

Pacific Hawaiian damselfly
(Megalagrion pacificum)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawai'i

5-YEAR REVIEW

Species reviewed: Pacific Hawaiian damselfly (*Megalagrion pacificum*)

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5-YEAR REVIEW
Pacific Hawaiian damselfly/*Megalagrion pacificum*

1.0 GENERAL INFORMATION

1.1 Reviewers

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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 January 22, 2018. The review is based on the final rule to list the Pacific Hawaiian damselfly, the recovery outline for two Hawaiian damselflies signed March 14, 2011, current published and unpublished materials, and expert opinions and knowledge on the *Megalagrion pacificum* species. The draft 5-year review was then reviewed by the Animal Recovery Coordinator and the Conservation and Restoration Team Manager before being signed for the Pacific Islands Fish and Wildlife Office Field Supervisor.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and threatened wildlife and plants; initiation of 5-year status reviews for 18 species in Hawaii, Oregon, Washington, Idaho, and Canada. Federal Register 83(14):3014-3015.

1.3.2 Listing history

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; listing the flying earwig Hawaiian damselfly and Pacific Hawaiian damselfly as endangered throughout their ranges. Federal Register 75 (121):35990-36012.

Date listed: June 24, 2010

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: N/A

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

[USFWS] U.S. Fish and Wildlife Service. 2011. Recovery outline for two Hawaiian damselflies. U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawai'i. 20 pp.

<https://www.fws.gov/pacific/ecoservices/endangered/recovery/documents/HI%20Damselflies%20Outline%20signed%20031511.pdf>

Name of plan or outline: Recovery outline for two Hawaiian damselflies

Date issued: March 2011

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:

No final recovery plan for *Megalagrion pacificum* had been developed at the time of completion of 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:

No new information on Pacific Hawaiian damselfly, *Megalagrion pacificum*, biology or life history has become known since being listed in 2010. The Pacific Hawaiian damselfly is an insect in the order Odonata and is endemic to the Hawaiian islands. In brief, the adult and immature (naiad) stages of this damselfly, or pinapinao (a Hawaiian name referring to damselflies), are predaceous. The naiad stage is aquatic and feeds on small aquatic invertebrates (Polhemus and Asquith 1996). The aquatic naiad stage lasts approximately 4 months, after which the mature naiads crawl out of the water and molt into winged adults. The adults remain in close proximity to the aquatic habitat from where they emerged (Moore and Gagné 1982, USFWS 2011). Adult pinapinao males are territorial and guard the area where females lay their eggs. During copulation, the male tightly holds the head of the female to protect the females against rival males and why pinapinao are commonly seen flying in tandem (USFWS 2011). Pacific Hawaiian damselflies are distinguished from other Hawaiian damselflies by the long lower abdominal appendages of the male (USFWS 2010).

Pacific Hawaiian damselflies historically were known to breed in lentic systems including marshes, seepage fed pools, large ponds, and quiet pools in gulches, usually in areas with dense surrounding vegetation. Their historic distribution was below 2,000 feet (600 meters) on all Hawaiian islands except Kaho'olawe and Ni'ihau (Polhemus and Asquith 1996, USFWS 2010, 2011). Observations confirmed that the Pacific Hawaiian damselfly is no longer found in lentic habitats in Hawai'i due to predation by nonnative fish and are restricted to seepage-fed pools of perennial streams surrounded by thick vegetation (Moore and Gagné 1982, Englund et al 2007, USFWS 2010). Adults do not stray far from the vicinity of the breeding pools and are rarely seen along main stream channels. Pacific damselflies do not disperse over long distances compared to other Hawaiian damselfies (Jordan et al 2007, USFWS 2011).

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:

Little is known about the abundance, population trends, and demographic features of the Pacific Hawaiian damselfly. The Pacific Hawaiian damselfly is believed to be extirpated from O'ahu, Kaua'i, and Lāna'i. In 1998, it was believed it was extirpated from Hawai'i island but one population was discovered in a small stream known to be occupied by

nonnative fish (Englund 1998, USFWS 2011). A survey of the one population on the island of Hawai‘i has not been completed since 1998. On Moloka‘i, there are at least seven streams populated by Pacific Hawaiian damselfly and 14 streams on Maui (USFWS 2010, 2011). There is no quantitative estimate of population size.

