

**Focal Species:** Hawaiian Crow or ‘Alalā (*Corvus hawaiiensis*)

**Synopsis:** The ‘Alalā has been extinct in the wild since 2002, but the number of birds in captivity has grown to over 100. The future of the species will depend on whether a viable wild population can be re-established by releases of captive-bred birds. Previous releases in the 1990s did not result in establishment of a wild population. Careful selection of a release site, restoration and management of forest habitat, predator control, and an adaptive approach to release methods will be needed to achieve successful re-introduction.



‘Alalā. Photo Jack Jeffrey.

<p><b>Geographic region:</b> Hawaiian Islands</p> <p><b>Group:</b> Forest birds</p> <p><b>Federal Status:</b> Endangered</p> <p><b>State status:</b> Endangered</p> <p><b>IUCN status:</b> Extinct in the Wild</p> <p><b>Conservation score, rank:</b> 202/20, At-risk</p> <p><b>Watch List 2007 Score:</b> RED</p> <p><b>Climate Change Score:</b> High</p>
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**Population Size and Trend:** The ‘Alalā is extinct in the wild, but 109 birds exist in captivity as of 30 September 2012, including 58 males and 51 females, of which 15 are juveniles hatched in 2012 (ZSSD 2012). In 2012 a total of 20 ‘Alalā pairs were set up for breeding. The captive population has increased steadily in size from 24 birds in 1999 to its present size. The wild population was in decline by the early 1900s and by the 1960s only scattered relict populations existed (Banko et al 2002). In 1976, the wild population was estimated at  $76 \pm 18$  (Scott et al. 1986). The last known wild birds, a pair, disappeared in 2002 (USFWS 2009).

**Range:** Extinct in the wild. Historically, the ‘Alalā was only known from Hawai’i Island, but subfossils indicated this or a closely related species also occurred on Maui (Banko 2009). On Hawai’i, it was restricted to the slopes of Hualālai and Mauna Loa Volcanoes (Perkins 1903, Munro 1944, Banko and Banko 1980). Since the 1960s, nesting was restricted to between 730 and 1,737 m in elevation on Hualālai and the western slope of Mauna Loa (Banko and Banko 1980). Based on subfossils, at least five crow species occurred in Hawai’i; only the ‘Alalā crow survives (James and Olson 1991).

**Essential Biology:** The ‘Alalā is medium-sized crow, from dark brown to black in color, with the wings lighter in color than the body and tail. The bill is relatively thick and the nares are covered by long bristly feathers (Banko et al. 2002). Males and females are similar, though males are larger and heavier ( $555 \pm 13$  g) than females ( $485 \pm 16$  g; Banko et al. 2002). Juveniles resemble adults, but may appear “fluffy” and retain a bright red mouth lining for about 18 months after hatching. Like many crows, ‘Alalā are raucous and gregarious. Vocalizations are extremely varied, including loud humanlike shrieks and howls and softer growls and mutterings (Banko et al. 2002).

Information about the species’ habitat needs, behavior, movements, and life history are incomplete because most of what is known about the ‘Alalā is from observations of fragmented and declining populations (Banko et al. 2002, USFWS 2009). ‘Alalā were found in dry woodlands and mesic ‘ōhi‘a (*Metrosideros polymorpha*) and ohia-koa (*Acacia koa*) forests

