endangered Species
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Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS), beginning on April 29, 2008. The review was based on the proposed rule and final critical habitat designation for *Munroidendron racemosum* and other species from the island of Kauai (USFWS 2003), as well as a review of current, available information. The National Tropical Botanical Garden provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The evaluation of Samuel Aruch, biological consultant, was reviewed by the Plant Recovery Coordinator. The document was then reviewed by the Assistant Field Supervisor for Endangered Species and Acting Deputy Field Supervisor before submission to the Field Supervisor for approval.

Background:

For information regarding the species listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species (http://ecos.fws.gov/tess_public).

Application of the 1996 Distinct Population Segment (DPS) Policy:

This Policy does not apply to plants.

Review Analysis:

Please refer to the final critical habitat designation for *Munroidendron racemosum* published in the Federal Register on June 17, 2003 (USFWS 2003) for a complete review of the species' status (including biology and habitat), threats, and management efforts. No new threats and no significant new information regarding the species' biological

status have come to light since listing to warrant a change in the Federal listing status of *M. racemosum*.

Historically, *Munroidendron racemosum* was known from scattered locations throughout the island of Kauai. In 2003, 17 populations were known on Kauai with approximately 59 to 99 individuals. These were on State lands (Hono o Na Pali Natural Area Reserve, Na Pali Coast State Park, Na Pali-Kona Forest Reserve, Nonou Forest Reserve, and Puu Ka Pele Forest Reserve) and privately owned lands. Those known populations were in Waiahuakua, Pohakuao, left and right branches of Kalalau Valley, Nakeikianaiwi Valley, Awaawapuhi Valley, Honopu Valley, Nualolo Valley, Poomau Valley, Kawaiiki Valley, Koaie Canyon, Nonou, Haupu, and Keopaweo (USFWS 2003).

No observations have been made in the last five years or more at Awaawapuhi, Poomau, or Keopaweo. There used to be two mature individuals on Niimalu Cliffs across from Nawiliwili Harbor, near the *Brighamia insignis* (alula), prior to Hurricane Iwa in 1982. Those individuals died during the hurricane. No individuals now grow on this side of Mt. Haupu, and only three grow on the other side of Haupu at Kipu Kai (Perlman 2008). Prior to Hurricane Iwa in 1982, there were also 20 to 30 large trees in Hoolulu Valley and on the cliffs near the *Brighamia insignis* (Perlman 2008), where there are now only three individuals. While there has been a decline in the number of populations, there has been a slight increase in the number of reported wild individuals. This could be the result of more intensive surveying of remote sites on the Na Pali Coast.

Munroidendron racemosum is endemic to Kauai. Currently, *Munroidendron racemosum* has approximately 114 naturally occurring individuals surviving in the wild. Along the Na Pali coast of northwest Kauai 103 trees occur. In Koaie Canyon of central Kauai, there are five mature individuals, in Kipu Kai in southern Kauai there are three mature individuals, and on Nonou Mountain (Sleeping Giant) in eastern Kauai there are also three individuals (Wood 2008).

On the Na Pali Coast of northwest Kauai there are eight populations of *Munroidendron racemosum*. Eight individuals occur in Hanakoa Valley at 183 to 351 meters (600 to 1,152 feet) elevation, last visited in May 2008. In Honopu Valley, there are three individuals at 244 meters (801 feet) elevation, last visited in May 2004. In Hoolulu, there are also three mature individuals, at 152 to 226 meters (499 to 741 feet) elevation, last visited in September 2006. At Kaalahina in Kalalau Valley, there are 14 individuals at 183 to 320 meters (600 to 1,050 feet) elevation, last visited in December 2008. At Nakeikianaiwi in Kalalau, there were 28 individuals at 150 to 244 meters (492 to 801 feet) elevation when visited in November 1999; in November 2005, 4 mature individuals were observed there at 122 to 152 meters (400 to 500 feet) elevation (Perlman 2008). An additional 50 mature individuals were estimated to grow scattered on the steep cliffs in Kalalau Valley, east of Kalepa Ridge. However, most of these sites are inaccessible (Tangalin 2008). At Nualolo Kai there were 19 individuals when last counted in August 2002, at 122 to 550 meters (400 to 1,804 feet) elevation. In Pohakuao, an individual was observed in July 2002, and 22 additional individuals were seen in November 2005, all between 122 and 488 meters (400 and 1,601 feet) elevation. At Waiahuakua, five

individuals were observed in May 2008 at 195 to 200 meters (640 to 656 feet) elevation (Wood 2008).

