

Picture-wing fly
(Drosophila differens)

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 differens*)

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

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from the Hawaiian Islands Final Rule, the Recovery Outline for 12 Hawaiian picture-wing flies, current published and unpublished materials and expert opinions and knowledge on the *Drosophila differens* species.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

One Critical Habitat unit totaling 400 hectares (988 acres) has been designated for *Drosophila differens* on the island of Molokai.

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

No

2.1.2 Is the species under review listed as a DPS?

Yes

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 differens* 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. *Drosophila differens* is restricted to the natural distribution of its host plants, *Clermontia arborescens* (family Campanulaceae), *Clermontia grandiflora* subspecies *munroi*, *Clermontia kakeana*, *Clermontia oblongifolia* subspecies *brevipes* listed as endangered, and *Clermontia pallida*. Montgomery (1975) found that *D. differens* larvae feed within the decomposing bark and stems of *Clermontia* sp. (family Campanulaceae) in wet rainforest habitat.

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 *D. differens* 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).

During 40 surveys between years 1965 and 1999, 63 individuals were recorded (Table). At Hanalilolilo, the species was observed on eight survey dates between 1967 and 1983, but was not observed on three subsequent survey dates, the most recent being 1999. At a second site, Kaunuohua, which was only surveyed twice, individuals were observed in 1969 but not in 1999. At the third site, Puu Kolekole, individuals were documented in 1969 and again in 1999 (K. Kaneshiro, *in litt.* 2005). Approximately 10 to 25 percent of *D. differens*' potential habitat on steep, difficult-to-access areas surrounding its known range remains unsurveyed for the species (Science Panel 2005; K. Kaneshiro, *pers. comm.* 2006). The last observation of this species occurred in March 1999 during a survey of Puu Kolekole, making it difficult to estimate population demographics and abundance.

TABLE. Total number of surveys (first number), number of surveys with *Drosophila differens* fly observations (second number), and total number of *D. differens* observed (third number) from 1965-2011 at Hanalilolilo and Puu Kolekole on Molokai.

Years	Total No. surveys/No. of surveys with <i>Drosophila differens</i> / Total number of flies observed		
	Hanalilolilo	Kaunuohua	Puu Kolekole
1965-1969	9/1/1	1/1/2	3/1/3
1970-1974	4/3/31		2/0/0
1975-1979	9/3/19		
1980-1984	2/1/5		1/0/0
1985-1989	1/0/0		
1990-1994			
1995-1999	2/0/0	1/0/0	5/1/2

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 differens* was described by Hardy and Kaneshiro (1975) from specimens first recorded at South Hanalilolilo, Molokai, in 1972. This species is larger than most picture-wings, approximately 7.0 millimeters (0.3 inches) in length, with wings 8.3 millimeters (0.3 inches) long. *Drosophila differens* has an entirely or predominantly yellow face and characteristic markings extending to the tip of the wings. The picture wing group is divided into four major subgroups based on maps of chromosomal inversions. *Drosophila differens* is in the plantitibia subgroup (Edwards et al., 2007).

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 differens was first recorded in 1972 at South Hanalilolilo, on the island of Molokai (Hardy and Kaneshiro, 1975). Found only on Molokai, *D. differens* is historically known from three sites on private land between 1,115 to 1,370 meters (3,650 and 4,500 feet) above sea level, within montane wet *Metrosideros polymorpha* forest (Hawaii Biodiversity and Mapping Program, 2005; K. Kaneshiro, *in litt.* 2005). Montgomery (1975) found that *D. differens* larvae feed within the decomposing bark

and stems of *Clermontia* sp. (family Campanulaceae) in wet rainforest habitat.