(Banko et al. 2002). The habitat with the highest breeding densities of ‘Alalā during the period 1970 to 1982 was relatively undisturbed ‘ōhi’a-koa forest; ‘Alalā avoided disturbed forest (Giffin et al. 1987). Dense understory vegetation appears to be important to ‘Alalā in avoiding predation by the ‘Io or Hawaiian Hawk (*Buteo solitarius*; USFWS 2009). The ‘Alalā feeds on fruits, invertebrates gleaned from tree bark and other substrates, and eggs and nestlings of other forest birds. Nectar, flowers, and carrion are minor diet components. ‘Alalā have been observed to eat at least 26 species of plants in the wild (Sakai and Carpenter, Sakai et al. 1986, Banko et al. 2002, Culliney et al. 2012), and preferences by captive ‘Alalā for some of these species and a few others also have been recorded (Kuehler et al. 1995). Jacobi and Price (2007) identified the following species as preferred food plants because they were behaviorally preferred by ‘Alalā, nutritionally rich, or produced a high abundance of fruit per plant: ‘ōlapa (*Cheirodendron trigynum*), ‘ōhā kēpau (*Clermontia* spp.), pilo (*Coprosma* spp.), ‘ie’ie (*Freycinetia arborea*), kāwa‘u (*Ilex anomala*), pūkiawe (*Styphelia tameiameia*), alani (*Melicope* spp.), kōlea (*Myrsine* spp.), ‘aiea (*Nothoecstrum longifolium*), māmaki (*Pipturus albidus*), hōawa (*Pittosporum* spp.), kōpiko (*Psychotria hawaiiensis*), ‘ākala (*Rubus hawaiiensis*), and ‘ōhelo (*Vaccinium* spp).

Nest construction usually begins in March and eggs are laid in April. Recorded nests have been predominantly in ‘ōhi’a, although other trees and ‘ie’ie vines may be used (Tomich 1971, Banko et al. 2002). Breeding pairs form long-term bonds, and both sexes participate in nest construction, but only females incubate eggs and brood young. Clutch size ranges from two to five (usually three), although typically only one or two nestlings fledge. Pairs will re-lay upon loss or removal of the first clutch, allowing for increased reproduction in captivity. Incubation lasts 19-22 days. Juveniles fledge approximately 40 days after hatching, but are poor flyers initially and may remain on or near the ground for several days. Wild juveniles depend on their parents for at least eight months and remain with their family group until the following breeding season (Banko et al. 2002).

The median home range recorded was 480 hectares (1,186 acres; USFWS 1999), and the shortest distance between active nests observed was 300 meters (984 feet; USFWS 2009). After the breeding season, wild ‘Alalā often disappeared for extended periods, and their actual home ranges probably were larger than documented. When the species was more abundant, flocks of ‘Alalā were observed to move seasonally in response to weather and availability of ‘ie’ie and other fruits (Munro 1944). ‘Alalā are known to have lived 18 years in the wild (one female) and 25 years in captivity (one male; Banko et al. 2002). Age at first breeding is approximately 2 years for females and 2 to 3 years for males. The annual survival rate of wild adult ‘Alalā was estimated to be 81% from observations of banded birds (NRC 1992). This estimate represents a period of population decline, and survival presumably was higher in the past when populations were more stable.

### **Primary Threats:**

- **Small Population Size.** Small populations are inherently more vulnerable to extinction because of the higher risks posed by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002). Lethal deformities are occurring at a higher than normal rate in the captive ‘Alalā population, suggesting inbreeding depression may be occurring (Zoological Society of San Diego, unpubl. data).
- **Habitat degradation.** Unlike mainland corvids, ‘Alalā did not adapt well to human-disturbed habitats, and habitat destruction and degradation probably was the most important cause of population declines (Giffin 1983, Scott et al. 1986, Giffin et al. 1987,

NRC 1992, Banko et al. 2002). Native forest was lost and degraded at low and high elevations by agriculture, logging, ranching, and non-native ungulates. This resulted in a compression of the belt of dry and mesic forest over which ‘Alalā ranged tracking fruit and rainfall. Feral ungulates degraded native forest by browsing, causing soil erosion, preventing regeneration, spreading and facilitating the invasion of alien plants, and creating breeding habitat for mosquitoes (USFWS 2009). Ungulates also open up closed canopy forests which probably increased the vulnerability of ‘Alalā to ‘Io predation.

