

Picture-wing fly
(Drosophila mulli)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

5-YEAR REVIEW
Species reviewed: Picture-wing fly (*Drosophila mulli*)

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5-YEAR REVIEW
Picture-wing fly/*Drosophila muli*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,
(503) 231-2349

Lead Field Office:

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,
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Cooperating Field Office(s):

N/A

Cooperating Regional Office(s):

N/A

1.2 Methodology used to complete the 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 8, 2010. The review was based on the final rule to list 12 Hawaiian picture-wing flies, designation of Critical Habitat for 12 species of picture-wing flies from the Hawaiian Islands Final Rule, the Recovery Outline for 12 Hawaiian picture-wing flies, current published and unpublished materials and expert opinions and knowledge on the *Drosophila muli* species. The draft five-year review was then reviewed by the Endangered Species Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before signature by the Pacific Islands Fish and Wildlife Office Field Supervisor and transmittal to the Regional Office.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 69 species in Idaho, Washington, Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands. Federal Register 75(67):17947-17950.

1.3.2 Listing history

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2006. Endangered and threatened wildlife and plants; Determination of status for 12 species of picture-wing flies from the Hawaiian Islands. Federal Register 71(89):26835-26852.

Date listed: May 9, 2006

Entity listed: Species

Classification: Threatened

Revised Listing, if applicable

FR notice: N/A

Date listed: N/A

Entity listed: N/A

Classification: N/A

1.3.3 Associated rulemakings:

[USFWS] U.S. Fish and Wildlife Service. 2008. Endangered and threatened wildlife and plants; Designation of critical habitat for 12 species of picture-wing flies from the Hawaiian Islands. Final Rule. 73(234):73794-73888.

Three Critical Habitat units totaling 281 hectares (693 acres) have been designated for *Drosophila mulli* on the island of Hawaii.

1.3.4 Review History: N/A

1.3.5 Species' Recovery Priority Number at start of this 5-year review: 5

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery Outline for 12 Hawaiian Picture-wing Flies

Date issued: August 2006

Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

 Yes

 X No

2.1.2 Is the species under review listed as a DPS?

 Yes

 X No

2.1.3 Was the DPS listed prior to 1996?

Yes
 No

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

Yes
 No

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

Yes
 No

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

Yes
 No

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

Yes
 No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery?

Yes
 No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

A draft recovery plan for *Drosophila mulli* is being developed but was not published at the time of completing this 5-year review.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

The general life cycle of Hawaiian *Drosophila* is typical of most flies: after mating, females lay eggs from which larvae (immature stage) hatch; as larvae grow they molt (shed their skin) through three successive stages (instars); when fully grown, the larvae change into pupae (a transitional form) in which they metamorphose and emerge as adults. Adult flies of *Drosophila mulli* are found only on the leaf undersides of the endemic fan palm, *Pritchardia beccariana* (family Arecaceae), which is the only known association of a *Drosophila* species with a native Hawaiian palm species. Individual *P. beccariana* are long-lived (approximately 100 years). The exact larval feeding site on this host plant remains unknown because attempts to rear *D. mulli* from decaying parts of *P. beccariana* have thus far been unsuccessful (Science Panel 2005).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Bait can be used to survey for Hawaiian *Drosophila* but only to indicate the presence or absence of taxa. There is no technique currently available to uniquely mark individual flies and thereby quantify the number of *Drosophila mulli* visiting the bait (K. Magnacca, *in litt.* 2010). In addition, Hawaiian *Drosophila* life cycles, are influenced by rainfall patterns and other environmental variables, making survey results difficult to compare over time and across sites. Even the very common species of picture-wing flies fluctuate widely seasonally as well as daily, confounding negative survey records for a taxa (K. Magnacca, *in litt.* 2012).

Drosophila mulli is restricted to the island of Hawaii and is historically known from three locations between 655 and 990 meters (2,150 and 3,250 feet) above sea level. The site of discovery for *D. mulli* is located within a State-owned montane wet *Metrosideros polymorpha* forest at O'laa Forest Reserve at approximately 985 meters (3,200 feet) above sea level. This site was surveyed at least 62 times between years 1965 and 2001, with fewer than ten individuals observed on four different dates. The last recorded observation at this site occurred in 2001 (K. Kaneshiro, *in litt.* 2005). Second and third localities were discovered in 1999 and 2000, approximately 15 kilometers (9 miles) from the original site within State-owned montane wet *M. polymorpha* forest reserves at Upper Waiakea Reserve and along Stainback Highway at approximately 1,219 meters

(4,000 feet) above sea level (Science Panel 2005). No records of *D. mulli* observations have been reported since 2001.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

No new information is available.