Other populations have fewer individuals. In Koaie Canyon in central Kauai, three small populations of *Munroidendron racemosum* remain. In Hipalau, one individual was seen in October 2004 at 655 meters (2,149 feet) elevation. In July 2007, one individual was observed at 470 meters (1,542 feet) elevation in Kawaiiki. In Koaie, three individuals were observed in July 2007 at 671 to 686 meters (2,201 to 2,250 feet) elevation (Wood 2008). On the slopes of Mt. Haupu, at Kipu Kai Gap in southern Kauai, three individuals remain at 240 meters (787 feet) elevation as of April 2008. On Nonou Mountain in eastern Kauai, there are also three remaining individuals at elevations from 174 to 262 meters (571 to 860 feet) as of January 2005 (Wood 2008). Perlman observed only two individuals there at 244 meters (800 feet) in 2006 (Perlman 2008).

The Araliaceae family is composed of 55 genera totaling about 1,500 species worldwide, with most distributed in the tropics and sub-tropics (Wood 2008). Hawaiian Araliaceae includes four genera with 15 endemic species: *Tetraplasandra* has eight species, *Cheirodendron* has five, and *Reynoldsia* and *Munroidendron* each have one. *Tetraplasandra* occurs on six of the main Hawaiian Islands, while *Munroidendron* is restricted to Kauai, the oldest and most floristically diverse Hawaiian island. Systematic relationships within *Tetraplasandra*, *Munroidendron*, and the Hawaiian *Reynoldsia* using morphological and DNA sequence data indicate that they form a single monophyletic group with a sister relationship between *Munroidendron racemosum* and *Reynoldsia sandwicensis* (Costello and Motley 2007; Wood 2008).

Munroidendron racemosum trees usually grow on vertical basalt cliffs in dry to mesic regions, as well as on moderately steep slopes or talus terraces, and are occasionally seen among basalt boulders near drainages (Wood 2008). Hanakoa's eight *Munroidendron racemosum* trees are located in a relic mesic *Diospyros sandwicensis* (lama) forest with introduced *Aleurites moluccana* (kukui) and native *Psydrax odorata* (alahee), below the cliffs associated native species include *Bidens sandwicensis* (kookoolau), *Chamaesyce celastroides* var. *hanapepensis* (akoko), *Lobelia niihauensis* (no common name [NCN]), and *Schiedea apokremnos* (NCN) (Wood 2008).

Three *Munroidendron racemosum* trees occurring in the Honopu Valley region are on the southern side, up the first streamlet to the spring area. The plant community is a mixed dry to mesic cliff habitat with *Artemisia australis* (ahinahina), *Bidens sandwicensis*, *Boehmeria grandis* (akolea), *Chamaesyce celastroides* var. *hanapepensis*, *Kadua cordata* (kopa), *Lipochaeta connata* var. *acris* (nehe), *Lobelia niihauensis*, *Nototrichium sandwicense* (kului), *Schiedea apokremnos* (NCN), *Sida fallax* (ilima), *Wilkesia hobdyi* (dwarf iliau), *Nototrichium divaricatum* (kului), *Vaccinium dentatum* (ohelo), and *Wilkesia gymnoxiphium* (iliau). Occasional small trees can be seen emerging out of soil pockets in the cliffs, including *Acacia koa* (koa), *Diospyros sandwicensis*, *Dodonaea viscosa* (aalii), *Hibiscus kokio* subsp. *saintjohnianus* (kokio ula), *Leptecophylla tameiameiae* (pukiawe), *Metrosideros polymorpha* var. *glaberrima* (ohia), *Pipturus albidus* (mamaki), *Pleomele aurea* (hala pepe), *Psydrax odorata*, *Rauvolfia sandwicensis*

