Picture-wing fly
(Drosophila substenoptera)

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 substenoptera*)

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

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, (808) 792-9400

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from the Hawaiian Islands Final Rule, the Recovery Outline for 12 Hawaiian picture-wing flies, current published and unpublished materials and expert opinions and knowledge on the *Drosophila substenoptera* species.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: Endangered

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.

Two critical habitat units totaling 131 hectares (324 acres) have been designated for *Drosophila substenoptera* on the island of Oahu.

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***
__X_ ***No***

2.2 Recovery Criteria

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

____ ***Yes***
_X__ ***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 substenoptera* 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:
Drosophila substenoptera is found in mesic forest in the Waianae Mountains. 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. Montgomery (1975) reported that the larvae of *Drosophila substenoptera* feed only within the decomposing bark of *Cheirodendron platyphyllum* subspecies *platyphyllum, Cheirodendron trigynum* subspecies *trigynum*, *Tetraplasandra kavaiensis*, and *Tetraplasandra oahuensis* trees, all of which are in the family Araliaceae. These host plants are particularly susceptible to ungulate damage when combined with competition from invasive plants (Magnacca et al., 2008). Management of this taxon will require maintaining these host trees in sufficient numbers and density to allow the perpetual presence of decaying host tree parts.

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 substenoptera* 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*. 2012b).

Drosophila substenoptera is historically known from seven localities in the wet native forest of the Koolau and Waianae Mountains on Oahu at elevations from 395 to 1,220 meters (1,300 to 4,000 feet) above sea level. *Drosophila substenoptera* was most recorded at Palikea in 1977 and on the summit of Mt. Kaala, where historically it was most consistently observed from 1968-1998. *Drosophila* researchers have devoted intensive efforts to relocating this species at other sites because the species is considered important for genetic studies of the *Drosophila planitibia*

phylogeny group. Surveys conducted from 1998 to 2005 failed to relocate this species at other sites (Science Panel 2005).

Currently, this species is known from three locations in the Waianae Mountains. One location is within the Schofield Barracks near Puu Kalena (2,800 ft. elevation). Dr. Steven Montgomery recorded 10 *Drosophila substenoptera* in May 2008 and four in June 2009 at Puu Kalena (OANRP 2008; OANRP 2009). *Drosophila substenoptera* was documented by Karl Magnacca at two additional locations; a site near Puu Palikea in September 2009 and a site near the Kaala Trail on the Makaha Reserve in 2011 (K. Magnacca *in litt*. 2012a). At Puu Palikea, several *D. substenoptera* observations were made over a period of three days, although it is unknown if the same fly was observed multiple times during this period or if multiple flies were present. At the Kaala trail site, one male *D. substenoptera* was observed. Comprehensive surveys for this taxa have not been completed. Surveys are needed in the Koolau Mountains and at under-surveyed parts of the Waianae Mountains.

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:
Hardy (1965) originally described this species as *Idiomyia substenoptera*. He later determined the genus *Idiomyia* to be synonymous with *Drosophila* (Hardy 1969), thus creating the current name of *Drosophila substenoptera*. This species is closely related to *Drosophila planitibia* and its relatives (Kaneshiro *et al*. 1995), but is distinguished by its wing markings, narrow wing shape, and complexity of the male genitalia. *Drosophila substenoptera* is predominantly yellow with two black stripes extending down the entire length of the top surface of the thorax. The legs are yellow and lack long hairs on the dorsal surfaces. Body length is 4.35 millimeters (0.171 inches), and the wings are 5.0 to 5.3 millimeters (0.2 to 0.21 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.):
Seasonal and day-to-day variability of *Drosophila* presence and lack of surveys for historical sites complicates assessing the current range of a species. Historically, *Drosophila substenoptera* was known from seven localities in the wet native forest of the Koolau and Waianae Mountains on Oahu at elevations from 395 to 1,220 meters (1,300 to 4,000 feet) above sea level. Currently, this species is known from three locations in the Waianae Mountains. One location is within the Schofield Barracks near

Puu Kalena. The second site is near Puu Palikea and the third site is near the Kaala trail within the Makaha Reserve. Comprehensive surveys for this species have not been completed. Surveys are needed in the Koolau Mountains and at under-surveyed parts of the Waianae Mountains to better estimate the current range and distribution.

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 substenoptera* are: (1) mesic to wet, lowland to montane, *Metrosideros polymorpha* (ohia) and *Acacia koa* (koa) forest between the elevations of 585–1,228 meters (1,920–4,030 feet); and (2) the larval stage host plants *Cheirodendron platyphyllum* subspecies *platyphyllum, Cheirodendron trigynum* subspecies *trigynum, Tetraplasandra kavaiensis,* and *Tetraplasandra oahuensis,* which exhibit one or more life stages (from seedlings to senescent individuals).