2.3.1.4 Taxonomic classification or changes in nomenclature:

No changes in taxonomic classification have occurred. *Drosophila mulli* was described by Perreira and Kaneshiro (1990) and named for William P. Mull, the Hawaiian naturalist who first discovered this species. The head of *D. mulli* is yellow on the front and covered with light, silvery grey fuzz. The face of the male is characteristically white, while that of the female is brown. The top of the thorax is brownish yellow and lacks conspicuous markings or stripes. The legs are predominantly yellow, and the front legs of males bear three distinct rows of long, curled hairs. The wings are two and one-half times longer than wide, with distinct brown markings at the base and the tip. The length of the body is 4.3 to 5.0 millimeters (0.17 to 0.2 inches), and the wings are 4.3 to 4.8 millimeters (0.17 to 0.19 inches) long.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Drosophila mulli is restricted to the island of Hawaii and is known from three locations between 655 and 990 meters (2,150 and 3,250 feet) above sea level. Adult flies of this species are found only on the endemic fan palm, *Pritchardia beccariana* (family Arecaceae). Individual *P. beccariana* can live approximately 100 years, but regeneration of the host plant is currently compromised by feral ungulates, rats, and scolytid beetles (Science Panel 2005).

The historical site of discovery for *Drosophila mulli* is located within a State-owned montane wet *Metrosideros polymorpha* forest at O'laa Forest Reserve at approximately 985 meters (3,200 feet) above sea level. This site was surveyed at least 62 times between 1965 and 2001, with fewer than ten individuals observed on four different dates. The last recorded observation at this site occurred in 2001 (K. Kaneshiro, *in litt.* 2005). Two additional sites were discovered in 1999 and 2000, approximately 15 kilometers (9 miles) from the original site within State-owned montane wet *M. polymorpha* forest reserves at Upper Waiakea Reserve and along Stainback Highway at approximately 1,219 meters (4,000 feet) above sea level (Science Panel 2005). These are the last reported observations for *D. mulli*, though recent surveys have been limited.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

In accordance with section 3(5)(A)(i) of the Endangered Species Act and the regulations at 50 CFR 424.12, in determining which areas occupied at the time of listing to propose as Critical Habitat, we consider the Primary Constituent Elements (PCE) to be those physical and biological features that are essential to the conservation of the species and that may require special management or protection. The PCEs for *Drosophila mulli* are: (1) wet, montane, ohia forest between the elevations of 596–1,093 meters (1,955–3,585 feet); and (2) the larval stage host plant *Pritchardia beccariana*, which exhibits one or more life stages (from seedlings to senescent individuals).

A Final Rule establishing Critical Habitat for *Drosophila mulli*, went into effect January 5, 2009 (USFWS, 2008). *Drosophila mulli*-Unit 1-Olaa Forest consists of 99 hectares (244 acres) of montane, wet, ohia forest and is located to the northeast of Kilauea Caldera on the southeastern flank of Mauna Loa on the island of Hawaii. Ranging in elevation from 950–1,005 meters (3,120–3,300 feet), this unit is owned by the State of Hawaii and is largely managed as part of a State forest reserve. According to the most recent survey data (K. Kaneshiro, *in litt.* 2005), this unit was occupied by *D. mulli* at the time of listing. This unit includes the known elevation range, moisture regime, and native forest components used by foraging adults that have been identified as the PCEs for this species. This unit also includes populations of *Pritchardia beccariana*, the larval stage host plant associated with this species.

Drosophila mulli-Unit 2-Stainback Forest consists of 31 hectares (76 acres) of montane, wet, ohia forest, and is located to the northeast of Kilauea Caldera on the southeastern flank of Mauna Loa on the island of Hawaii. Ranging in elevation from 595–660 meters (1,955–2,165 feet), this unit is owned by the State of Hawaii and is largely managed as part of a State forest reserve. According to the most recent survey data (K. Kaneshiro, *in litt.* 2005), this unit was occupied by *D. mulli* at the time of listing. This unit includes the known elevation range, moisture regime, and native forest components used by foraging adults that have been identified as the PCEs for this species. This unit also includes populations of *Pritchardia beccariana*, the larval stage host plant associated with this species.

Drosophila mulli-Unit 3-Waiakea Forest consists of 151 hectares (373 acres) of montane, wet, ohia forest, and is located to the northeast of Kilauea Caldera on the southeastern flank of Mauna Loa on the island of Hawaii. Ranging in elevation from 955–1,095 meters (3,130–3,585 feet),

this unit is owned by the State of Hawaii and is largely managed as part of a State forest reserve. According to the most recent survey data (K. Kaneshiro, *in litt.* 2005), this unit was occupied by *D. mulli* at the time of listing. This unit includes the known elevation range, moisture regime, and native forest components used by foraging adults that have been identified as the PCEs for this species. This unit also includes populations of *Pritchardia beccariana*, the larval stage host plant associated with this species.