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

Apparent limits of the current Pacific Hawaiian damselfly population, relatively low dispersal, and long distances between known populations will likely reduce genetic diversity and may lead to inbreeding depression.

2.3.1.4 Taxonomic classification or changes in nomenclature:

No changes in taxonomic classification have occurred.

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.):

Historically, Pacific Hawaiian damselflies were noted on all Hawaiian islands except Kaho‘olawe and Ni‘ihau (Polhemus and Asquith 1996, USFWS 2010, 2011). At the end of the 19th century the Pacific Hawaiian damselfly was described as the most common and widespread of the native damselfly species (Howarth (1991). Due to the effects of nonnative fish introduced to control mosquitoes, a decline in this species was observed as early as 1905 (USFWS 2010).

A possible sighting of an adult Pacific Hawaiian damselfly occurred during 2009-2010 USGS surveys at 40 sites of 25 perennial streams on Maui where surveyors could wade (Wolff 2012). In May 2015, 10 sites were surveyed for pinapinao along the entire length of the Waioni stream corridor west of Hāna, Maui. Pacific Hawaiian damselfly was not observed, though three other native species of pinapinao were (Dan Polhemus 2015, personal communication). Follow up surveys of Waioni stream were conducted in 2017 for presence of any listed pinapinao (Polhemus 2017). The two-day survey concluded that listed pinapinao were not present at the 11 survey stations of Waioni stream. Currently, Pacific Hawaiian damselflies are found on Maui and Moloka‘i with one population found on Hawai‘i island (USFWS 2010, 2011).

Day-to-day variability of *Megalagrion* species presence and lack of surveys for historical sites complicates assessing the current status and range of this species. Pinapinao are very sensitive to changes in the weather and are rarely seen on cold, rainy, or blustery days, being more active during warm sunny days, which can affect detectability during

surveys (Polhemus and Asquith, 1996). The absence of adult native pinapinao at some of the study sites during the USGS surveys from 2009 to 2010 may have been a consequence of suboptimal weather conditions during the sampling periods, as it was not practical to sample only during optimal weather conditions (Wolff 2012).

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

Critical habitat has not been identified for the Pacific Hawaiian damselfly. It is known from observations that this species is almost completely restricted to seepage-fed pools along overflow channels in perennial streams along terminal reaches and surrounded by thick vegetation (Moore and Gagne 1982, Englund et al 2007, USFWS 2011). Extensive stream and wetland conversion, alteration or modification, and predation of nonnative fish has reduced available habitat for the species (USFWS 2010). Recent state Commission of Water Resource Management decisions to restore stream flows and reduce or eliminate flow diversions in East Maui watershed may provide future suitable habitat if nonnative predatory fish are excluded (DLNR 2018).

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:

Degradation, modification, and destruction of native riparian streams threaten the existence of the Pacific Hawaiian damselfly. The factors that contribute to these detriments are stream diversion and channelization, agricultural and urban development, improper water well placement, dewatering of aquifers, invasive plants, hurricanes, landslides, and drought (USFWS 2011). The ongoing and likely increasing effects of global climate change such as increasing temperature and changing rainfall patterns are also likely to directly or indirectly impact the stream habitat of the pinapinao in general.

Ongoing and extensive stream diversions continue to degrade the quality of the Pacific Hawaiian damselfly habitat and its capability to support viable populations (USFWS 2011). The invasive nonnative *Urochloa mutica* (California grass) continues to altar marshland habitat for Pacific Hawaiian damselfly into meadowlands not suitable for the species (USFWS 2010, 2011). The combination of restricted range, limited habitat quantity and quality, and low population size makes the Pacific Hawaiian damselfly especially vulnerable to extinction (USFWS 2011).

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

Over collection is currently not known to be a threat to the Pacific Hawaiian damselfly (USFWS 2011).

2.3.2.3 Disease or predation:

Predation by nonnative animal species (fish, bullfrogs, ants, and backswimmers) poses a significant threat to the Pacific Hawaiian damselfly throughout its current and historical range for the reasons that follow.

