

Focal Species: Laysan Duck (*Anas laysanensis*)

Synopsis: The Laysan Duck is a small, primarily nocturnal and terrestrial duck that is restricted to the small islands of Laysan and Midway. It formerly was more widespread on the larger Hawaiian Islands. The Midway population was created by translocations from Laysan in 2004 and 2005. Rising sea level, increasing storm surge, and lower precipitation associated with global climate change are expected to have serious impacts on the low-lying islands where this species occurs. Occasional outbreaks of avian botulism can cause high mortality. The primary conservation actions are preventing predators and other alien species from becoming established on these remote islands, managing habitat to provide adequate foraging and nesting sites, and establishing populations on additional islands by translocation.



Male Laysan Duck, Midway. Photo Eric VanderWerf



Created wetland, Midway. Photo Eric VanderWerf



Laysan Ducks feeding on brine flies around the hypersaline lake on Laysan. Photo Cameron Rutt

<p>Geographic region: Northwestern Hawaiian Islands</p> <p>Group: Water birds</p> <p>Federal Status: Endangered</p> <p>State status: Endangered</p> <p>IUCN status: Critically Endangered</p> <p>Conservation score, rank: 17/20, At-risk</p> <p>Watch List 2007 Score: Red</p> <p>Climate Change Vulnerability: High</p>

Population Size and Trend: On Laysan, the most recent (2010) population estimate was 434±72 birds (Reynolds et al. 2011), but estimates have fluctuated from 322-688 over the last several decades (USFWS 2004). The population trend on Laysan is thought to be stable, but it has been difficult to determine due to the fluctuations. On Midway, 42 birds were translocated in two cohorts from Laysan in 2004 and 2005. The population on Midway increased rapidly to 473 (95% CI 439–508) in 2010 (Reynolds et al. 2012), though it has declined to around 300 after botulism outbreaks and the 2011 Japan tsunami (USFWS unpubl. data). Laysan Ducks have been kept in captivity since 1957, but most captive birds are not considered useful for reintroduction purposes because of concerns about the spread of disease and genetic introgression from hybridization with other waterfowl species in captivity (Reynolds and Kozar 2000).

Range: The Laysan Duck currently is found only on Laysan Island and Midway Atoll, which are located in the Northwestern Hawaiian Islands (NWHI). The ducks use most of each island,

but both islands are very small; Laysan is 414 hectares (1,023 acres) in size, and Midway encompasses 596 hectares (1,473 acres; Krause et al. 2012). Even with the establishment of a second population on Midway, the Laysan Duck is thought to have the smallest range of any waterfowl species in the world, less than 10 km². Laysan Ducks were still extant on Lisianski, also in the NWHI, as late as 1844 (Olson and Ziegler 1995). Fossil and subfossil evidence indicates that Laysan Ducks were widespread in the Hawaiian Islands prior to the arrival of rats (*Rattus* spp.) and occurred on Hawai‘i, Moloka‘i, O‘ahu, Maui, and Kaua‘i (USFWS 2004).



Essential Biology: The Laysan Duck is a small (420-500 g) brownish duck with orange legs and a white patch around the eye. The bill is greenish in males and orange in females. The amount of white on the head increases with age (Moulton and Marshall 1996). Laysan Ducks are unusual among waterfowl in being largely nocturnal and terrestrial. They forage primarily at night and rarely fly, preferring to walk. They exhibit several adaptations to a largely terrestrial lifestyle, including longer legs, shorter wings, fewer primary feathers, and reduced flight muscles (Moulton and Marshall 1996). Because they nest on the ground and tend to freeze rather than flush, Laysan Ducks are vulnerable to predation by mammals and today occur only on predator-free islands.