2.3.1.7 Other:

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Native vegetation on all of the main Hawaiian Islands has undergone extreme alteration because of past and present land management practices, including ranching, introduction of nonnative plants and animals, and agricultural development (Cuddihy and Stone 1990). Lands with suitable *Drosophila mulli* habitats, such as the forests of Hawaii Volcanoes National Park and the Critical Habitat units in the Olaa Forest, Stainback Forest, and Waiakea Forest need management and control for feral ungulates, such as pigs, goats and cattle; yellowjackets, scolytid beetles, and other nonnative insects; rats; and nonnative plants (Smith 1985; Cuddihy and Stone 1990; Science Panel 2005).

Feral ungulates, such as goats, pigs, cattle, and sheep, have devastated native vegetation in many areas of the Hawaiian Islands (Cuddihy and Stone 1990). In addition to the damage these nonnative herbivores cause by browsing and grazing, goats, pigs, and other ungulates that inhabit steep and remote terrain cause severe erosion of whole watersheds due to their foraging and trampling behaviors (Cuddihy and Stone 1990). Disturbance caused by ungulates can lead to invasion of several nonnative plants, particularly *Psidium cattleianum*, *Rubus ellipticus* (yellow Himalayan raspberry), *Passiflora mollissima*, and *Pennisetum setaceum*, contributes to the degradation of picture-wing host plant habitat on the island of Hawaii (Wagner *et al.* 1999; Science Panel 2005). *Psidium cattleianum* and *R. ellipticus* form dense stands that exclude other plant species (Cuddihy and Stone 1990; Wagner *et al.* 1999), and the vine *Passiflora mollissima* overloads the branches of native trees and shades out native plants below (Wagner *et al.* 1999).

Management efforts for *Drosophila mulli* in a forest in the Hawaii Volcanoes National Park that is adjacent to a known *D. mulli* site, are being undertaken to reduce the severity of those threats to its host plant.

As a result of these actions, some regeneration of *Pritchardia beccariana* has been observed (K. Magnacca, pers. comm. 2006). Within *D. mulli*'s second habitat site in the Upper Waiakea Reserve area, ongoing and planned pig fencing is expected to reduce the effects of browsing pigs upon the host plant population (K. Magnacca, *in litt.* 2006). Because of ongoing management efforts benefiting *D. mulli*, and because its host plant can live for 100 years, *D. mulli* is not immediately at risk of extinction.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Overutilization is not known to be a threat to this species.

2.3.2.3 Disease or predation:

Disease is not known to be a threat to any of the Hawaiian picture-wing flies. However, predation by nonnative insects and other arthropods poses a grave threat to Hawaii's native *Drosophila*, through direct predation or possibly parasitism as well as competition for food or space (Howarth and Medeiros 1989; Howarth and Ramsay 1991; Howarth et al. 2001).

The Hawaiian Islands now support several species of nonnative beetles (family Scolytidae, genus *Coccotrypes*), a few of which bore into and feed on the nuts produced by native plant species including *Pritchardia beccariana*, the host plant of *Drosophila mulli*. Affected *Pritchardia* plants drop their fruit before the nuts reach maturity due to the boring action of the scolytid beetles. Little natural regeneration of this host plant species has been observed in the wild since the arrival of this scolytid beetle (K. Magnacca, *in litt.* 2005; Science Panel 2005). *Pritchardia beccariana* is long lived, up to 100 years, but attacks over time by scolytid beetles can have a significant impact on the availability of habitat for *D. mulli*.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Regulatory mechanisms remain inadequate for thorough protection of the species, particularly quarantine regulations pertaining to the prevention of accidentally introduced arthropods, and augmentation and introduction of biological control agents in Hawaii.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Several species of nonnative rats, including the Polynesian rat (*Rattus exulans*), the roof rat (*Rattus rattus*), and the Norway rat (*Rattus norvegicus*), are present on the Hawaiian Islands and cause considerable environmental degradation (Kishinami 2001). The seeds, bark, and flowers of the picture-wing flies' host plant, *Pritchardia beccariana*, are susceptible to herbivory by all the rat species (Science Panel 2005; K.

Magnacca, *in litt.* 2005). The herbivory by rats causes host plant mortality, diminished vigor, and seed predation, resulting in reduced host plant fecundity and viability (Science Panel 2005; K. Magnacca, *in litt.* 2005).

