Palila
(*Loxioides bailleui*)

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: Palila (*Loxioides bailleui*)

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5-YEAR REVIEW
Palila/ *Loxioides bailleui*

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:
Region 1, Sarah Hall, Chief, Division of Recovery, (503) 231-2071

Lead Field Office:
Pacific Islands Fish and Wildlife Office, Gina Shultz, Deputy Field Supervisor for Endangered Species, (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 (PIFWO) of the U.S. Fish and Wildlife Service (USFWS) in 2008. The Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006) and recent palila surveys (Leonard *et al.* 2008) provided most of the updated information on the current status of *Loxioides bailleui*. The evaluation of the lead PIFWO biologist was reviewed by the Vertebrate Recovery Coordinator and these comments were incorporated into the draft five-year review. The document was then reviewed by the Recovery Program Leader and the Deputy Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

1.3 Background:

1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:

USFWS. 2007. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 71 species in Oregon, Hawaii, Commonwealth of the Northern Mariana Islands, and Territory of Guam. Federal Register 72(45):10547-10550.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 1967. Office of the Secretary; native fish and wildlife; endangered species; notices. Federal Register 37(32):4001.
Date listed: March 11, 1967
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. 1977. Determination of critical habitat for six endangered species. Federal Register 42:40685-40690. Critical habitat was designated for *Loxioides bailleui* in one unit totaling 24,357 hectares (60,187 acres) on the island of Hawai`i, Hawai`i. This designation includes habitat almost entirely on State lands (USFWS 1977).

1.3.4 Review History:

Species status review (FY 2008 Recovery Data Call [September 2008]): Declining

Recovery achieved:
2 (26-50%) (FY 2008 Recovery Data Call)

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

1

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Revised Recovery Plan for Hawaiian Forest Birds
Date issued: September 22, 2006
Dates of previous revisions, if applicable:
1986 (USFWS. 1986. Recovery Plan for Palila. U.S. Fish and Wildlife Service, Portland, OR. 65 pages); 1978 (USFWS. 1978. Palila Recovery Plan [prepared by Palila Recovery Team]. Approved by Director on January 23, 1978.)

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?

__X_ ***Yes***
__-__ ***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?

__X_ ***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?

_X_ ***Yes***
___ ***No***

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

__X_ ***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:

The palila may be downlisted from endangered to threatened when all of the following four criteria have been met:

(1) Palila occur in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species, and viable populations exist on the southwestern slope of Mauna Kea, either the northern, eastern or the southern slope of Mauna Kea, and at least one other location on Hualālai or Mauna Loa, over a 15-year period. Palila currently exist in only one viable population on the southwestern slope of Mauna Kea.

This criterion has not been met as there is only a small reintroduced palila population (approximately 10 individuals) on the north slope of Mauna Kea and the main population on the southwestern slope. The overall population is declining and range has contracted over the past 20 to 30 years.

(2) Either (a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or (b) demographic monitoring shows that each population or the metapopulation exhibits an average growth rate (λ or lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason.

This criterion has not been met; numbers of palila have declined at least 58 percent since 2003.

(3) Sufficient recovery area is protected and managed to achieve criteria 1 and 2 above.

While some recovery area for palila is in protected status (e.g., Forest Reserve), almost all areas of palila habitat are not adequately managed.

(4) The threats that were responsible for the decline of the species have been identified and controlled.

Threats responsible for the decline of palila have been identified, but are not adequately controlled.

The palila may be delisted when all four of the criteria above have been met for a 30-year period.

2.3 Updated Information and Current Species Status

The palila is one of the larger Hawaiian honeycreepers with an overall length of 15.0 to 16.5 centimeters (6.0 to 6.5 inches) and an adult weight of 38 to 40 grams (1.3 to 1.4 ounces). Adult palila have a yellow head and breast, greenish wings and tail, and are gray dorsally and white ventrally (Jeffrey *et al.* 1993, page 493). The palila is an extreme food specialist, preferring unhardened māmane (*Sophora chrysophylla*) seeds in green pods (Banko *et al.* 2002, pages 4-5). Seeds in small developing pods and in hardened brown pods are rarely eaten, but very small pods with unexpanded seeds are sometimes eaten whole (USFWS 2006, page 2-57). Palila also eat māmane flowers, buds, and leaves, and naio (*Myoporum sandwicense*) berries, especially when other foods are in short supply. Caterpillars and other insects are important in the diet of nestlings and are eaten frequently by adults (Banko *et al.* 2004, page 21.6).