(hao), *Santalum freycinetianum* var. *pyrularium* (iliahi), and *Xylosma hawaiiense* (maua). Herbs and vines include *Alyxia stellata* (maile), *Cocculus orbiculatus* (huehue), *Dianella sandwicensis* (uki uki), *Peucedanum sandwicense* (makou), *Pilea peploides* (NCN), and *Smilax melastomifolia* (pioi). Common grasses and sedges include *Agrostis avenacea* (heupueo), *Carex meyenii* (NCN), *Carex wahuensis* (NCN), *Cyperus phleoides* (NCN), *Eragrostis variabilis* (kawelu), *Heteropogon contortus* (pili), and *Panicum lineale* (NCN). Native ferns include *Adiantum capillus-veneris* (iwa iwa), *Doryopteris decipiens* (kumuniu), *Doodia kunthiana* (okupukupu), *Microlepia strigosa* (palapalai), *Psilotum nudum* (moa), *Pteridium aquilinum* var. *decompositum* (kilau), *Selaginella arbuscula* (lepelepe a moa), *Sphenomeris chinensis* (palaa), and *Tectaria gaudichaudii* (iwa iwa lau nui) (Wood 2008).

Three *Munroidendron racemosum* trees occur in Hoolulu Valley. One tree occurs on mixed lowland mesic basalt sea cliffs and is associated with *Alyxia stellata*, *Artemisia australis*, *Bidens sandwicensis*, *Bobea* sp. (ahakea), *Carex wahuensis*, *Chamaesyce celastroides* var. *hanapepensis*, *Charpentiera densiflora* (papala), *Christella* sp. (NCN), *Cordyline fruticosa* (ti), *Diospyros sandwichensis*, *D. hillebrandii* (lama), *Doryopteris decipiens* (kumuniu), *Eragrostis variabilis*, *Hibiscus kokio* var. *saintjohnianus*, *Ochrosia kauaiensis* (holei), *Pandanus tectorius* (hala), *Peucedanum sandwicensis*, *Pittosporum napaliense* (hoawa), *Pritchardia napaliensis*, *Psychotria mariniana* (kopiko), *Psydrax odorata*, and *Rauvolfia sandwicensis*. The other two trees occur in an *Aleurites moluccana* introduced coastal mesic lowland forest with patches of *Diospyros sandwicensis* – *Nestegis sandwicensis* relic forest and associated with *Freycinetia arborea* (ie ie), *Metrosideros polymorpha*, *Ochrosia kauaiensis*, *Pandanus tectorius*, *Psydrax odorata*, and *Wikstroemia oahuensis* (akia) (Tangalin 2008; Wood 2008).

Fourteen *Munroidendron racemosum* trees occur in the Kaaalahina region of Kalalau Valley, which is an *Aleurites moluccana* invasive introduced forest associated with relic native *Dodonaea viscosa* shrubland and small patches of *Diospyros sandwicensis*, *Pleomele* sp., and *Psydrax odorata*. Twenty-eight trees of *M. racemosum* occurring in the Nakeikianaiwi region of Kalalau Valley are located on vertical basalt walls and around the bases of spire-like cliffs. This region is a mixed dry to mesic shrubland and cliff community with *Artemisia australis*, *Chamaesyce celastroides* var. *hanapepensis*, *Eragrostis variabilis*, *Lobelia niihauensis*, and *Wilkesia gymnoxiphium*, above degraded *Diospyros sandwicensis* dry forest with relictual *Psydrax odorata* and occasional *Metrosideros polymorpha* (Wood 2008).