- Predation. ‘Alalā nests are vulnerable to feral cats (*Felis catus*) and rats, particularly the black or ship rat (*Rattus rattus*), which are good climbers. ‘Alalā fledglings often remain on or near the ground for several days after leaving the nest, when they are vulnerable to a wider range of predators including small Indian mongooses (*Herpestes auropunctatus*), dogs (*Canis familiaris*), and feral pigs (*Sus scrofa*; USFWS 2009). The ‘Io or Hawaiian Hawk also is known to prey on juvenile and adult ‘Alalā. Predation by ‘Io was the leading cause of death during releases of ‘Alalā in Kona in the 1990s, although some of those birds may have been weakened by disease (USFWS 2009).
- Disease. Toxoplasmosis is a disease caused by an intracellular protozoan parasite, *Toxoplasma gondii*, and is widespread throughout the world and can affect all warm-blooded animals (Elmore et al. 2010, Innes 2010). The role that toxoplasmosis played in the decline of the wild Alalā population is unknown, but captive ‘Alalā are highly susceptible to toxoplasmosis, which was diagnosed in five of the 27 birds released in the 1990s and was the second largest source of mortality (after predation), causing the death of least three birds (Work et al. 2000, USFWS 2009). Cats are the only definitive host for the sexual stages of *T. gondii*, and are thus the primary reservoir of infection. One cat can shed millions of oocytes that can persist for months in damp soil (Elmore et al. 2010, Innes 2010). Asexual tissue cysts form in cats and intermediate hosts that become infected through contact with oocytes, and also can serve as a source of infection. ‘Alalā thus could contract toxoplasmosis through direct contact with cat feces, contact with soil containing oocysts, or from preying on or scavenging carcasses of intermediate hosts such as rodents or insects (Work et al. 2000, Innes 2010). Danner et al. (2007) found that 37% of feral cats captured on Mauna Kea were infected with *T. gondii*.

The lethality of avian malaria for ‘Alalā in the wild is unknown, but the decline in the ‘Alalā population between 1890 and 1910 coincided with declines in other native birds in mid-elevation forests and may have been due to malaria outbreaks (Munro 1944). Seasonal movements by ‘Alalā may have increased their exposure to diseases; mosquitoes and avian malaria cannot survive at high elevations (above 1,500 m) due to cool temperatures.

West Nile virus is another mosquito-borne pathogen that infects a wide range of bird species and to which corvids are especially susceptible (Kilpatrick et al. 2006). West Nile virus spread rapidly across North America from 2000 to 2005 (Marra et al. 2004), but it has not been recorded in Hawai’i (Kilpatrick et al. 2004). The high level of mortality exhibited by other corvids exposed to West Nile virus and subsequent population declines suggests that arrival of this disease in Hawai’i would seriously compromise recovery efforts for the ‘Alalā (USFWS 2009).

- Persecution by Humans. Many ‘Alalā were reportedly shot around farms between 1890 and the 1930s because they were believed to raid crops (Munro 1944). Despite legal protection in 1931, malicious shooting of ‘Alalā on private lands continued into the 1980s (Giffin et al. 1987). Habitat restoration (fencing and ungulate eradication) needed for the

establishment of wild populations is unpopular with some hunters and communities. Some hunters have been known to shoot the ‘Alalā because they make loud noises when they see pigs or hunters, and this has affected the hunter’s ability to catch pigs (State of Hawaii 2012b, pp. 62, 128).

- Disturbance. Wild ‘Alalā could be sensitive to disturbance by humans, other ‘Alalā and ‘Io, especially at the nest (Banko and Banko 1980, Banko et al. 2002).

**Conservation Actions to Date:** The ‘Alalā has been legally protected by the State of Hawai‘i since 1931 and was recognized as federally endangered in 1967. The first recovery plan for the ‘Alalā was published in 1982 (USFWS 1982) and in 1991 the USFWS commissioned the National Research Council of the National Academy of Sciences to undertake a review of the status of the ‘Alalā and to recommend appropriate recovery actions. A report was published in 1992 (NRC 1992) and the USFWS developed a new long-term management plan for the species’ recovery (USFWS 1993). The ‘Alalā Recovery Team was formed in 1992 to provide recovery recommendations, and a related group, the ‘Alalā Partnership, was formed to facilitate implementation of conservation actions on private lands. A revised recovery plan was completed in 2009 (USFWS 2009).