2.3.1 Biology and Habitat

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

No new information.

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:

Fossil remains of palila have been found at sea level on O`ahu (Olson and James 1982, page 39), suggesting that the species once occurred over a much larger range than was known historically. Before the first Polynesians arrived around 400 A.D., the lowlands of the main islands supported extensive dryland forests suitable for palila (Scott *et al.* 1984, page 660). Historically, the palila was known only from the island of Hawai`i, were it occurred in māmane-naio forests on the upper slopes of Mauna Kea, the northwestern slope of Mauna Loa, and probably the southern and eastern slopes of Hualālai. In the 1890s, Perkins found the palila to be "extremely numerous" in the māmane belt of the Kona region between 1,210 and 1,830 meters (4,000 to 6,000 feet) elevation (USFWS 2006, page 2-61). Palila were still locally common in the 1940s between 2,360 and 2,530 meters (7,800 to 8,350 feet) elevation on the western and northeastern slopes of Mauna Kea (Richards and Baldwin 1953, page 222). Palila have been surveyed annually since 1980 (Leonard *et al.* 2008, page 27). Data from the 2005-2007 surveys resulted in population estimates ranging from a high of 5,337 birds in 2005 to a low of 3,862 birds in 2007. Data from 2008 indicate that this decline has continued with the most current population estimate being 2,640 (Leonard *et al.* 2008, page 28). From 2003 to 2007, the estimated number on the southwestern slope of Mauna Kea has declined by 58 percent, the first statistically significant population decline for the entire period of annual monitoring that began in 1980 (Leonard *et al.* 2008, page 28).

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.

2.3.1.4 Taxonomic classification or changes in nomenclature:

No new information.

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.):

The range of palila apparently shrank relatively quickly in the early 1900s to a small area on the upper slopes of Mauna Kea, and Munro (1944, page 126) determined that the species was in danger of extinction. The distribution of palila has continued to contract in recent decades. The upper elevation limit appears to coincide with tree-line at about 2,850 meters (9,400 feet) and the lower elevation limit is approximately 2,000 meters (6,600 feet) at the transition from māmane or māmane-naio forest to scrub forest or grassland (Scott *et al.* 1984, page 653). In the early 1980s palila occupied about 139 square kilometers (53.7 square miles) or 25.6 percent of the 545 square kilometers (212 square miles) of māmane woodlands remaining on Mauna Kea (USFWS 2006, pages 2-61 and 2-62). However, decline in abundance of populations on the eastern and southern slopes suggests continued and ongoing range contraction (Scott *et al.* 1984, page 651; Grey *et al.* 1999, pages 36-37). As much as 96 percent of the entire wild palila population currently occurs within about 30 square kilometers (11.6 square miles) of forest on the southwestern slope of Mauna Kea (USFWS 2006, page 2-71).

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

Recent surveys of palila critical habitat show significant habitat damage caused by browsing sheep including removal of lower branches of māmane trees, bark stripping of māmane, and killing of young māmane trees (Swindle 2008, slides 36-38, 40-41, and 43-44). Examination of forest structure and composition detected ungulate damage to trees in 219/479 (46%) of plots, suggesting that continued and widespread ungulate impacts are slowing forest recovery on Mauna Kea (Farmer *et al.* 2008).

2.3.1.7 Other:

N/A

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

Habitat loss and modification, avian disease, and predation by introduced mammals are thought to have caused the palila population to become endangered, and these factors continue to limit the palila

population today (Scott *et al.* 1984, pages 661-662; Jacobi *et al.* 1996, pages 367-368; Pratt *et al.* 1997, page 330).