Nineteen *Munroidendron racemosum* trees occur in Nualolo Aina Valley on diverse dry to mesic cliffs with native species including *Eragrostis variabilis*, *Bidens sandwicensis*, *Artemisia australis*, *Nototrichium sandwicense*, *Myoporum sandwicensis* (naio), *Lobelia niihauensis*, *Carex meyenii*, *Carex wahuensis*, *Chamaesyce celastroides*, *Cyperus phleoides*, *Diospyros sandwicensis*, *D. hillebrandii*, *Dodonaea viscosa*, *Doryopteris decipiens*, *Hibiscus kokio* subsp. *saintjohnianus*, *Lipochaeta connata* var. *acris*, *Lythrum maritimum* (pukamole), *Metrosideros polymorpha*, *Nephrolepis hirsutula* (NCN), *Neraudia melastomifolia* (maalaa), *Panicum lineale*, *Peperomia blanda* (ala ala wai nui), *Peucedanum sandwicensis*, *Pilea peploides* (NCN), *Plectranthus parviflorus* (ala ala wai

nui pua ki), *Pleomele aurea*, *Psilotum nudum*, *Psydrax odorata*, *Sida fallax*, *Wikstroemia oahuensis*, and *Wilkesia gymnoxiphium* (Wood 2008).

Twenty-three *Munroidendron racemosum* trees occur in Pohakuao Valley. Most trees occur in secondary invasive forest of *Aleurites moluccana* and *Psidium guajava* (common guava), with some native components including *Carex wahuensis*, *C. meyenii*, *Diospyros sandwicensis*, *Psydrax odorata*, and *Rauvolfia sandwicensis*. There are still some richer sections where *M. racemosum* occurs in relictual *Diospyros sandwicensis* – *Metrosideros polymorpha* mesic forest that, besides the previously mentioned native taxa, also have *Canavalia napaliensis* (awikiwiki), *Microlepis strigosa*, *Ochrosia kauaiensis*, *Pleomele aurea*, *Psychotria mariniana*, *Streblus pendulinus* (aiiai), and *Tetraplasandra waimeae* (ohe ohe). One of the 23 Pohakuao *M. racemosum* trees occurs in an upper hanging valley where there is a relictual Kauai diverse mesic forest with *Antidesma platyphylla* (hame), *Bidens sandwicensis*, *Boehmeria grandis*, *Chamaesyce celastroides* var. *hanapepensis*, *Charpentiera densiflora*, *Diospyros sandwicensis*, *Lipochaeta connata* var. *acris*, *Metrosideros polymorpha* var. *glaberrima*, *Myrsine lanaiensis* (kolea), *Nesoluma polynesianum* (keahi), *Pleomele sandwicensis*, *Pouteria sandwicensis* (alaa), *Pritchardia napaliensis* (loulu), *Psychotria mariniana*, *Psydrax odoratum*, *Rauvolfia sandwicensis*, *Santalum freycinetianum* var. *pyrularium*, and *Wilkesia gymnoxiphium* (Wood 2008). *Pteralyxia kauaiensis* (kaulu) also occurs in Pohakuao Valley (Tangalin 2008).

The five individuals of *Munroidendron racemosum* in Waiahuakua Valley occur in an *Aleurites moluccana* non-native forest associated with a mesic *Diospyros sandwicensis* – *Nestegis sandwicensis* relic forest with *Artemisia australis*, *Chamaesyce celastroides* var. *hanapepensis*, *Dryopteris* sp., *Eragrostis variabilis*, *Freycinetia arborea*, *Metrosideros polymorpha*, *Ochrosia kauaiensis*, *Pisonia umbellifera*, *Rauvolfia sandwicensis*, and *Wikstroemia oahuensis* (Tangalin 2008; Wood 2008).

The single *Munroidendron racemosum* tree occurring in Hipalau Valley is located in a degraded mixed mesic forest with *Antidesma platyphylla*, *Diospyros sandwicensis*, *Dodonaea viscosa*, *Erythrina sandwicensis* (wili wili), *Hibiscus waimeae* (kokio keokeo), *Metrosideros polymorpha*, *Pleomele aurea*, *Pouteria sandwicensis*, and *Psydrax odorata* (Wood 2008).