Nonnative fish – Predation by nonnative fish is a significant threat to pinapinao species with aquatic life stages, such as the Pacific Hawaiian damselfly (USFWS 2010). The Pacific Hawaiian damselfly naiads are particularly vulnerable to predation from nonnative fish, especially species within the Poeciliidae family, as they feed and rest near the surface of the water (USFWS 2010). The absence of Pacific Hawaiian damselflies, and other pinapinao in many streams and aquatic habitat in the main Hawaiian Islands, strongly correlates with the presence of predatory nonnative fish (Englund 1999, 2004, Englund et al 2007). Predation of nonnative fish is considered an immediate and significant threat to the Pacific Hawaiian damselfly (USFWS 2011).

Bullfrogs – Nonnative bullfrogs, *Rana catesbeiana*, are strongly correlated with the absence of Hawaiian damselflies (Englund et al 2007). Bullfrogs are reported on all of the main Hawaiian islands (IUCN 2015). The bullfrog prefers habitats with dense vegetation and relatively calm water (Bury and Whelan 1985). Because of this behavior, it is likely of particular threat to the Pacific Hawaiian damselfly because this species also prefers calm water habitat. Bullfrog tadpoles feed mainly on aquatic plants and some invertebrates. Adults consume a wide range of animals, including insects (Bury and Whelan 1985). Capable of breeding within small pools of water, bullfrog tadpoles and adults are a potential threat to the Pacific Hawaiian damselfly naiads and adults

Ants – Nonnative, predatory ant species pose a threat to Pacific Hawaiian damselfly naiads. These life stages are vulnerable to predation when emerging from the water for metamorphosis to adults. The range of the Pacific Hawaiian damselfly overlaps with that of several particularly aggressive, nonnative, predatory ant species. Notable predatory species that pose a direct threat include the big headed ant, *Pheidole megalcephala*, the long-legged ant (also known as yellow crazy ants), *Anoplolepis gracilipes*, Argentine ant, *Linepithema humile*, and *Solenopsis papuana* that currently occur on all of the main Hawaiian Islands (Reimer 1993, Bertelsmeier et al 2015, Krushelnycky et al 2017). Based on observations by Dr. David Foote of the U.S. Geological Survey (pers comm 2008), long-legged ants threaten populations of Pacific Hawaiian damselflies in mesic areas up to 2,000ft (600m) in elevation. Numerous

other ant species are also recognized as threats to Hawaii's native invertebrates that may include the pinapinao. In addition, an unknown number of new species of ants are established every few years (Staples and Cowie 2001).

Backswimmers – Backswimmers are nonnative, aquatic insects in the family Notonectidae, that may prey on aquatic pinapinao naiads in streams and other aquatic habitat. Several species (*Anisops kuroiwae*, *Buena pallipes*, and *Notonecta indica*) are established on the islands of Maui, Hawai'i, Lāna'i, and O'ahu (USFWS 2016). The presence of backswimmers in pinapinao aquatic habitat causes a reduction in naiad foraging behavior which reduces their growth, development, and survival (USFWS 2010 & 2011). Backswimmers are reported on all main Hawaiian islands except for Kaho'olawe and are considered a threat to Pacific Hawaiian damselflies since this predatory species has an aquatic life stage. Without controlling or eliminating nonnative backswimmers, the USFWS (2011) expects this threat to continue or increase over time.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

The State of Hawai'i considers all natural flowing surface water (streams, springs, and seeps) as State property (Hawai'i Revised Statutes 174c 1987). The State Water Code has the regulatory mechanism in place to protect this species or their habitat. Historically, water regulations have not been followed or enforced in a consistent manner by the State's Water Commission to prevent degradation of habitat. Administration of the Clean Water Act permitting program by the U.S. Army Corps of Engineers has not provided substantive protection of damselfly habitat, including any requirements for retention of adequate instream flows. In June 2018, the State of Hawaii Commission on Water Resource Management ordered the full restoration of flows to 10 streams in Maui and ordered no, or limited diversions, for seven streams in the east Maui watershed (DLNR 2018). The Commission's decision will return free flowing water, with no upstream diversions, to the following streams: Hanehoi, Honopū, Huelo, Kualani, Makapipi, 'Ōhi'a (Waianui), Palauhulu, Pi'ina'au, Wailuanui, and Waiokamilo. The majority of these 10 streams have been diverted for over 100 years. The Commission's decision also orders East Wailua Iki, Honomanū, Kopiliula, Waikamoi, Punalau/Kōlea, Waiohue, and West Wailua Iki streams to have limited or no water diversions in order to foster improved habitat for native fish and other stream animals. The two exceptions are Waiohue and West Wailua Iki streams which are to remain un-diverted so that total flow is restored as habitat reference streams and important estuaries.