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

Feral ungulates first became established in the māmane forest in the early 1800s and have since caused widespread loss and modification of palila habitat on Mauna Kea and elsewhere. Feral sheep became established on Mauna Kea in the 1820s and the sheep population reached about 40,000 animals by the early 1930s (USFWS 2006, page 2-64). Heavy browsing by sheep and goats lowered tree-line and reduced tree density in many areas (Scowcroft and Giffin 1983, page 498; Scott *et al.* 1984, page 661). In addition, browsing removed lower branches of māmane trees, thus lowering the productivity of individual trees and reducing the availability of palila food resources (USFWS 2006, page 2-64). Control measures were initiated to protect habitat during the 1930s, and only 200 sheep remained in 1950 when management of Mauna Kea changed to sustained yield hunting (Scott *et al*. 1984, page 660). Over the following decade sheep again increased to levels where significant habitat damage was again observed (Warner 1960, page 12). Following legal rulings under section 9 of the Endangered Species Act, feral ungulate numbers were reduced in palila critical habitat beginning in 1980. As result, recruitment of māmane and other native plants increased. However, ongoing efforts over the past three decades to completely remove sheep have been only partly effective in part because of disrepair of the Mauna Kea Forest Reserve fence that was constructed in 1935 around the lower boundary of the Mauna Kea Forest Reserve (Warner 1960, page 9). Constant effort aerial (twice annual) and public hunting together from 1998 to 2007 has resulted in removal each year of between 349 and 1036 sheep, with the highest number (1036) removed in 2007 (Leonard 2008). Removal effort over the last decade has been adequate at best at maintaining sheep numbers and significant damage to māmane trees is still occurring. Adequate census of sheep has not been conducted; however, recent (2007) numbers of sheep removed (1036 animals) approximate the number of sheep on a graph by Warner (1960, page 12) showing the point at which severe plant damage was reported with little or no reproduction of māmane.

Palila were detected more frequently at sites with numerous, tall māmane, and nests were found more often in trees >4 meters tall (Farmer *et al.* 2008). Sixty-one percent of māmane trees measured during 1999-2001 were <4 meters tall (Farmer *et al.* 2008), and Conrad and Scowcroft's (1988) growth model indicates māmane trees <4 meters in height are also <25 years old. This may signify that most māmane trees on Mauna Kea sprouted after intensive ungulate reduction efforts were reinitiated in 1980 (Farmer *et al.* 2008).

Palila habitat also continues to be threatened by alien weeds and fire (Hess *et al.* 1999, page 218). The abundance, distribution, and impact of weeds are under investigation by U.S. Geological Survey, but management is needed soon for species that are spreading rapidly and whose impacts are already known. Especially worrisome is the spread of alien species of annual grasses and the accumulation of fine fuels that may carry large, destructive fires. Many weeds are now established in areas where soils were highly disturbed by large populations of ungulates. Some alien species may decline in abundance as native species increase and soil disturbance by ungulates is reduced. Other species, however, must be controlled before they spread further. For example, fountain grass (*Pennisetum clandestinum*), a fire-promoting grass is one of the most aggressive and potentially damaging introduced plants in Hawai`i. It has already become the dominant ground cover in large areas of Kona and the area between Mauna Kea, Mauna Loa, and Hualālai; colonies have also become established on the southern and western slopes of Mauna Kea. Another noxious weed, fireweed (*Senecio* spp.) has been spreading rapidly in recent years at all elevations. Cape ivy (*Deleiria odorata*) is another weed that threatens palila habitat by climbing on and smothering native trees and shrubs. Gorse (*Ulex europaeus*) is a highly invasive shrub that threatens māmane forest on the eastern slope of Mauna Kea. Efforts to control gorse have met with only moderate success, and it will spread into palila habitat from pastures below Mauna Kea Forest Reserve unless concerted measures are taken. The threats posed by many other weed species are lesser known, but some likely help support invertebrate pests that threaten insect prey of palila.

Fire is an ever-present threat to the dry forest habitat of palila, and the risk of large destructive fires is increased by the accumulation of fine leaves and stems of alien annual grasses

and other weeds. The chief concern about fire is that palila could be deprived of critical food resources over large areas for several years before recovery and regeneration of māmane and other native plants occurred. Although māmane can recover quickly after fire, alien grasses and other weeds are likely to increase in abundance and distribution, thus increasing the potential frequency and intensity of fires.

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

Not a limiting factor at this time.

2.3.2.3 Disease or predation:

Avian malaria (*Plasmodium relictum*) and avian pox (*Poxvirus avium*) have had devastating effects on the numbers and distribution of Hawai`i's native birds (Warner 1968, pages 106-113; van Riper *et al.* 1986, pages 341-342). These diseases are spread by mosquitoes, which are uncommon at the high elevations where palila are now found. Palila are highly susceptible to malaria (van Riper *et al.* 1986, pages 338-339), and although it is not thought to be an important mortality factor for palila because of the elevation of their current range, avian disease may prevent palila from recolonizing their former range at lower elevations.

There are many dead and dying māmane trees of all age classes around the mountain, but especially on the western and southern slopes. Demographic patterns of māmane mortality are being investigated by U.S. Geological Survey, but additional research may be warranted to identify possible pathogens.

