

CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Phlegmariurus stemmermanniae*

COMMON NAME: Wawae`iole

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: February 2003

STATUS/ACTION (Check all that apply):

New candidate

Continuing candidate

Non-petitioned

Petitioned - Date petition received: ____

90-day positive - FR date: ____

12-month warranted but precluded - FR date: ____

Is the petition requesting a reclassification of a listed species?

Listing priority change

Former LP: ____

New LP: ____

Latest date species first became a Candidate: ____

Candidate removal: Former LP: ____ (Check only one reason)

A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

F - Range is no longer a U.S. territory.

M - Taxon mistakenly included in past notice of review.

N - Taxon may not meet the Act's definition of "species."

X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Ferns and Allies, Lycopodiaceae (clubmoss family)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Maui and Hawaii

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Maui and Hawaii

LEAD REGION CONTACT (Name, phone number): Scott McCarthy, 503-231-6131

LEAD FIELD OFFICE CONTACT (Office, name, phone number): Pacific Islands (Ecological Services), Christa Russell, 808-541-3441

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

Phlegmariurus stemmermannii was described in 1986 from collections on east Maui. Additional populations are found in Laupahoehoe on the island of Hawaii. Only four populations are known, totaling less than 20 individuals. This species is epiphytic on living trees or fallen logs in mesic *Metrosideros polymorpha* (ʻohiʻa)/*Acacia koa* (koa) forests on both islands (Medeiros *et al.* 1996; Art Medeiros, U.S. Geological Survey-Biological Resources Division, pers. comm., 1997).

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change):

A. The present or threatened destruction, modification, or curtailment of its habitat or range. *Phlegmariurus stemmermanniae* is highly and imminently threatened by feral goats, pigs, and cattle, which are still a threat to the newly discovered population (Medeiros *et al.* 1996; A. Medeiros, pers. comm., 1997). As early as 1778, European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on Maui. Feral ungulates trample and eat native vegetation and disturb and open areas. This causes erosion and allows the entry of alien plant species (Cuddihy and Stone 1990; Wagner *et al.* 1990).

The pig (*Sus scrofa*) is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on Maui and four other islands, and inhabit rain forests and grasslands. Pig hunting is allowed on all islands either year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources (DLNR) n.d.-a, n.d.-b, n.d.-c, 1990). While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Cuddihy and Stone 1990; Medeiros *et al.* 1986; Scott *et al.* 1986; Smith 1985; Stone 1985; Tomich 1986; Wagner *et al.* 1990).

The goat (*Capra hircus*), a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently, populations exist on Kauai, Oahu, Maui, and Hawaii. Goat hunting is allowed year-round or during certain months, depending on the area (DLNR n.d.-a, n.d.-b, n.d.-c, 1990). Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980; Cuddihy and Stone 1990; Culliney 1988; Scott *et al.* 1986; Tomich 1986; van Riper and van Riper 1982).

Although many plant species survive on steep cliffs inaccessible to goats, the original range of these plants was probably much larger. These species are now vulnerable to the long-term,

indirect effects of goats, such as large-scale erosion (Corn *et al.* 1979). Dry and mesic habitats were damaged in the past by goats, and these effects are still apparent in the form of alien vegetation and erosion. This species is threatened by direct damage from feral goats, such as trampling of plants and seedlings and erosion of substrate (Clarke and Cuddihy 1980; Culliney 1988; Scott *et al.* 1986; van Riper and van Riper 1982).

Cattle (*Bos taurus*), the wild progenitor of which was native to Europe, northern Africa, and southwestern Asia, were introduced to the Hawaiian Islands in 1793. Large feral herds developed as a result of restrictions on killing cattle decreed by King Kamehameha I. While small cattle ranches were developed on Kauai, Oahu, and West Maui, very large ranches of tens of thousands of acres were created on East Maui and Hawaii. Much of the land used in these private enterprises was leased from the State or was privately owned and considered Forest Reserve and/or Conservation District land. Feral cattle can presently be found on the island of Hawaii, and ranching is still a major commercial activity there. Hunting of feral cattle is no longer allowed in Hawaii (Hawaii Department of Land and Natural Resources 1985). Cattle eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas into which alien plants invade, and spread seeds of alien plants in their feces and on their bodies. The forest in areas grazed by cattle becomes degraded to grassland pasture, and plant cover is reduced for many years following removal of cattle from an area. Several alien grasses and legumes purposely introduced for cattle forage have become noxious weeds (Cuddihy and Stone 1990; Tomich 1986).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

None known.