The habitat requirements of the Laysan Duck include dense vegetated cover for nesting, a year-round prey base, and a source of fresh water (USFWS 2004). They use all available habitats on Laysan and Midway, including upland vegetation, ephemeral wetlands, freshwater seeps, mudflats, the hypersaline lake, and coastal areas. Laysan Ducks feed on terrestrial and wetland invertebrates, algae, and seeds (USFWS 2004). Historical and paleoecological evidence suggests this species was a habitat generalist and occurred in a wide range of habitats. On high elevation islands, Laysan Ducks once were found in both coastal wetland and upland forests.

The clutch size is small for a duck, averaging 3.8 eggs (Moulton and Marshall 1996). The chicks are precocial and can walk and swim almost immediately after hatching, but they follow the female to learn how and where to feed. Ducklings have more restrictive habitat requirements than adults because of their higher nutritional needs for growth and initial inability to process salt water. Duckling activities therefore are concentrated around sources of fresh water with nearby cover and high prey densities. The female provides almost all parental care, but breeding pairs exhibit long-term pair bonds (Reynolds et al. 2009). Laysan Ducks molt all of their flight feathers simultaneously, usually in July-August, causing them to become flightless

for several weeks until the new feathers have grown in, during which time they are even more vulnerable to predation. Annual adult survival is high; survival of released birds on Midway was 0.65 ± 0.08 (Reynolds et al. 2012), but juvenile survival is low (10-30%; USFWS 2002).

Primary Threats:

- Small population size and range. Small populations with limited ranges are especially vulnerable to a variety of natural processes. Fluctuations in demographic parameters such as survival and reproduction can cause population declines and even extinction. The Laysan Duck's limited range exacerbates the risk of extinction due to catastrophes such as droughts, tsunamis, severe storms, and disease epizootics. Loss of genetic variation is more likely in small populations, potentially limiting adaptation to changing conditions, although there is no evidence of inbreeding depression in Laysan Ducks so far.
- Habitat loss and degradation. On Laysan, filling of the hypersaline lake by invasive wetland plants and declining precipitation during drought are concerns given the importance of the lake as foraging habitat. On Midway, some of the freshwater wetlands created for ducks were inundated with salt water and physically damaged by the Japan tsunami in March 2011. Most of these wetlands have recovered to near pre-tsunami levels after being pumped and salinity is steadily dropping. These wetlands continue to be vulnerable to saltwater incursions from high wave events and rising sea level, requiring periodic maintenance including removal of alien mosquito fish (*Gambusia affinis*) and preventing algae and plants from filling the wetlands.
- Non-native predators. Laysan Ducks disappeared from the main Hawaiian Islands 800–900 years ago after rats were introduced. Laysan and Midway, where the Laysan Duck is currently found, are free of non-native mammalian predators but accidental introduction of predators to Midway and Laysan is a potential threat. However, the long-term recovery strategy for the species calls for re-establishment of populations on the larger, high-elevation Hawaiian Islands, all of which are inhabited by a variety of non-native predators. Establishment of such populations will require protecting them from predators including feral dogs (*Canis familiaris*), feral cats (*Felis silvestris*), small Indian mongooses (*Herpestes auropunctatus*), rats (*Rattus* spp.), Cattle Egrets (*Bulbulcus ibis*), Barn Owls (*Tyto alba*), and bullfrogs (*Rana catesbeiana*). These predators are pervasive throughout the islands, but mongooses are not established on Kauai, Kahoolawe, or Niihau.
- Non-native invasive plants. Several species of invasive alien plants can alter habitat structure and decrease its value for Laysan Ducks. On Laysan, the non-native grass *Cenchrus echinatus* is highly invasive and can crowd out the native bunch grass *Eragrostis variabilis*, which is the preferred nesting substrate for Laysan Ducks. Eradication of this invasive grass was expensive and required 10 years of year-round effort. *Pluchea indica* is a wetland invasive shrub that degrades foraging habitat on Laysan and accelerates wetland filling.
- Avian diseases. Avian botulism has occurred in Laysan Ducks on Midway and a severe outbreak in August 2008 caused the death of 181 ducks (Work et al. 2010). Botulism is a paralytic disease caused by ingestion of a toxin produced by the bacterium *Clostridium botulinum*, which thrives under anaerobic conditions in warm water with decomposing vegetation and animal carcasses. Birds can be treated and vaccinated if detected early. Removing carcasses of dead birds helps to reduce the severity of the outbreak. Wetland

exclusion and water control structures have been proposed as additional methods of reducing the impact of outbreaks and possibly controlling the environmental conditions that can foster botulism. Mortality has been documented on Laysan due to drought, emaciation, and infestation by the nematode *Echinurea uncinata* (Work et al. 2004).