A Final Rule establishing two critical habitat units for *Drosophila substenoptera* went into effect January 5, 2009 (USFWS, 2008). *Drosophila substenoptera*-Unit 1-Mt. Kaala consists of 47 hectares (116 acres) of montane, wet, *Metrosideros polymorpha* (ohia) forest within the northern Waianae Mountains of Oahu. Ranging in elevation from 840–1,230 meters (2,750–4,030 feet), this unit is owned by the City and County of Honolulu and the State of Hawaii, and is largely managed as part of a State forest reserve and natural area reserve.

Drosophila substenoptera-Unit 2-Palikea consists of 84 hectares (208 acres) of lowland, mesic, *Metrosideros polymorpha* (ohia) and *Acacia koa* (koa) forest within the southern Waianae Mountains of Oahu. Ranging in elevation between 585–910 meters (1,920–2,985 feet), this unit is privately and State-owned, and is part of a larger area called the Honouliuli Preserve, administered and managed by The Nature Conservancy of Hawaii.

According to the most recent survey data (K. Kaneshiro *in litt*. 2005; K. Magnacca *in litt.* 2012a), these units were occupied by *Drosophila substenoptera* 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. These units also include populations of *Cheirodendron* spp. and

Tetraplasandra spp., the larval stage host plants 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:

Lands with suitable habitats that are designated as critical habitat units need management and control for feral ungulates, such as pigs and goats; nonnative insects such as ants, yellowjackets, and tipulids; rats; nonnative plants; and wildfire (Cuddihy and Stone 1990; Howarth et al. 2001; Kishinami 2001; Science Panel 2005). The host plants of *D. substenoptera* are highly susceptible to damage by feral ungulates such as pigs and goats, especially when combined with competition from invasive plants (Magnacca et al., 2008). The invasion of several nonnative plants, particularly *Psidium cattleianum* (strawberry guava) and *Clidemia hirta* (Koster's curse), further contributes to the degradation of native forests and the host plants of picture-wing flies (Wagner *et al.* 1999; Science Panel 2005). *Psidium cattleianum* can form dense stands, thickets, or mats that shade or outcompete native plants. *Melinis minutiflora* is a grass that increases fire risk and tends to replace native plants following fires (Smith 1985; Cuddihy and Stone 1990; Wagner *et al*. 1999), and *Lantana camara* produces chemicals that inhibit the growth of other plant species (Smith 1985; Wagner *et al*. 1999). *Passiflora mollissima* (banana poka) is a vine that causes damage or death to native trees by overloading the branches and also shades out native plants beneath its dense canopy cover (Wagner *et al*. 1999).

Fire threatens the picture-wing flies living in forests on Oahu. A large factor in the alteration of Hawaiian lowland mesic regions in the past 200 years has been the increase in fire frequency, a condition to which the native flora is not adapted. The invasion of fire-adapted alien plants, especially *Melinis minutiflora*, facilitated by ungulate disturbance, has increased the susceptibility of native areas to wildfire and increased fire frequency. The impact of an altered fire regime is a serious and immediate threat to the mesic habitats (Hughes *et al*. 1991; Blackmore and Vitousek 2000). The Waianae Mountains are very susceptible to wildfire from a variety of sources, Army training, agriculture, and arson.

The Oahu Army Natural Resources Program, U.S. Army Garrison, Hawaii completed an Integrated Natural Resource Management Plan (INRMP) for Schofield Barracks in 2000. This INRMP includes several conservation measures that benefit *Drosophila substenoptera.* The measures include:

(1) outplanting of native plants, which provides for the natural forest conditions necessary for adult fly foraging; (2) feral ungulate control, which prevents both direct loss of the larval stage host plants and adult foraging substrate and prevents habitat alteration by feral ungulates; and (3) nonnative plant control, which prevents habitat alteration.

The Final Implementation Plan for the Makua Military Reservation, Oahu, includes a stabilization plan for *Drosophila substemoptera* on lands within Schofield Barracks (OANRP 2010). This plan includes a wildfire management plan to minimize risk of fire during Army training, managing ungulates through fencing, conducting weed control, monitoring for alien predatory insects, and expanding habitat restoration. The plan also includes surveys for *D. substenoptera* in the Waianae and Koolau Mountains at the Kawailoa Training Area and Schofield Barracks, East Range.