C. Disease or predation.

None known.

D. The inadequacy of existing regulatory mechanisms.

There is no current Federal or State protection for this taxon. The State of Hawaii does not recognize this species as endangered until it is federally listed as endangered.

E. Other natural or manmade factors affecting its continued existence.

Numerous weed species threaten *Phlegmariurus stemmermanniae* (Medeiros *et al.* 1996; A. Medeiros, pers. comm., 1997). The original native flora of Hawaii consisted of about 1,000 species, 89 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world and nearly 100 species have become pests (Smith 1985; Wagner *et al.* 1990). Naturalized, introduced species compete with native plants for space, light, water, and nutrients (Cuddihy and Stone 1990). Some of these species were brought to Hawaii by various groups of people, including the Polynesian immigrants, for food or cultural reasons. Plantation owners, alarmed at the reduction of water resources for their crops caused by the destruction of native forest cover by grazing feral animals, supported the introduction of alien tree species for reforestation. Ranchers intentionally introduced pasture grasses and other species for agriculture, and sometimes inadvertently

introduced weed seeds as well. Other plants were brought to Hawaii for their potential horticultural value (Cuddihy and Stone 1990; Scott *et al.* 1986; Wenkam 1969).

Introduced species that are a threat to *Phlegmariurus stemmermanniae* include *Passiflora mollissima* (banana poka), *Psidium cattleianum* (strawberry guava), *Cyathea cooperi* (Australian tree fern), *Clidemia hirta* (Koster's curse), and *Miconia calvescens* (miconia) (Medeiros *et al.* 1996). *Passiflora mollissima* (banana poka), a woody vine, poses a serious problem to mesic forests on Kauai and Hawaii by covering trees, reducing the amount of light which reaches trees as well as understory, and causing damage and death to trees by the weight of the vines. Animals, especially feral pigs, eat the fruit and distribute the seeds (Cuddihy and Stone 1990; Escobar 1990). Two small tree species, *Psidium cattleianum* (strawberry guava) and *Psidium guajava* (common guava), were brought to Hawaii and have become widely naturalized on all the main islands, forming dense stands in disturbed areas. Strawberry guava, found in mesic and wet forests, develops into stands in which few other plants grow, physically displacing natural vegetation and greatly affecting Hawaiian plants, many of which are narrowly endemic taxa. Pigs depend on strawberry guava for food and, in turn, disperse the plant's seeds through the forests (Smith 1985; Wagner *et al.* 1990). Strawberry guava is considered to be the greatest weed problem in Hawaiian rain forests (Smith 1985).

Recently introduced to Hawaii, *Cyathea cooperi* (Australian tree fern) is being promoted for commercial propagation in Hawaii to decrease exploitation of native tree ferns. Australian tree fern has recently become established on the island of Maui (Cuddihy and Stone 1990; A. Medeiros, pers. comm., 1994). Koster's curse, a noxious shrub native to tropical America, is found in mesic to wet forests on at least six islands in Hawaii (Almeda 1990; Hawaii Department of Agriculture 1981; Smith 1992). This noxious pest forms a dense understory, shading out other plants and hindering plant regeneration, and is considered the major alien plant threat (Cuddihy and Stone 1990). *Miconia calvescens* (velvet tree) is a recently naturalized species native to tropical America. This species has become invasive in the Hilo and Pahoia areas of the island of Hawaii, and has become established on East Maui. This species has the potential to be very disruptive, as it has become an understory dominate where introduced to similar habitat in Tahiti (Almeda 1990; Cuddihy and Stone 1990).

Fire is also a threat to *Phlegmariurus stemmermanniae* (Medeiros *et al.* 1996). Because Hawaiian plants were subjected to fire during their evolution only in areas of volcanic activity and from occasional lightning strikes, they are not adapted to recurring fire regimes and do not quickly recover following a fire. Alien plants are often better adapted to fire than native plant species, and some fire-adapted grasses have become widespread in Hawaii. Native shrubland and dry forest can thus be converted to land dominated by alien grasses. The presence of such species in Hawaiian ecosystems greatly increases the intensity, extent, and frequency of fire, especially during drier months or drought. Fire-adapted alien plant taxa can reestablish in a burned area, resulting in a reduction in the amount of native vegetation after each fire. Fire can destroy dormant seeds as well as plants, even in steep or inaccessible areas. Fires may result from natural causes, or they may be accidentally or purposely started by humans (Cuddihy and Stone 1990).