Beginning in 1958, concern over rapid declines in the wild led the State of Hawai‘i to begin opportunistically acquiring sick or injured ‘Alalā for rehabilitation in captivity. Between 1970 and 1981, a total of 12 ‘Alalā were brought into captivity, and they were transferred from various locations to Olinda, Maui, in 1986. In 1993, The Peregrine Fund (TPF) assumed management of the ‘Alalā program. A new captive propagation facility dedicated to reproduction of ‘Alalā and other endangered Hawaiian forest birds was completed on Hawai‘i in 1996 and designated the Keauhou Bird Conservation Center (KBCC). In 1996, TPF assumed operations of the Olinda Endangered Species Propagation Facility from the State of Hawai‘i, and renamed it the Maui Bird Conservation Center (MBCC). The Zoological Society of San Diego took over the operation of both KBCC and MBCC in 2000, and titled the combined program the Hawaiian Endangered Bird Conservation Program. Fledgling production has increased substantially over the last several years (2008-2012) and production of between 15 and 20 fledglings annually now appears sustainable.

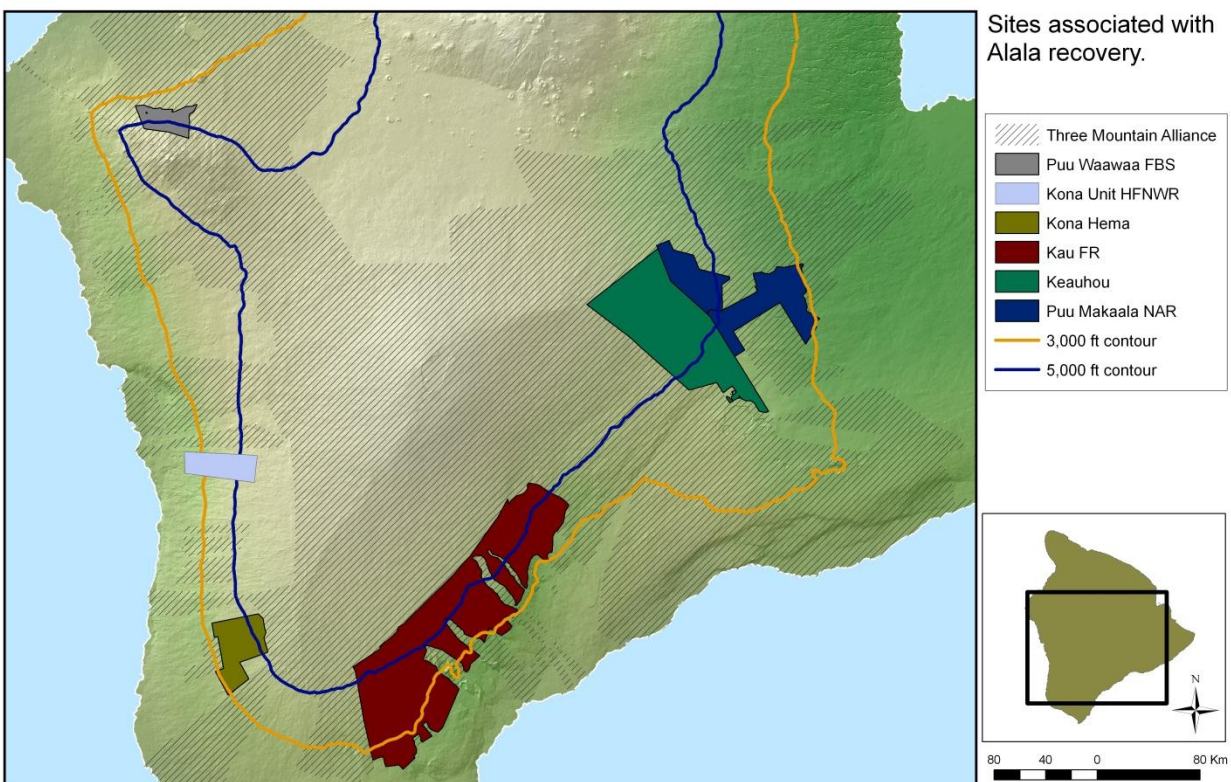
Releases of captive-bred ‘Alalā were conducted in Kona in the 1990s in an attempt to re-establish a wild population. Between 1993 and 1998, The Peregrine Fund, with support from the USFWS and the USGS, released 27 juveniles into an area of suboptimal habitat on the McCandless Ranch that supported the only remaining wild ‘Alalā population, which initially consisted of 11 adults and a juvenile but which declined throughout the release period. Habitat management was not implemented prior to or during the releases, but predators were controlled. Intensive field studies of the wild population and released juveniles were conducted between 1992 and 2002. Twenty-one of these birds subsequently died from a variety of causes, although some lived for four years in the wild. ‘Io predation was suspected in the loss of seven birds, and three birds died from toxoplasmosis. The remaining six birds were recaptured in 1998 and 1999 and re-integrated back into the captive population (USFWS 2009).

