# 5-YEAR REVIEW

Short Form Summary

**Species Reviewed**: Kauaʻi ʻōʻō (*Moho braccatus*)

**Current Classification**: Endangered

**Federal Register Notice announcing initiation of this review**:

[USFWS] U.S. Fish and Wildlife Service. 2015. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 133 species in Hawaii, Oregon, Idaho, and Washington. Federal Register 80(30):8100–8103. February 13, 2015.

**Lead Region/Field Office**: Region 1, Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaiʻi

**Name(s) of reviewer(s)**:

Michelle Clark, Fish and Wildlife Biologist, PIFWO
Megan Laut, Animal Recovery Coordinator, PIFWO
Gregory Koob, Conservation and Restoration Team Manager, PIFWO
Kristi Young, Acting Project Leader, PIFWO

**Methodology used to complete this 5-year review**:

This review was conducted by USFWS, PIFWO staff beginning on August 10, 2018. The review was based on an analysis of current, available information since the last 5-year review for Kauaʻi ʻōʻō (*Moho braccatus*) (USFWS 2009). The evaluation by Michelle Clark, Fish and Wildlife Biologist, was reviewed by the Animal Recovery Coordinator and the Conservation and Restoration Team Manager before it was forwarded to the acting Project Leader and then to the Regional Office for review and approval.

**Background:**

For information regarding the species listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species at: *http://ecos.fws.gov/tess_public*.

**Review analysis**:

Please refer to the previous 5-year review for Kauaʻi ʻōʻō (*Moho braccatus*) published on July 29, 2009 (available at: *https://ecos.fws.gov/docs/five_year_review/doc2534.pdf*), for a complete review of the species' status, threats, and management efforts. New information regarding the biological status of Kauaʻi ʻōʻō has come to light since listing to warrant a change in its Federal listing status.

The Kauaʻi ʻōʻō is one of four known Hawaiian species of the genus *Moho* and one of five known Hawaiian bird species within the family Mohoidae (Fleischer *et al*. 2008). It is 19.5 centimeters (7.7 inches) long and somewhat smaller than the ʻōʻō species on the other Hawaiian islands. Its plumage is glossy black on the head, wings, and tail; smoky brown on the lower back, rump and abdomen; and rufous-brown on the upper tail coverts.

It has a prominent white patch at the bend of the wing. The thigh feathers are golden yellow in adults and black in immatures (Berger 1972).

Summary of species status information:

*Historical observations*

- The Kauaʻi ʻōʻō was very common from near sea level to the high interior forests of Kauaʻi until the end of the 19th century, but after only 3 decades it was thought to be close to extinction (Munro 1944). Except for inconclusive reports of possible vocalizations, it went without observation until rediscovered by Donagho (1941) and again by Richardson and Bowles (1961). Upon rediscovery in the late 1960s the Kauaʻi ʻōʻō population was estimated to be only 36 individuals (Sincock 1982). Sincock located and described the first nest in a tree cavity in 1971, and followed subsequent nests in 1972 and 1973. Only a single pair was found during an intensive survey made in 1981 (Scott *et al*. 1986). Two hurricanes that struck Kauaʻi in 1982 and 1992 caused much forest damage and may have possibly eliminated the remnant population. The last plausible record of a Kauaʻi ʻōʻō was a vocal response to a recorded vocalization played by a field biologist on April 28, 1987, in the locality of Halehaha/Halepaʻakai Stream (J. Krakowski, Hawaiʻi Department of Land and Natural Resources, pers. comm. 1987).