The historical loss of stream habitat, resulting in the present curtailment of habitat available to the Pacific Hawaiian damselfly, combined with the threat of predation by nonnative fish in the remaining stream habitat,

continues to restrict and reduce the amount of habitat potentially available to this species. As water is returned to stream systems, the amount of habitat available to the Pacific Hawaiian damselfly may increase if the water return were to be implemented carefully to prevent the spread of nonnative fish species upstream (USFWS 2010).

State and Federal regulatory mechanisms are not adequately controlling the spread of nonnative animal species between islands and watersheds. Predation by nonnative animal species poses a major ongoing threat to the Pacific Hawaiian damselfly. Because existing regulatory mechanisms are inadequate to maintain aquatic habitat for the damselflies and to regulate the spread of nonnative species, the inadequacy of existing regulatory mechanisms continues to be a significant and immediate threat.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Coqui frogs – Coqui frogs, *Eleutherodactylus coqui*, were introduced to the State of Hawai‘i in the late 1980s (Woolbright et al 2006) and are present on Maui and Hawai‘i island. The frogs have limited predators (mongoose, rats, and feral cats) enabling them to become successful invaders across wet forest habitats and allowing their populations to grow extraordinarily dense compared to in their native habitat of Puerto Rico (Woolbright et al. 2006). On Maui, populations of frogs are known in and around nurseries and hotels, residential areas, and there are several large populations in natural areas (Maui Invasive Species Committee 2018). It could likely expand into the habitat of the Pacific Hawaiian damselfly where it will compete for food resources. An analysis of coqui frog diets at lowland sites on the islands of Hawai‘i and Maui found many invertebrates consumed by the frogs were leaf litter insects, however, a large number of flying insects were also present, indicating that these frogs are actively foraging while climbing vegetation (Beard 2007). If conditions are wet, all size classes of the frog may forage higher off the ground (Townsend 1986), therefore allowing for aerial insect consumption to be more likely. The frogs have the ability to consume 4,500–56,000 prey/hectare/night, with 1,500–19,000 of these being aerial insects (Bernard and Mautz 2016). The small size of the coqui frog would likely limit this species’ ability to prey on Pacific Hawaiian damselfly adults or on the terrestrial naiad stage during molting to the adult stage. However, invasion of the pinapinao habitat by coqui and the high density the coqui are known to achieve, poses a likely threat through competition for aerial and terrestrial resources given the small dispersal distance of the Pacific Hawaiian damselfly.

The Pacific Hawaiian damselfly is subject to reduced levels of reproductive vigor due to inbreeding depression from isolated populations and subject

to reduced genetic variability that may diminish their capacity to adapt to environmental changes and lessening their long-term persistence (USFWS 2010 and 2011). Catastrophic events, such as landslides or hurricanes, could result in the extirpation of the Pacific Hawaiian damselfly due to their several small, dispersed populations. Pinapinao with few populations are less resilient to threats but might be minor impacts to species with larger populations. Redundancy for the species to survive stochastic events has been lost as a result in the extreme reduction of their range (USFWS 2011).

Table 1. Threats to *Megalagrion pacificum* and ongoing conservation or management actions.