A single *Munroidendron racemosum* tree occurs in Kawaiiki Valley, also in degraded *Aleurites moluccana* mesic forest with a few native trees of *Antidesma platyphylla*, *Diospyros sandwicensis*, *Dodonaea viscosa*, *Hibiscus waimeae* subsp. *waimeae*, *Metrosideros polymorpha*, *Pisonia sandwicensis* (papala kepau), *Psydrax odorata*, and *Xylosma hawaiiense*. Three *M. racemosum* trees occur on slopes above the main Koaie stream. Two individuals occur together in the “great escarpment” region at 686 meters (2,251 feet) elevation in a mixed mesic forest community above cliffs with trees such as *Bobea timonioides*, *Diospyros hillebrandii*, *Diospyros sandwicensis*, *Flueggea neowawraea* (mehamehame), *Hibiscus waimeae*, *Kadua affinis* (manono), *Melicope barbigera* (alani), *Metrosideros polymorpha* var. *glaberrima*, *Myoporum sandwicense*, *Myrsine lanaiensis*, *Nesoluma polynesianum*, *Pleomele aurea*, *Pouteria sandwicensis*,

Pteralyxia kauaiensis, and *Santalum freycinetianum* var. *pyrularium*. Vines include *Canavalia kauaiensis* (awikiwiki) and *Smilax melastomifolia*, and herbs are *Spermolepis hawaiiensis* (NCN) and *Korthalsella complanata* (hulumoa). Ferns are *Microlepia strigosa*, *Dicranopteris linearis* (uluhe), *Psilotum nudum*, *Pteris* × *hillebrandii* (NCN), and *Selaginella arbuscula*. The third tree occurs on a north-facing steep ridge above Koaie Stream at 671 meters (2,201 feet) elevation. This *M. racemosum* can be observed with binoculars on the ridge just before the Waialele Mahoi (Twin Falls) side gulch. The ridge is only sparsely covered with mesic forest trees around 200 meters (650 feet) above the stream (Wood 2008). Also occurring in the Hipalau - Kawaiiki - Koaie area are native species including *Acacia koaia*, *Alyxia stellata*, *Artemisia australis*, *Carex meyenii*, *Carex wahuensis*, *Chamaesyce celastroides* var. *hanapepensis*, *Chenopodium oahuense* (aheahea), *Dianella sandwicensis*, *Doryopteris decora* (NCN), *Eragrostis variabilis*, *Hibiscadelphus distans* (hau kuahiwi), *Lipochaeta connata* var. *acris*, *Lobelia niihauensis*, *Neraudia melastomifolia*, *Nototrichium sandwicense*, *Plectranthus parviflorus*, and *Sida fallax* (Tangalin 2008).

Three *Munroidendron racemosum* trees occur at Kipu Kai in highly disturbed lowland alien forest dominated by *Aleurites moluccana*, *Schinus terebinthifolius* (Christmas berry), and *Psidium guajava*, with native relics of *Canavalia kauaiensis*, *Metrosideros polymorpha*, *Pisonia umbellifera*, *Pleomele aurea* and native ferns *Asplenium nidus*, *Psilotum nudum*, and *Lepisorus thunbergianus* (pakahakaha), as well as introduced ferns *Nephrolepis exaltata* (Boston fern, sword fern), *Microsorium grossum* (maile scented fern), *Phlebodium aureum* (golden polypody, rabbit's foot fern), and *Blechnum appendiculatum* (NCN) (Tangalin 2008; Wood 2008).

The three *Munroidendron racemosum* trees occurring on Nonou Mountain are in an area which has relic *Acacia koa* with secondary *Psidium cattleianum* (strawberry guava) forest, interspersed with *Pleomele aurea* and *Pandanus tectorius*. The ground cover has native components such as *Microsorium spectrum* var. *pentadactylum* (peahi), *Bidens* sp., *Gahnia aspera* subsp. *globosa* (NCN), *Chamaesyce celastroides* var. *celastroides* (akoko), and *Carex wahuensis*, along with non-native *Nephrolepis multiflora* (NCN) and *Passiflora laurifolia* (yellow granadilla). *Hibiscus clayi* (aloalo) and *Pritchardia hardyi* (loulou) are outplanted in an enclosure nearby (Tangalin 2008; Wood 2008).