In 1984, DOWAW created the 1,541 ha (3,806 ac) Pu‘u Wa‘awa‘a Forest Bird Sanctuary on the northern slope of Hualālai for the protection of native birds including the ‘Alalā. In 1997, the USFWS purchased 2,145 ha (5,300 ac) on the western slope of Mauna Loa primarily for the ‘Alalā, which became the Kona Forest Unit of Hakalau Forest National Wildlife Refuge (NWR), in order to begin intensive habitat improvements in the core of the ‘Alalā’s former range. Legal

disputes on access and other topics with the former landowners impeded management of the refuge for years, but fencing was completed in 2012 and ungulate eradication is being planned.

In 1999, a draft Environmental Assessment was prepared examining the potential of five sites on Hawai'i to support an 'Alalā release program (USFWS 1999). In 2007, a vegetation assessment of six potential release sites was conducted (Jacobi and Price 2007) and the 'Alalā Recovery Team ranked these sites based on this information and other criteria. The Kūlani-Keauhou area was ranked as the best site and the southwestern Ka'ū Forest Reserve ranked second. Kūlani is now part of the Pu'u Maka'ala Natural Area Reserve, and Keauhou is owned by Kamehameha Schools. Parts of the Kūlani-Keauhou area have been fenced and ungulate free for 20 years, which has resulted in significant habitat recovery. Other sites evaluated included the Kona Forest Unit of Hakalau Forest NWR, Kona Hema Preserve (TNC), central Ka'ū Forest Reserve, and Kapāpala Forest Reserve. Restoration of Keauhou, Pu'u Maka'ala Natural Area Reserve, and Kona Hema is ongoing. In 2012, an Environmental Assessment was completed for fencing, ungulate control, and other management actions in the Ka'ū Forest Reserve (State of Hawai'i 2012).

In 2010, an 'Alalā Restoration Working Group was formed with members from the USFWS, DOWAW, ZSSD, and the Three Mountain Alliance (TMA), with the goal of planning for a second release, which is scheduled for 2014. The Kūlani-Keauhou area has been selected as the site for the initial releases, and the Ka'ū Forest Reserve as a site for future releases once the habitat has been sufficiently restored. Drafting of a release plan to restore the species to the wild was contracted to Pacific Rim Conservation in April 2012. An 'Alalā Outreach program was initiated in 2010 to facilitate public acceptance and support for the release of captive birds and for management in the Ka'ū Forest Reserve. Lack of community support was a major obstacle to past recovery efforts for the 'Alalā. Because of the wide-ranging nature of the 'Alalā, and its historical vulnerability to shooting, public support is essential.



**Planning/Research Needs:**

- Complete a restoration plan by April 2013 to guide the establishment of a wild population.
- Complete a Safe Harbor Agreement with Kamehameha Schools.
- Complete analysis of data collected during 1990s release program to help guide development of the restoration plan.
- Develop methods to teach predator avoidance to captive ‘Alalā prior to their release.