FOR RECYCLED PETITIONS:

- a. Is listing still warranted? ____
- b. To date, has publication of a proposal to list been precluded by other higher priority

listing actions?__

- c. Is a proposal to list the species as threatened or endangered in preparation? ___
d. If the answer to c. above is no, provide an explanation of why the action is still precluded.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify non-private owners): Two populations occur on State land within natural area reserves, and two populations occur on private land being considered for inclusion in Haleakala National Park.

PRELISTING (Describe status of conservation agreements or other conservation activities): The National Park Service is considering the land including the populations on Maui for inclusion in Haleakala National Park. However, the rate of acquisition and large-scale protection may be too slow in the immediate future to protect *Phlegmariurus stemmermaniae* without some emergency actions.

REFERENCES (Identify primary sources of information (e.g., status reports, petitions, journal publications, unpublished data from species experts) using formal citation format):

The information in this form is based on the results of two meetings of 20 botanical experts held by the Center for Plant Conservation in December 1995 and November 1996, who are cited where appropriate in the text.

Almeda, F. 1990. Melastomataceae: in Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 83:903-917.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation; effects of humans, their activities and introductions. Coop. Natl. Park Resources Stud. Unit, Hawaii. 138 pp.

Culliney, J.L. 1988. Islands in a far sea; nature and man in Hawaii. Sierra Club Books, San Francisco. 410 pp.

Escobar, L.K. 1990. Passifloraceae: in Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 83:1007-1014.

Hawaii Department of Agriculture. 1981. Title 4, Subtitle 6, Chapter 68, Noxious weed rules. State of Hawaii, Honolulu. Administrative rules, 12 pp.

Hawaii, Department of Land and Natural Resources. N.d.-a. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Oahu. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-b. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Molokai. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-c. Summary of Title 13, Chapter

- 123, Game mammal hunting rules, island of Maui. Division of Forestry and Wildlife, Honolulu. 2 pp.
- Hawaii, Department of Land and Natural Resources. 1985. Hunting in Hawaii, fourth revision. Division of Forestry and Wildlife, Honolulu, 32 pp.
- Hobdy, R.W., A.C. Medeiros, and L.L. Loope. 1989. *Cyanea obtusa* and *Cyanea lobata* (Lobeliaceae): Recent apparent extinctions of two Maui endemics. Hawaiian Botanical Society Newsletter 29(1):3-6.
- Lammers, T.G. 1990. Campanulaceae: in Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 83:420-489.
- Medeiros, A.C., Jr., L.L. Loope, and R.A. Holt. 1986. Status of native flowering plant species on the south slope of Haleakala, East Maui, Hawaii. Coop. Natl. Park Resources Stud. Unit, Hawaii, Techn. Rept. 59:1-230.
- Medeiros, A.C., W.H. Wagner, Jr., and R.W. Hobdy. 1996. A new Hawaiian hanging firmoss (Lycopodiaceae: *Phlegmariurus*) from the eastern Hawaiian Islands. American Fern Journal 86(3):89-97.
- Scott, J.M., S. Mountainspring, F.L. Ramsey, and C.B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: Their dynamics, ecology, and conservation. Studies in Avian Biology 9:1-429. Cooper Ornithological Society, Los Angeles.
- Smith, C.W. 1985. Impact of alien plants on Hawai'i's native biota: in Stone, C.P., and J.M. Scott (eds.), Hawai'i's terrestrial ecosystems: preservation and management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 180-250.
- Stone, C.P. 1985. Alien animals in Hawai'i's native ecosystems: toward controlling the adverse effects of introduced vertebrates: in Stone, C.P., and J.M. Scott (eds.), Hawai'i's terrestrial ecosystems: preservation and management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 251-197.
- Tomich, P.Q. 1986. Mammals in Hawai'i; a synopsis and notational bibliography. Bishop Museum Press, Honolulu. 375 pp.
- van Riper, S.G., and C. van Riper III. 1982. A field guide to the mammals in Hawaii. The Oriental Publishing Company, Honolulu. 68 pp.
- Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 83:1-1853.
- Wenkam, R. 1969. Kauai and the park country of Hawaii. Sierra Club, San Francisco. 160 pp.

LISTING PRIORITY (* after number)

THREAT

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2 *
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

Imminence:

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Rowan Gould March 6, 2003
Regional Director, Fish and Wildlife Service Date

Concur: _____
Director, Fish and Wildlife Service Date

Do not concur: _____
Director, Fish and Wildlife Service Date

Director's Remarks:

-

-

Date of annual review: 2/03

Conducted by: _____

Comments:

-

-