Threats to the individuals of *Munroidendron racemosum* at Hanakoa include pigs (*Sus scrofa*); goats (*Capra hircus*); rats (*Rattus rattus*) (Factors A and C); unidentified introduced insects (Factor C); fire (Factor E); and invasive introduced plant species including *Aleurites moluccana*, *Bryophyllum pinnatum* (airplant), *Clidemia hirta* (Koster's curse), *Elephantopus mollis* (elephant's-foot), *Furcraea foetida* (Mauritius hemp), *Lantana camara* (lantana), *Pluchea carolinensis* (sourbush), *Psidium guajava*, and *Syzygium cumini* (Java plum) (Factor E) (Wood 2008).

Threats to the Honopu region include landslides (Factor E); goats (Factors A and C); rats (Factor C); unidentified introduced insects (Factor C); and invasive introduced plant species including *Lantana camara*, *Pluchea carolinensis*, and *Xanthium strumarium* var. *canadense* (cocklebur), herbs of *Ageratum conyzoides* (billy goat weed), *Bryophyllum*

pinnatum, *Conyza bonariensis* (hairy horseweed), *Erigeron karvinskianus* (daisy fleabane), and *Salvia occidentalis* (West Indian sage). Invasive introduced grasses include *Andropogon virginicus* (broomsedge), *Bromus rigidus* (rip gut grass), *Ehrharta stipoides* (meadow ricegrass), *Oplismenus hirtellus* (basketgrass), and *Vulpia bromoides*, (brome fescue). Invasive introduced ferns include *Adiantum hispidulum* (rough maidenhair fern), *Adiantum raddianum* (NCN), *Blechnum appendiculatum*, *Christella dentata* (downy wood fern), and *Nephrolepis multiflora* (NCN) (Factor E) (Wood 2008).

Threats to *Munroidendron racemosum* located in Hoolulu include goats (Factors A and C); rats (Factor C); introduced insects (Factor C); and invasive introduced plant species including *Bryophyllum pinnatum*, *Lantana camara*, *Pluchea carolinensis*, *Neonotonia wightii* (NCN), *Setaria parviflora* (yellow foxtail); and landslides (Factor E) (Wood 2008).

The slopes of the Kaaalahina region of Kalalau Valley are dominated by a secondary succession of invasive vegetation which threatens *Munroidendron racemosum* including invasive introduced plant species *Aleurites moluccana*, *Bryophyllum pinnatum*, *Erigeron karvinskianus*, *Syzygium cumini*, *Lantana camara*, and *Psidium guajava* (Factor E). Goats (Factors A and C), rats (Factor C), introduced insects (Factor C), fire (Factor E), and landslides are also serious threats (Factor E) (Wood 2008).

In Nakeikianaiwi, major threats are landslides; goats (Factors A and C); rats (Factor C); and invasive introduced species including *Aleurites moluccana*, *Bryophyllum pinnatum*, *Melia azedarach* (pride of India), and *Psidium* spp. Any fruit that was ripe would fall into extremely weedy and goat filled areas, which prevent the establishment of new seedlings (Factor E). No immature individuals were observed in gulches, although there were a few on the walls away from where goats could reach (Tangalin 2008).

Threats to the Nualolo Aina region containing *Munroidendron racemosum* include goats (Factors A and C); rats (Factor C); unidentified introduced insects (Factor C); fire (Factor E); landslides (Factor E); and invasive introduced plants such as *Abutilon grandifolium* (hairy abutilon), *Ageratum conyzoides*, *Bryophyllum pinnatum*, *Erigeron karvinskianus*, *Lantana camara*, *Melia azedarach*, *Setaria parviflora*, *Psidium guajava*, and *Vulpia bromoides* (Factor E) (Wood 2008).

Threats to the individuals of *Munroidendron racemosum* at Pohakuao include goats (Factors A and C); rats (Factor C); introduced insects (Factor C); fire (Factor E); competition with invasive introduced plant species such as *Andropogon glomeratus* (bluestem), *Bryophyllum pinnatum*, *Erigeron karvinskianus*, *Lantana camara*, *Pluchea carolinensis*, *Psidium guajava*, *Rubus rosifolius* (thimbleberry), and *Setaria parviflora*; and the loss of reproductive vigor as the result of limited numbers of interbreeding individuals (Factor E) (Wood 2008).