- Although variable circular plots (VCP) have been the primary method used to count birds in Hawaiʻi, it is not appropriate for all species and provides poor estimates for extremely rare birds (Camp *et al.* 2009, p. 92). In recognition of this problem, the Rare Bird Search (RBS) was undertaken from 1994 to 1996 to update the status and distribution of 13 "missing" Hawaiian forest birds (Reynolds and Snetsinger 2001, pp. 134-137). The RBS was designed to improve efficiency in the search for extremely rare species using the method of continuous observation during 20- to 30-minute timed searches in areas where target species were known to have occurred historically in conjunction with audio playback of species vocalizations (when available). Several recent surveys and searches, including the RBS, have been unsuccessful in detecting Kauaʻi ʻōʻō despite intensive survey efforts by wildlife biologists in 1993, 1994, 2000, 2005, and 2011 to 2018 (Hawaiʻi Department of Land and Natural Resources unpubl. data; Reynolds and Snetsinger 2001, Crampton *et al*. 2017, L. Crampton pers. comm. 2018).

*Subsequent survey efforts and extinction assessments*

- During the RBS, Reynolds and Snetsinger's (2001) coverage of the search area was extensive, and they thus had a high probability of detecting Kauaʻi ʻōʻō. None were detected and they concluded Kauaʻi ʻōʻō was likely extinct ($P \geq 0.95$).

- Elphick *et al.* (2010, p. 620) developed a method by which the predicted probability of a species extinction is determined based on time (years) since the species was last observed. Using 1987 for the last credible sighting of Kauaʻi ʻōʻō based on independent expert opinion, the authors estimated date for the species extinction was 1991, with 95% confidence of the species having gone extinct by 2000. This

approach for establishing extinction probability when applied to extremely rare species has the drawback that an incorrect assignment of species extinction may occur due to inadequate survey effort and/or insufficient time by qualified observers spent for the area the species could still potentially exist.

- Extensive time, however, has been spent by qualified observers in the historical range of Kauaʻi ʻōʻō searching for puaiohi (*Myadestes palmeri*), ʻakekeʻe (*Loxops caeruleirostris*) and ʻakikiki (*Oreomystis bairdi*). Hawaiʻi Forest Bird Surveys were conducted in 1981, 1989, 1994, 2000, 2005, 2007, 2008, 2012, and 2018 (Paxton *et al*. 2016, L. Crampton pers. comm. 2018). The Kauaʻi Forest Bird Recovery Project (KFBRP) conducted occupancy surveys for puaiohi in Kokeʻe State Park, Hono O Na Pali Natural Area Reserve, Na Pali Kona Forest Reserve and the Alakaʻi Wilderness Preserve, from 2011 to 2013 (Crampton *et al*. 2017) and spent over 1,500 person hours per year from 2015 to 2018 searching for ʻakikiki and ʻakekeʻe nests. Hawaiʻi Forest Bird Surveys (HFBS) in 2012 and 2018, occupancy surveys and nest searches did not yield any new detections of Kauaʻi ʻōʻō. The KFBRP conducted mist netting in various locations within the historical range for Kauaʻi ʻakialoa from 2006 through 2009 and from 2011 through 2018, and no Kauaʻi ʻakialoa or ʻōʻō were caught or encountered (L. Crampton pers. comm. 2018).

*Threats evaluation*

- A recent analytic tool proposes using information on threats to infer species extinction based on an evaluation of whether identified threats are sufficiently severe and prolonged to cause local extinction and are extensive in geographic scope to eliminate all occurrences (Keith *et al.* 2017, p. 320). At elevations below 1,500 meters (4,921 feet) in Hawaiʻi, the key factor driving disease epizootics of pox virus (*Avipoxvirus*) and avian malaria (*Plasmodium relictum*) is the seasonal and altitudinal distribution and density of the primary vector of these diseases, the mosquito *Culex quinquefasciatus* (Atkinson and LaPointe 2009a, pp. 237-238, 245-246). The disappearance of many Hawaiian honeycreeper species over the last century from areas below 1,500 meters (4,921 feet) points to the effects of avian disease having been sufficiently severe and prolonged and extensive in geographic scope to cause widespread species range contraction and possible extinction. It is highly likely that avian disease is the primary causal factor for the disappearance of several species of Hawaiian honeycreepers from forested areas below 1,500 meters (4,921 feet) on the islands of Kauaʻi, Oʻahu, Molokaʻi, and Lānaʻi and the retreat by Hawaiian honeycreepers to forest above 1,500 meters (4,921 feet) on higher islands of Maui and Hawaiʻi (Scott *et al.* 1986, p. 148; Banko and Banko 2009, pp. 52-53; Atkinson and Lapointe 2009a, pp. 237-238). Kauaʻi ʻōʻō was once considered a very common species in the lowlands as well as in the upland forests. *Moho* species on other islands disappeared around the same period as Kauaʻi ʻōʻō which suggests that disease as a major limiting factor, coupled with the fact the last remaining Kauaʻi ʻōʻō were found only at higher mosquito-free elevations. These observations suggest avian disease is a primary causal factor for the disappearance of Kauaʻi ʻōʻō (USFWS 2006, p. 2-49).