- **Global climate change.** Climate change and associated sea-level rise caused by thermal expansion of ocean water and melting of ice sheets is a serious long-term threat to all birds on atolls in the Northwestern Hawaiian Islands, including the Laysan Duck. Recent projections estimate a rise in sea level of 1-2 meters by the end of the 21st century (Vermeer and Rahmstorf 2009). The mean elevation of Laysan is 3.8 meters (12 feet) and the mean elevation of Sand Island on Midway is only 2.5 meters (8 feet). Rising sea level and storm surge are predicted to result in substantial losses of foraging and nesting habitat for the Laysan Duck caused by inundation, physical damage, and incursions of salt water into freshwater wetlands (Berkowitz et al. 2012, Krause et al. 2012). Other predicted results of climate change in the Hawaiian Islands include rising temperatures and declining precipitation, both of which could facilitate botulism outbreaks and *Echinuria uncinata* nematode infestation (Work et al. 2004, 2010).

Conservation Actions to Date: The Laysan Duck was federally listed as endangered in 1967 (USFWS 2004). Conservation actions have focused on maintaining the population on Laysan and creating a new population on Midway. Management actions conducted by the USFWS on Laysan have included removal of invasive alien plants such as *Cenchrus echinatus* and *Pluchea indica*, restoration of native plant species, and biosecurity to prevent introduction of additional alien plants and animals. The Laysan Duck population on Midway was created by translocation of 42 birds in two cohorts from Laysan in 2004 and 2005 (Reynolds and Klavitter 2006, Reynolds et al. 2008). Management conducted by the USFWS for Laysan Ducks on Midway has included enhancement and creation of freshwater wetlands, responding to outbreaks of avian botulism, and monitoring movements, habitat use, and demography.

A substantial amount of research has been conducted on the Laysan Duck in preparation for translocations and to monitor populations, primarily by the U.S. Geological Survey Biological Resources Division Pacific Islands Ecosystem Research Center, including habitat use, home range size, survival and causes of mortality, nesting phenology and behavior, demography and population dynamics, diseases, and vulnerability to climate change (see references).

Planning/Research Needs:

- Complete translocation plans for sites deemed suitable, particularly Lisianski, Kure, and Kaho’olawe (see USFWS 2004 for more details on site suitability assessments).
- Assess options for re-establishing a breeding population of Laysan Ducks on Kaua’i, O’ahu, or Maui, including methods of excluding or controlling predators, such as predator-proof fences. The cost-effectiveness of various options may differ among sites and should be investigated on a site by site basis. Potential sites include but are not limited to Hanalei and Huleia National Wildlife Refuges on Kauai, James Campbell National Wildlife Refuge on Oahu, and Kealia Pond National Wildlife Refuge and Kanaha Pond State Wildlife Sanctuary on Maui.
- Conduct research to further investigate demographic parameters that drive population fluctuations and cause differences in clutch size and fecundity on Laysan and Midway, including food and water resources, hatchability, and brood survival.

- Determine if the avian botulism outbreaks could be reduced at Midway Atoll by eliminating mosquito fish from the managed wetlands.