Threats to the individuals of *Munroidendron racemosum* at Waiahuakua include pigs (Factors A and C); rats (Factor C); introduced insects (Factor C); goats (Factors A and C); fire (Factor E); and invasive introduced plants such as *Aleurites moluccana*,

Bryophyllum pinnatum, *Clidemia hirta*, *Elephantopus mollis*, *Lantana camara*, *Melia azedarach*, *Pluchea carolinensis*, *Psidium guajava*, and *Syzygium cumini* (Factor E) (Tangalin 2008; Wood 2008). Threats to the Hupalau *Munroidendron racemosum* include goats (Factors A and C); fire (Factor E); rats (Factor C); introduced insects (Factor C); and invasive introduced plant species such as *Bryophyllum pinnatum*, *Hyptis pectinata* (comb hyptis), *Lantana camara*, *Melia azedarach*, *Setaria parvula*, and *Triumfetta semitriloba*. Threats to the Kawaiiki *M. racemosum* include pigs and goats (Factors A and C); fire (Factor E); rats (Factor C); unidentified introduced insects (Factor C); and invasive introduced plant species such as *Bryophyllum pinnatum*, *Grevillea robusta*, *Hyptis pectinata*, *Lantana camara*, *Melia azedarach*, *Psidium guajava*, *Setaria parvula*, and *Triumfetta semitriloba* (Sacramento bur) (Factor E) (Wood 2008).

Threats to the trees in Koaie include goats (Factors A and C); rats (Factor C); predation by unidentified introduced seed-eating insects (Factor C); catastrophic extinction through environmental events (Factor E); and competition with invasive introduced plant species such as *Lantana camara*, *Grevillea robusta* (silk oak), *Melia azedarach*, *Setaria parviflora*, *Abutilon grandifolium*, *Adiantum hispidulum*, *Aleurites moluccana*, *Bidens pilosa*, *Bryophyllum pinnatum*, *Centaurium erythraea* (bitter herb), *Cyperus meyenianus* (NCN), *Hyptis pectinata*, *Leucaena leucocephala* (koa haole), *Lythrum maritimum*, *Oxalis corniculata* (yellow wood sorrel), *Passiflora edulis* (passion fruit), *Pluchea carolinensis*, *Ricinus communis* (castor bean), *Synedrella nodiflora* (nodeweed), *Triumfetta semitriloba*, and *Vulpia bromoides* (annual fescue). Additional threats include possible landslides, human disturbance, fire, and reduced reproductive vigor as the result of limited numbers of existing individuals (Factor E) (Tangalin 2008; Wood 2008).

Threats to the trees at Kipu Kai include pigs and cattle (*Bos taurus*) (Factors A and C); rats (Factor C); introduced insects (Factor C); and invasive introduced plant species such as *Schinus terebinthifolius*, *Psidium guajava*, *Syzygium cumini*, and *Melinis minutiflora* (molasses grass) (Factor E) (Wood 2008). Threats to the Nonou *Munroidendron racemosum* include rats (Factor C); pigs (Factors A and C); introduced insects (Factor C); human disturbance and horses on the trail (Factor E); fire (Factor E); and invasive introduced species such as *Clidemia hirta*, *Lantana camara*, *Melinis repens* (Natal redtop), *Nephrolepis multiflora*, *Passiflora laurifolia*, *Pluchea* sp., *Psidium cattleianum*, *Rubus* sp., *Schefflera actinophylla* (octopus tree), *Schinus terebinthifolius*, and *Stachytarpheta* sp. (NCN) (Factor E) (Tangalin 2008; Wood 2008). Mule deer (*Odocoileus hemionus*) (Factor A) and hurricanes (Factor E) are also threats to *M. racemosum* (Perlman 2008).

Rats appear to be getting all the fruit before they mature (Factor C). There were no seedlings in the enclosure at Nonou Mountain (Tangalin 2008). Climate change may also pose a threat to *Munroidendron racemosum* (Factors A and E). However, current climate change models do not allow us to predict specifically what those effects, and their extent, would be for this species.

In addition to all of the other threats, species like *Munroidendron racemosum* that are endemic to small portions of a single island are inherently more vulnerable to extinction

than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations and localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks (Factor E). The effects of these processes on this single-island endemic are exacerbated by anthropogenic threats, such as habitat loss for human development or predation by introduced species (Factor E) (USFWS 1995).