The effects of climate change on picture-wing flies and host-plant range will likely be significant. Life cycle characteristics such as length of larval period and adult longevity are highly dependent on temperature and other environmental factors affected by climate change. In general, stage length and longevity decrease with temperature increase. Fecundity and sex ratio can also be influenced by temperature. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

2.3 Synthesis

Hawaii picture-wing fly, *Drosophila mulli*, is an endangered endemic species found only on the island of Hawaii. *Drosophila mulli* is restricted to the natural distribution of its host plant, *Pritchardia beccariana* (family Arecaceae). Adult flies of *D. mulli* are found only on the leaf undersides of this endemic fan palm, but the exact larval feeding site on this host plant remains unknown. *Drosophila mulli* was recorded in 2001 at its historical site on the Olaa Forest Reserve. In 1999 and 2000, two additional sites occupied by *D. mulli* were recorded.

The host plant can live to 100 years, but nonnative scolytid beetles bore into the plant and feed on the nuts. Affected *Pritchardia* spp. drop their fruit before the nuts reach maturity due to this boring action. Little natural regeneration of the host plant has been observed in the wild since the arrival of this scolytid beetle. The seeds, bark, and flowers of *P. beccariana* are also susceptible to herbivory by all the rat species. The herbivory by rats causes host plant mortality, diminished vigor, and seed predation, resulting in reduced host plant fecundity and viability. Ungulates, such as pigs and goats, damage the plant host and habitat through browsing, trampling, and land disturbance which leads to invasion of nonnative plants and erosion. Currently, existing regulations offer inadequate protection to *Drosophila mulli* from the introduction of nonnative insects and the loss of their host plants.

The Primary Constituent Elements for *Drosophila mulli* are: (1) wet, montane, ohia forest between the elevations of 596–1,093 meters (1,955–3,585 feet) and (2) the larval stage host plant *Pritchardia beccariana*, which exhibits one or more life stages (from seedlings to senescent

individuals). Three Critical Habitat units totaling 281 hectares (693 acres) have been designated for *Drosophila mulli* on the island of Hawaii. These are located in the Olaa, Waiakea, and Stainback Forests.

Management efforts for *Drosophila mulli* in a forest in the Hawaii Volcanoes National Park that is adjacent to a known *D. mulli*-inhabited site, are being undertaken to reduce the severity of those threats to its host plant. As a result of these actions, some regeneration of *Pritchardia beccariana* has been observed. Within *D. mulli*'s second habitat site in the Upper Waiakea Reserve area, ongoing and planned pig fencing is expected to reduce the effects of browsing pigs upon the host plant population. Because of ongoing management efforts benefiting *D. mulli*, and because its host plant can live for 100 years, *D. mulli* is not immediately at risk of extinction. Climate change may significantly impact the life cycle characteristics of *D. mulli* and the range of its host plants. No records of *D. mulli* observations have been reported since the species was listed as threatened under the Endangered Species Act, but surveys have been limited in number. Therefore, *D. mulli* meets the definition of threatened, as it remains likely to become an endangered species within the foreseeable future throughout its range.

3.0 RESULTS

3.1 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist

Extinction

Recovery

Original data for classification in error

No change is needed

3.2 New Recovery Priority Number:

Brief Rationale:

3.3 Listing and Reclassification Priority Number: N/A

Reclassification (from Threatened to Endangered) Priority Number: _____

Reclassification (from Endangered to Threatened) Priority Number: _____

Delisting (regardless of current classification) Priority Number: _____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

1. Conduct surveys for *Drosophila mulli*.
2. Develop and implement a Recovery Plan.
3. Protect *Drosophila mulli* and *Pritchardia beccariana* habitat and control fire, rat, nonnative insects, and ungulate threats.
4. Eliminate or manage nonnative scolytid beetles and other nonnative insects that reduce host plant regeneration and fitness for *Drosophila mulli*.
5. Survey and document predatory threats.
6. Develop and implement a systematic *Drosophila mulli* survey and monitoring plan that includes historic habitats and other suitable habitats.
7. Conduct research to confirm larval stage host plants and evaluate larval resource competition or predation.
8. Evaluate the need to re-establish or supplement *Pritchardia beccariana* and wild picture-wing fly populations within their historical range.

5.0 REFERENCES

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Picture-wing fly
(*Drosophila mulli*)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: _____

Review Conducted By:

Diane Sether, Invertebrate Biologist
Jess Newton, Endangered Species Recovery Program Leader
Assistant Field Supervisor for Endangered Species

Approved Jess Newton Date 8/28/2012
for Field Supervisor, Pacific Islands Fish and Wildlife Office