- Not much is known about the nesting behavior of Kauaʻi ʻōʻō, but the few descriptions of nests by Sincock indicate that they were cavity nesters and used large old-growth snags for nesting. The two hurricanes that struck Kauaʻi in 1982 and 1992 likely limited the Kauaʻi ʻōʻō's ability to find suitable nest sites. Habitat destruction and degradation and predation by introduced predators likely also contributed to the disappearance of Kauaʻi ʻōʻō (USFWS 2006, pp. 2-49).

- It is widely established that small populations of animals are inherently more vulnerable to extinction because of random demographic fluctuations and stochastic environmental events (Mangel and Tier 1994, p. 607; Gilpin and Soulé 1986, pp. 24-34). Formerly widespread populations that become small and isolated often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (*e.g.*, Barrett and Kohn 1991, p. 4; Keller and Waller 2002, p. 240; Newman and Pilson 1997, p. 361). As populations are lost or decrease in size, genetic variability is reduced resulting in increased vulnerability to disease and restricted potential evolutionary capacity to respond to novel stressors (Spielman *et al.* 2004, p. 15,261; Whiteman *et al.* 2006, p. 797). From 1968 to1973, Sincock conducted extensive surveys in the Alakaʻi Wilderness Preserve and estimated the Kauaʻi ʻōʻō population to be 36 ± 22 individuals (USFWS 1983). Based on this estimate it is likely that small population size also negatively impacted Kauaʻi ʻōʻō, reducing its ability to persist.

- Climate change and temperature increase present additional threats specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs. In Hawaiʻi, the threshold temperature for transmission of avian malaria is estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak *Plasmodium relictum* prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Atkinson and LaPointe 2009b, p. 58-59). The mid to high-elevation forests with temperatures between 13 and 17 degrees Celsius are considered to be a transition zone where some transmission is possible but limited.

  Benning et al. (2002, p. 14,248) used Geographic Information Systems simulation to show that an increase in temperature of 2 degrees Celsius (36 degrees Fahrenheit), which is within the range predicted by different climate models, in 100 years will result in the shrinking of the transition zone from 37,649 acres (15,236 hectares) to 5,680 acres (2,299 hectares) on Kauaʻi. This is assuming lack of effective intervention with respect to avian malaria transmission. There are currently no forests on Kauaʻi which remain cool enough to be free from avian malaria (mean ambient temperature below 13 degrees Celsius; 55 degrees Fahrenheit).

  Prevalence of malaria infection in forest birds increased significantly on Kauaʻi from 1994 to 1997 and 2007 to 2013 at elevations between 1,100 and 1,350 meters (3,609 and 4,429 feet) due to increased air temperatures, declining precipitation, and changes

in stream flow that improved conditions for mosquito breeding (Atkinson *et al.* 2014, p. 2427). The related Hawaiian honeycreeper, ʻiʻiwi (*Drepanis coccinea*), is highly vulnerable to avian malaria (Atkinson *et al.* 1995, p. S59). The ʻiʻiwi has experienced sharp declines with a projected trend over 25 years of a 92% decline on Kauaʻi and a 34% decline within the northeastern region of East Maui (Paxton *et al.* 2013 p. 12). Liao *et al.* (2015, p. 3,486) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and predicted even high-elevation forest bird habitat (above 1,500 meters; 4,921 feet) will remain relatively mosquito-free only until about the middle of this century.