Predation by black rats (*Rattus rattus*), feral cats (*Felis catus*), and the Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*) is another important factor limiting the palila population, particularly through its effects on the distribution of nesting by palila. Pletschet and Kelly (1990, pages 1017 and 1020) attributed 4 percent of palila nest mortality to egg depredation and 21 percent to nestling depredation by black rats and feral cats, and thought that predation might have contributed to the high rate of nest abandonment they observed. Snetsinger *et al.* (1994, page 48) found that 68 percent of cat scats collected near Pu`u Lā`au on Mauna Kea contained bird remains, and

thought that feral cats were an important predator on native birds. Studies by van Riper (1980, pages 470-471), Pratt *et al.* (1997, page 336), and Banko *et al.* (2004, pages 19.2-19.6) have also shown that feral cats prey on palila nests and adults.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Current regulatory mechanisms appear adequate. The palila was federally listed as endangered on March 11, 1967 (USFWS 1967), and thus receives regulatory protection under the Federal Endangered Species Act. Species listed under the Federal Endangered Species Act are automatically added to the State of Hawai`i list of endangered species, and are thus also protected by State regulations. Critical habitat for the palila was designated on September 22, 1977 (USFWS 1977).

2.3.2.5 Other natural or manmade factors affecting its continued existence:

The absence of palila in the Pōhakuloa Flats (downslope, southeast of existing populations) remains unexplained. Scott *et al.* (1984) suggested site tenacity, thermal stress, or avian disease as plausible hypotheses. However, recent studies indicate that alien ants and predatory wasps are established in the area, and other alien wasps heavily parasitize native caterpillars that are eaten by palila (Banko *et al.* 2004, pages 26.5-26.7). Disturbance from military activities in Pōhakuloa Training Area may also affect palila distribution.

Severe weather may be an important mortality factor in certain years. Populations are restricted to the higher elevations where freezing temperatures occur frequently during part of the nesting season. Rains are infrequent but can be heavy and cause eggs or chicks to die of exposure. In other years, droughts lead to low levels of māmane pod production that result in fewer nesting attempts and delayed breeding by palila. High winds can blow young out of nests, especially those placed in terminal forks of a tree (USFWS 2006, page 2-67).

Species that are endemic to a single island and highly localized, such as the palila, are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a single population by random demographic fluctuations and

localized catastrophes such as fires, hurricanes, and disease outbreaks.

2.4 Synthesis

From 2003 to 2007, the estimated number of palila on the southwestern slope of Mauna Kea declined by 58 percent, the first statistically significant population decline for the entire period of annual monitoring that began in 1980 (Leonard *et al.* 2008). As much as 96 percent of the entire wild palila population occurs within about 30 square kilometers (11.6 square miles) of forest on the southwestern slope of Mauna Kea (USFWS 2006, page 2-71). Reasons for this fairly precipitous population decline are not clear; however, they probably include ongoing drought conditions, continued habitat damage from browsing sheep, predation (primarily by feral cats), and other factors including alien insects and weeds that reduce food for palila nestlings and compete with māmane.

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: 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

Habitat protection. Increase frequency and improve efficacy of aerial hunting to remove all mouflon sheep from palila critical habitat. At the same time, repair the Mauna Kea Forest Reserve fence to prevent ingress of sheep and other ungulates into palila critical habitat. Implement fire risk reduction measures by establishing green fuel breaks and improving existing roadway fire breaks; improve fire detection and response by stationing fire response resources (such as water trucks and fire spotters) on the west slope of Mauna Kea in key habitat; and conduct road improvements where necessary and construct helicopter water dip tanks to allow more rapid and effective ground and aerial response to fire.

Predator control. Increase predator control efforts (particularly for cats) in all areas where palila breed.

Habitat Research. Examine experimental approaches to restore māmane in heavily degraded areas and improve māmane tree vigour and density by applying fertilizers, giving water, and/or removing competing weeds in the less impacted māmane forest habitats.

Population Surveys and Monitoring. Continue annual population surveys.

Captive Propagation and Reintroduction. Continue and enhance the captive propagation and release program for palila to bolster the small north slope palila population and conduct additional translocations of wild birds to this same area.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Palila (*Loxioides bailleui*)

Current Classification: ___E___

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:
Jay Nelson, Fish and Wildlife Biologist
Holly Freifeld, Vertebrate Recovery Coordinator
Marilet A. Zablan, Recovery Program Leader and acting Assistant Field Supervisor for Endangered Species
Gina Shultz, Deputy Field Supervisor

Approved: Gina M Shultz Date 31 July 2009
Acting Field Supervisor, Pacific Islands Fish and Wildlife Office