Threats	Listing Factor	Current Status	Conservation or Management Actions
Agriculture/urban development	A	Ongoing	Agriculture and urban development continue to pose a threat to the pinapinao habitat through encroachment and modification of water resources.
Stream alteration	A	Ongoing	Removal and reduction of stream flow diversions has been ordered on 17 streams in east Maui. Ongoing and extensive stream diversion and channelization continues to degrade the quantity and quality of pinapinao habitat elsewhere on Maui and Hawai'i islands.
Habitat modification by nonnative plants	A	Ongoing	Nonnative plants that turn marshes into meadowlands and modify the riparian community lower or destroy the capability of the habitat to support viable populations of the Pacific Hawaiian damselfly.
Stochastic events	A	Ongoing	The extreme reduction in range and dispersed populations put Pacific Hawaiian damselflies at risk of extirpation.
Climate change	A	Ongoing	Climate change is expected to affect water levels of streams. Reduced genetic diversity of the remaining population may limit the ability of the Pacific Hawaiian damselfly to adapt.
Predation	C	Ongoing	Nonnative fish, backswimmers, ants, and bullfrogs pose a threat to Pacific Hawaiian damselfly throughout their habitat.
Inadequate habitat protection	D	Ongoing	The State of Hawai'i considers all natural flowing surface water (streams springs, and seeps) as State property (Hawai'i Revised Statues 174c 1987). Historically, the State's Water Commission has not consistently enforced State Water Code regulations to protect pinapinao stream habitat. Recent ordering of stream flow restoration in the east Maui watershed may provide an increase in the amount of habitat available to the Pacific Hawaiian damselfly if the water return were to be implemented carefully to prevent the spread of nonnative fish species upstream.
Limited populations	E	Ongoing	<i>Megalagrion pacificum</i> is restricted to one population on Hawai'i island, seven streams on Moloka'i, and 14 streams on Maui with an unknown population estimate at each stream location. The species appears to have low representation, resiliency, and redundancy.
Competition for food resources	E	Ongoing	Coqui frog would compete with the pinapinao for food resources should the frog become established in the Pacific Hawaiian damselfly habitat.

2.4 Synthesis

The Pacific Hawaiian damselfly, *Megalagrion pacificum*, is an endangered endemic species historically known to breed in lentic systems including marshes, seepage-fed pools, large ponds, and quiet pools in gulches, and its presence was known from below 2,000ft (600m) on all Hawaiian islands except Kaho‘olawe and Ni‘ihau, but now believed to be limited to the islands of Maui and Moloka‘i and one population found in 1998 on Hawai‘i island. Observations confirmed that the Pacific Hawaiian damselfly is no longer found in lentic habitats in Hawai‘i due to predation by nonnative fish and are now believed to be restricted to seepage-fed pools of perennial streams surrounded by thick vegetation. Adults do not stray far from the vicinity of the breeding pools and are rarely seen along main stream channels. Long-distance dispersal is limited compared to other Hawaiian damselfies.

Current threats to the *Megalagrion pacificum* include predation by nonnative fish, backswimmers, bullfrogs, and ant species; and lack of population representation, resiliency, and redundancy due to its extreme reduction in range and dispersed populations (Table 1). Restoration of stream flows may increase the amount of habitat for the Pacific Hawaiian damselfly if the rewatering of the streams is done carefully to prevent introduction of nonnative predators to the resulting new habitats. Currently, existing regulations are inadequate to protect this species from introduction of nonnative species and to maintain their aquatic and riparian habitat. A Recovery Outline that included *Megalagrion pacificum* was published in March 2011. Threats identified in the Final Listing Rule, the Recovery Outline, and this 5-Year Review are not sufficiently managed throughout the range of the species. Therefore, the Pacific Hawaiian damselfly 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: N/A

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

- Develop and implement a detailed monitoring plan for *Megalagrion pacificum* and its preferred habitat.
- Conduct targeted surveys for *Megalagrion pacificum* to determine the distribution of the species.
- Stabilize and protect extant populations of *Megalagrion pacificum*.
- Identify the primary habitat features and characteristics necessary for *Megalagrion pacificum* recovery.
- Identify and evaluate the primary biological characteristics necessary for *Megalagrion pacificum* recovery.
- Develop the recovery plan for *Megalagrion pacificum*.
- Refine and calibrate the indexes for invertebrate communities that are used for monitoring programs to improve stream habitat.
- Eliminate or manage nonnative predators of *Megalagrion pacificum*.
- Survey, document, and manage threats to *Megalagrion pacificum*.
- Once habitat requirements are understood, translocate *Megalagrion pacificum* to other suitable sites.

5.0 REFERENCES

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Pacific Hawaiian Damselfly
(*Megalagrion pacificum*)

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:

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FIELD OFFICE APPROVAL:

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