Seasonal and day-to-day variability of *Drosophila* presence and detection with baits significantly complicates assessing the range of a species. During 40 surveys between 1965 and 1999, 63 *Drosophila differens* individuals were recorded (see Table in Section 3.2.1.2). At Hanalilolilo, the species was observed on eight survey dates between 1967 and 1983, but was not observed on three subsequent survey dates, the most recent being 1999. At a second site, Kaunuohua, which was only surveyed twice, individuals were observed in 1969 but not in 1999. At the third site, Puu Kolekole, individuals were documented in 1969 and again in 1999 (K. Kaneshiro, *in litt.*, 2005). Approximately 10 to 25 percent of the species' potential habitat on steep, difficult to access areas on State Natural Area Reserve lands surrounding its known range remains unsurveyed for the species (Science Panel 2005; K. Kaneshiro, *pers. comm.* 2006). The last observation of this species occurred in March 1999 during a survey of Puu Kolekole. No survey results for *D. differens* have been reported since 1999 making it difficult to determine the spatial 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 conservation of the species and that may require special management for protection. The PCE for *Drosophila differens* are: (1) Wet, montane, ohia forest between the elevations of 1,111–1,370 meters (3,645–4,495 feet); and (2) the larval stage host plants *Clermontia arborescens* subspecies *waihia*, *Clermontia granidiflora* subspecies *munroi*, *Clermontia kakeana*, *Clermontia pallida*, and *Clermontia oblongifolia* subspecies *brevipes*, and which exhibit one or more life stages ranging from seedlings to senescent individuals (USFWS, 2008).

A Final Rule establishing Critical Habitat for *Drosophila differens* went into effect January 5, 2009 (USFWS, 2008). *Drosophila differens*-Unit 1-Puu Kolekole consists of 400 hectares (988 acres) of montane, wet, ohia forest within the eastern Molokai mountain range on the island of Molokai. Ranging in elevation between 1,110–1,370 meters (3,645–4,495 feet), this unit is privately owned and is managed by The Nature Conservancy of Hawaii as part of the Kamakou and Pelekunu preserves. According to the most recent survey data (K. Kaneshiro, *in litt.* 2005), this unit was occupied by *D. differens* 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 *Clermontia* sp., 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:

Drosophila differens larvae feed within the decomposing bark and stems of *Clermontia* spp. One of these host species, *C. oblongifolia* subspecies *brevipes*, is also listed as endangered. 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 *D. differens* habitats, such as the Kamakou Preserve and the Critical Habitat unit in the Kamakou Preserve, need management and control for feral ungulates, such as pigs, goats and axis deer; yellowjackets, tipulids, and other nonnative insects; rats; and nonnative plants such as *Psidium cattleianum* (Smith, 1985; Cuddihy and Stone 1990; Science Panel 2005).

Kamakou Preserve is managed by The Nature Conservancy of Hawaii. The primary management goals within Kamakou Preserve are to prevent degradation of native forest by reducing feral ungulate damage, suppressing wildfires, and improving or maintaining the integrity of native ecosystems in selected areas of the preserve by reducing the effects of nonnative plants. Specific management actions to address feral ungulate impacts include the construction of fences, including strategic fencing (fences placed in proximity to natural barriers such as cliffs); staff hunting; and implementation of organized hunting through the Molokai Hunters Working Group. By monitoring ungulate activity within the preserve, the staff are able to direct hunters to problem areas (areas of high feral ungulate densities), thereby increasing hunting success. If increased hunting pressure does not reduce feral ungulate activity in the preserve, the preserve staff will work with the hunting group to identify and implement alternative methods for their control.

The nonnative plant control program within Kamakou Preserve focuses on habitat-modifying nonnative plants (weeds) and prioritizes their control according to the degree of threat to native ecosystems. A weed priority list has been compiled for the preserve, and control and monitoring of the highest priority species are ongoing. Weeds are controlled manually, chemically, or through a combination of both techniques. Preventive measures (prevention protocol to keep weeds out) are required by all who

enter the preserve. This protocol includes such things as brushing footwear before entering the preserve to remove seeds of nonnative plants. In addition, the preserve staff actively promote awareness of detrimental nonnative plants in Hawaii and their impacts to native ecosystems in the local communities on Molokai through public education at schools, fairs, and displays at the airport.