New management actions:

- Surveys / inventories as described above.

**Synthesis**:

For this review, we applied a standard of demonstrated species absence at the 95% confidence level to recommend species status change from "unknown" to "delisting" due to presumed extinction. This standard means we assumed a species is potentially extant until survey or other information shows the species is absent with 95% confidence from suitable habitat it was known to have occupied historically during roughly the last half-century. Several recent surveys and searches, including the RBS and HFBS, have been unsuccessful in detecting Kauaʻi ʻōʻō despite intensive survey efforts by wildlife biologists in 1989, 1993, 1994, 2000, 2005, and 2011 to 2018 (Hawaii Department of Land and Natural Resources unpubl. data; Reynolds and Snetsinger 2001, Crampton *et al*. 2017, L. Crampton pers. comm. 2018). Elphick *et al.* (2010, p. 620) used 1987 for the last credible sighting based on independent expert opinion, the authors estimated date for the species extinction is 1991, with 95% confidence of the species having become extinct by 2000. Reynolds and Snetsinger (2001) determined Kauaʻi ʻōʻō was likely extinct at the time of the RBS in 1994 ($P \geq 0.95$). We maintain that the status of the Kauaʻi ʻōʻō should be changed from "unknown" to "presumed extinct." This recommendation is based on lack of detections during extensive searches conducted throughout the species' range in Kokeʻe State Park, Hono O Na Pali Natural Area Reserve, Na Pali Kona Forest Reserve and Alakaʻi Wilderness Preserve, and for the reasons stated above.

**Recommendations for future actions:**

- Captive propagation for reintroduction and genetic storage – There are instances where rare Hawaiian birds have been rediscovered after they were presumed extinct or have been found in larger populations than expected (Reynolds and Snetsinger 2001, p. 142). Should Kauaʻi ʻōʻō be rediscovered we recommend that the Rare Bird Discovery Protocol in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006, pp. 3-17 – 3-21) be followed with regard to decisions of whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) *in situ*.

**Table 1. Trends in status of Kauaʻi ʻōʻō since listing.**

| Date (Action) | Number of Wild Individuals | Key Recovery Actions | Actions Accomplished |
|---|---|---|---|
| 1967 (Listing) | Very rare | • Improve habitat conditions<br>• Decrease threat of avian disease<br>• Systematically search area of suitable forest habitat | |
| 1983 (First recovery plan) | 36 ± 22 | See above | |
| 1995 (Hawaiʻi Rare Bird Search) | Unknown | See above | • Improve habitat conditions<br>• Systematically search area of suitable forest habitat |
| 2006 (Revised recovery plan) | Unknown | See above | See above |
| 2009 (5-year review) | Unknown | See above | See above |
| 2019 (5-year review) | Extinct | See above | See above |

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**U.S. FISH AND WILDLIFE SERVICE**
**SIGNATURE PAGE for 5-YEAR REVIEW of**
**Kaua‘i ‘ō‘ō (*Moho braccatus*)**

**Pre-1996 DPS listing still considered a listable entity?** __N/A_____

**Recommendation resulting from the 5-year review**:

| | |
|---|---|
| ____X____ | Delisting – Presumed Extinct |
| _____ | Reclassify from Endangered to Threatened status |
| _____ | Reclassify from Threatened to Endangered status |
| _____ | No Change in listing status |

**Appropriate Listing/Reclassification Priority Number, if applicable**:_____

Approved by:

KATHERINE MULLETT

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Date: 2019.03.25 13:25:09 -10'00'

**Project Leader,**
**Pacific islands Fish and Wildlife Office**

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