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). *Drosophila substenoptera* flies at all life stages, face substantial predation pressure from nonnative insects such as western yellowjacket wasps. The *D. substenoptera* larval stage faces resource competition from nonnative tipulid flies (crane flies, family *Tipulidae*) which also feed within the decomposing bark of *Cheirodendron* sp. (Science Panel 2005). Currently, existing regulations offer inadequate protection to these species from the introduction of nonnative insects and the loss of their host plants.

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 larval host plants sp. may be susceptible to herbivory by rats (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 may also be influenced by temperature in some species. 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.

2.4 Synthesis

Hawaii picture-wing fly, *Drosophila substenoptera* is an endangered endemic species found only on the island of Oahu. The larvae of *D. substenoptera* feed only within the decomposing bark of *Cheirodendron platyphyllum* ssp. *Platyphyllum* and *C. trigynum* ssp. *Trigynum, Tetraplasandra kavaiensis,* and *T. oahuensis* trees (Family *Araliaceae*). *Tetraplasandra* spp. are particularly vulnerable to ungulate damage, especially when combined with competition from invasive plants. Management of this taxon will require maintaining these host trees in sufficient numbers and density to allow the perpetual presence of decaying host tree parts.

Historically, *Drosophila substenoptera* was known in seven localities found in the wet native forest of the Koolau and Waianae Mountains on Oahu at elevations from 395 to 1,220 meters (1,300 to 4,000 feet) above sea level. Currently, this species is known from three locations in the Waianae Mountains. One location is within the Schofield Barracks near Puu Kalena; a second site is near Puu Palikea (2,900 ft. elevation) and a third is near the Kaala Trail within the Makaha Reserve. Comprehensive surveys for this taxa have not been completed. Surveys are needed in the Koolau Mountains and at under-surveyed parts of the Waianae Mountains.

The Primary Constitutive Elements for *Drosophila substenoptera* are: (1) mesic to wet, lowland to montane, *Metrosideros polymorpha* (ohia) and *Acacia koa* (koa) forest between the elevations of 585–1,228 meters (1,920–4,030 feet); and (2) the larval stage host plants *Cheirodendron platyphyllum* subspecies *platyphyllum, Cheirodendron trigynum* subspecies *trigynum, Tetraplasandra kavaiensis,* and *Tetraplasandra oahuensis,* which exhibit one or more life stages (from seedlings

to senescent individuals). On January 5, 2009, the Final Rule establishing critical habitat for *D. substenoptera* went into effect. Two critical habitat units totaling 131 hectares (324 acres) have been designated for *D. substenoptera* on the island of Oahu. The two units are largely managed as part of a forest and natural area reserves.

The Oahu Army Natural Resources Program, U.S. Army Garrison, Hawaii has developed a stabilization plan for *Drosophila substenoptera* on lands within Schofield Barracks. This plan includes a wildfire management plan to minimize risk of fire during Army training, managing ungulates through fencing, conducting weed control, monitoring for alien predatory insects, and expanding habitat restoration.

Current threats to *Drosophila substenoptera* include feral ungulates such as goats and pigs; nonnative insects such as yellowjacket wasps, ants, and tipulids; rats; invasive plants; and wildfire. Lands with suitable habitats and those designated as critical habitat need management and control for these threats. Currently, existing regulations offer inadequate protection to these species from the introduction of nonnative insects and the loss of their host plants. Climate change may significantly impact the life cycle characteristics of *D. substenoptera* and the range of its host plants. A draft recovery plan for this species is being developed.

Eighteen observations of *Drosophila substenoptera* have been reported from only three of seven historic locations since the species was listed as endangered under the Endangered Species Act. Although some management is occurring, most threats are not being managed throughout the species range. Therefore, *D. substenoptera* meets the definition of endangered, as it remains in danger of extinction 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*
__X__ 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. Develop and implement a Recovery Plan.

2. Protect the habitat of *Drosophila substenoptera* and its larval plant host plants *Cheirodendron platyphyllum* subspecies *platyphyllum*, *Cheirodendron trigynum* subspecies *trigynum*, *Tetraplasandra kavaiensis*, and *Tetraplasandra oahuensis*, and control fire, rat, nonnative insect, and ungulate threats.

3. Eliminate or manage nonnative plants that compete with *Drosophila substenoptera* host plants and increase wildfire risk.

4. Survey and document predatory threats.

5. Develop and implement a systematic *Drosophila substenoptera* survey and monitoring plan that includes historic habitats and other suitable habitats in the Waianae and Koolau Mountains.

6. Evaluate the need to re-establish or supplement *Drosophila substenoptera* and host plant populations within their historical and current range.

7. Conduct research to identify additional larvae and adult host range.

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ 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 _____ Date 8/28/2012
for **Field Supervisor, Pacific Islands Fish and Wildlife Office**