**5-Year Conservation Goals:**

- Maintain health and productivity of the captive ‘Alalā population.
- Continue habitat management at Kūlani- Keauhou.
- Release captive birds at Kūlani- Keauhou and monitor their status, movements, and any nesting attempts.
- Restore native habitat in the Ka‘ū Forest Reserve so it is suitable as a release site for Alalā.
- Gain public support through public outreach for re-establishment of a wild Alalā population.

**Conservation Actions:**

- Captive Breeding. Maintain the captive ‘Alalā population and allow for its continued growth in 2013 by constructing additional aviaries.
- Habitat management.
  - Maintain fences at Kūlani-Keauhou to ensure the area remains ungulate free. Monitor for ungulate ingress and remove any animals detected.
  - Construct fences in the Ka‘ū Forest Reserve to create management unit(s) at least 4,000 ha in size. Once fences are completed, eradicate ungulates, then inspect and repair fences, monitor for ungulate ingress and removal any animals as needed. Outplant native food plants if necessary based on the results of plant surveys.
- Predation.
  - Choose release sites with adequate understory vegetation to provide ‘Alalā with adequate cover to escape from ‘Io.
  - Survey release sites for the presence of ‘Io and avoid nests and areas of high ‘Io density to the maximum extent practicable. ‘Io likely occur throughout the release areas but their density and activity levels may vary somewhat.
  - Control non-native predators (feral cats, rats, mongooses) within an area of at least 1 km<sup>2</sup> area centered on release site(s).
  - Train captive-bred ‘Alalā before release to recognize ‘Io as predators and to respond with appropriate defensive or evasive behaviors.
- Disease.
  - Control feral cats to prevent ‘Alalā from contracting toxoplasmosis.
  - Monitor health of released ‘Alalā and quickly treat any birds that show signs of toxoplasmosis, malaria, or poxvirus.
- Releases of Captive ‘Alalā.
  - Construct field aviary(ies) and other infrastructure at Kūlani- Keauhou. More than one aviary may be needed if it is decided that multiple release sites are preferable to reduce interference among cohorts from different years.
  - Release ‘Alalā in each of five years, monitor their movements, health, behavior, and any nesting attempts.

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- **Public Outreach.** Continue outreach to increase public acceptance of landscape scale management required for successful releases and the restoration of ‘Alalā to the wild.

### Summary and Estimated Costs of Conservation Actions, 2013-2017:

Conservation Action	Years	Annual Cost	Total Cost
Construct additional aviaries at KBCC	1	\$200,000	\$200,000
Build release aviary and prepare infrastructure at Kūlani- Keauhou	1-2	\$100,000	\$200,000
Control feral cats, rats, and mongooses at Kūlani-Keauhou	2-5	\$100,000	\$500,000
Release ‘Alalā and monitor them	1-5	\$300,000	\$1,500,000
Fencing and ungulate removal in Ka‘ū FR	2-5	\$1,500,000	\$6,000,000
Outreach	1-5	\$100,000	\$500,000

**Potential Partners:** Hawai‘i Division of Forestry and Wildlife, U.S. Fish and Wildlife Service, Zoological Society of San Diego, U.S. Geological Survey Pacific Island Ecosystems Research Center, Kamehameha Schools, Three Mountain Alliance, National Park Service, University of Hawai‘i, and the The Nature Conservancy of Hawai‘i.

**Ancillary Species:** Conservation actions aimed at the ‘Alalā , including fencing, ungulate control, forest restoration, and predator control, would benefit all native bird species that use forest habitat on the island of Hawai‘i, including the ‘Oma‘o (*Myadestes obscurus*), Hawai‘i ‘Elepaio (*Chasiempis sandwichensis*), Hawai‘i ‘Amakihi (*Hemignathus virens*), Hawai‘i Creeper (*Oreomystis mana*), Hawai‘i Ākepa (*Loxops coccineus*), ‘Akiapola‘au (*H. munroi*), ‘I‘iwi (*Vestiaria coccinea*), and ‘Apapane (*Himatione sanguinea*).

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