Wildfire pre-suppression and response plans are coordinated with the Maui County Fire Department and the Department of Land and Natural Resources Maui District Forester. The Kamakou Wildfire Management Plan is reviewed annually with the fire department and updated as necessary. Vegetation is monitored throughout the preserve to document long-term ecological changes; rare plant species are monitored to assess population status; and, following fires on the boundaries or within the preserve, burned areas are assessed for ingress of weeds and recovery of native plants. In addition, the preserve staff provides logistical support to scientists and others who are conducting research within the preserve.

In addition, The Nature Conservancy of Hawaii, Department of Land and Natural Resources, USFWS, other Federal agencies including the National Park Service, and neighboring landowners of East Molokai's watershed areas have formed a partnership (East Molokai Watershed Partnership) through a memorandum of understanding to ensure the protection of over 8,903 hectares (22,000 acres) of land on the island. The members have agreed, in principle, to participate in cooperative management activities within the East Molokai watershed because they believe that effective management is best achieved through the coordinated actions of all major landowners in the watershed.

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 differens flies at all life stages, face substantial predation pressure from nonnative insects such as yellowjacket wasps. The *D. differens* larval stage, faces resource competition from nonnative tipulid flies (crane flies, family Tipulidae) which also feed within the decomposing bark of *Clermontia* spp. (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 several of the picture-wing flies' host plants, including *Clermontia* spp., 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.

2.4 Synthesis

Hawaii picture-wing fly, *Drosophila differens*, is an endangered endemic species found only on the island of Molokai. *Drosophila differens* is restricted to the natural distribution of its host plants, *Clermontia* spp. (family Campanulaceae). Montgomery (1975) found that *D. differens* larvae feed within the decomposing bark and stems of *Clermontia* sp. hosts in wet rainforest habitat.

The Primary Constitutive Elements (PCE) for *Drosophila differens* are: (1) Wet, montane, ohia forest between the elevations of 1,111–1,370 meters (3,645–4,495 feet); and (2) the larval stage host plants *Clermontia arborescens* subspecies *waihia*, *Clermontia granidiflora* subspecies *munroi*, *Clermontia kakeana*, *Clermontia oblongifolia* subspecies *brevipes*, and *Clermontia pallida*, which exhibit one or more age classes, from seedlings to senescent phases. On January

5, 2009, the Final Rule establishing Critical Habitat (CH) for *D. differens*, went into effect. CH, designated *Drosophila differens*—Unit 1—Puu Kolekole consists of 400 hectares (988 acres) of montane, wet, *Metrosideros polymorpha* (ohia) forest within the eastern Molokai mountain range on the island of Molokai. According to the most recent survey data this unit was occupied by *D. differens* at the time of listing.

Current threats to *Drosophila differens* include feral ungulates, such as goats, pigs, and axis deer; yellowjackets, tipulids, and other nonnative insects; rats; invasive plants, and wildfire. Lands with suitable habitats, such as Kamakou Preserve and that 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 will significantly impact the life cycle characteristics of *D. differens* and the range of its host plants. A draft recovery plan for this species is being developed.

New observations of *Drosophila differens* have not been reported since the species was listed as endangered under the Endangered Species Act. Most threats are not being managed. Therefore, *D. differens* 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

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 *Drosophila differens* and *Clermontia* spp. habitat and control fire, rat, nonnative insects, and ungulate threats.
3. Eliminate or manage nonnative *Psidium cattleianum* plants and other invasive plants that compete with *Clermontia* spp. and increase wildfire risk.
4. Survey and document predatory threats.
5. Develop and implement a systematic *Drosophila differens* survey and monitoring plan that includes historic habitats and other suitable habitats.
6. Evaluate the need to re-establish or supplement *Clermontia* spp. 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 differens*)

Current Classification: Endangered

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