To safeguard existing genetic material, propagation for genetic storage and reintroduction is occurring at the National Tropical Botanical Garden. They have been collecting and propagating *Munroidendron racemosum* for over twenty years, and have 337 individuals outplanted in their gardens and 173 in restoration projects on Kauai (National Tropical Botanical Garden 2008). Approximately 14,000 seeds are currently in storage, representing 6 populations and 13 individuals (National Tropical Botanical Garden 2009b). The Conservation and Horticulture Center in Lawai Valley has 350 individuals in propagation (National Tropical Botanical Garden 2009a). The University of Hawaii's Lyon Arboretum Micropropagation Laboratory (2008) has 14 individual propagules. There are 11,342 seeds stored at the Center for Conservation, Research and Training Seed Storage Facility (2008). Although *M. racemosum* is endemic to Kauai, it is easily grown and is planted widely throughout the Hawaiian Islands in most botanical gardens, mostly for ornamental or education purposes. Kauai Department of Land and Natural Resources has *Munroidendron racemosum* outplanted in four of its exclosures, and growing in the Kokee Rare Plant Facility (Hawaii Department of Land and Natural Resources 2008).

Stabilizing, downlisting, and delisting objectives are provided in the recovery plan for plants from the island of Kauai (USFWS 1995), based on whether the species is an annual, a short-lived perennial (fewer than 10 years), or a long-lived perennial. *Munroidendron racemosum* is a long-lived perennial, and to be considered stable, the taxon must be managed to control threats (e.g., fenced) and be represented in an *ex situ* (at other than the plant's natural location, such as a nursery or arboretum) collection. In addition, a minimum of three populations should be documented on the island of Kauai. Each of these populations must be naturally reproducing and increasing in number, with a minimum of 25 mature individuals per population.

The interim stabilization goals for this species have not been met (see Table 1), as only one population has more than 25 mature individuals and all threats are not being managed. Most reintroduced individuals have not yet reached maturity. Therefore, *Munroidendron racemosum* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Collect seed between November and February, for best quality and availability, from all known populations.
- Fence all populations possible to exclude negative impacts from ungulates.

- Propagate individuals representing all populations for reintroduction.
- Reintroduce new populations in protected areas within suitable habitat.
- Control invasive introduced species at as many populations as possible.
- Work with Hawaii Division of Forestry and Wildlife and Hawaii State Parks to initiate planning and contribute to implementation of ecosystem-level restoration and management to benefit this species.

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Table 1. Status of *Munroidendron racemosum* from listing through 5-year review.

| Date | No. wild indivs | No. outplanted | Stability Criteria identified in Recovery Plan | Stability Criteria Completed? |
|-------------------------|------------------------|-----------------------|---|--------------------------------------|
| 1994 (listing) | 57-100 | Unknown | All threats managed in all 3 populations | No |
| | | | Complete genetic storage | No |
| | | | 3 populations with 25 mature individuals each | No |
| 1995 (recovery plan) | 200 | >400 | All threats managed in all 3 populations | No |
| | | | Complete genetic storage | Partially |
| | | | 3 populations with 25 mature individuals each | Partially |
| 2003 (critical habitat) | 59-99 | >400 | All threats managed in all 3 populations | Partially |
| | | | Complete genetic storage | Partially |
| | | | 3 populations with 25 mature individuals each | Partially |
| 2009 (5-year review) | 114 | >400 | All threats managed | Partially |
| | | | Complete genetic storage | Partially |
| | | | 3 populations with 25 mature individuals each | Partially |

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SIGNATURE PAGE for 5-YEAR REVIEW of *Munroidendron racemosum*
(no common name)

Pre-1996 DPS listing still considered a listable entity? N/A

Recommendation resulting from the 5-year review:

- Delisting
- Reclassify from Endangered to Threatened status
- Reclassify from Threatened to Endangered status
- No Change in listing status

for **Field Supervisor, Pacific Islands Fish and Wildlife Office**



Date AUG 27 2010