5-Year Conservation Goals:

- Continue management of Laysan Ducks and their habitat on Laysan and Midway.
- Establish breeding populations of Laysan Ducks on both Lisianski Island and Kure Atoll. After Midway, these two islands have been identified as the most suitable sites for establishing populations of Laysan Ducks. Each island would require wetland habitat preparation before it could support Laysan Ducks, and each presents different challenges. Lisianski is Laysan’s nearest neighbor and is known to have previously supported Laysan Ducks, but mammal introductions in the mid-1800s resulted in loss of vegetation cover and shifting sands that filled the island’s wetland. Test pits dug by hand in 2006 had difficulty reaching fresh groundwater and use of heavy equipment would be difficult on this remote island. On Kure, two small freshwater seeps were dug by hand in 2006 and 2007, but additional habitat would be needed, including creation of at least one more wetland or the installation of several 500-gallon artificial wetlands (“Guzzlers”). Control of golden crown-beard (*Verbesina encelioides*), an invasive alien plant that is used by Laysan Ducks for nesting but is detrimental to nesting seabirds, would need to be controlled before ducks are brought to the island.
- Re-establish a breeding population of Laysan Ducks on one of the southeastern Hawaiian Islands.

Conservation Actions:

- Establish breeding populations of Laysan Ducks on both Lisianski and Kure.
- Habitat management.
 - Continue to manage wetlands on Midway, including removal of mosquito fish.
 - Eradicate mice (*Mus musculus*) from Sand Island, Midway to increase natural recruitment of native bunch grass to ensure availability of quality nesting habitat.
 - Continue habitat management on Laysan, including removal of alien plants such as *Pluchea indica*, and restoration of native plants.
- Avian diseases.
 - Respond to any outbreaks of avian botulism that occur by removing dead bird carcasses.
 - Investigate methods of controlling water level and environmental conditions that can lead to botulism outbreaks on Midway.
- Global climate change. Develop feasibility plans for re-establishing a breeding population of Laysan Ducks on Kauai, Oahu, Kahoolawe, or Maui, which are high islands that would provide more of a refuge from rising sea level and storm events.

Summary of 5-year Actions, 2013-2017:

Conservation Action	Year(s)	Annual cost	Total Cost
Continue habitat management on Laysan, including biosecurity, removal of detrimental alien plants, and restoration of native plants	1-5	\$100,000	\$500,000
Maintain wetlands on Midway	1-5	\$50,000	\$250,000

Respond to botulism outbreaks on Midway	1-5	\$30,000	\$150,000
Habitat management on Lisianski and Kure to prepare wetland sites for translocation of ducks	1-3	\$100,000	\$300,000
Translocate ducks to Lisianski	4-5	\$250,000	\$500,000
Translocate ducks to Kure	4-5	\$200,000	\$400,000
Investigate feasibility of establishing Laysan Ducks on Kaua'i, O'ahu, Kaho'olawe, and Maui, including methods of predator control or exclusion	1-2	\$30,000	\$60,000

Potential Partners: U.S. Fish and Wildlife Service, U.S. Geological Survey Biological Resources Division Pacific Islands Ecosystem Research Center, Papahānaumokuākea Marine National Monument, Hawaii Division of Forestry and Wildlife, Hawaii Wetland Joint Venture, Ducks Unlimited, Bird Conservation International, American Bird Conservancy.

Ancillary Species: Habitat management on Laysan also would benefit the endangered Laysan Finch (*Telespiza cantans*) and the endangered Millerbird (*Acrocephalus familiaris*), which was re-introduced to the island in 2011. Management on Laysan and Midway would benefit numerous species of seabirds, migratory waterfowl, and shorebirds, including the Bonin Petrel (*Pterodroma hypoleuca*), Hawaiian Petrel (*Pterodroma sandwichensis*), Bulwer's Petrel (*Bulweria bulwerii*), Wedge-tailed Shearwater (*Puffinus pacificus*), Christmas Shearwater (*Puffinus nativitatis*), Tristram's Storm-petrel (*Oceanodroma tristrami*), White-tailed Tropicbird (*Phaethon lepturus*), Red-tailed Tropicbird (*Phaethon rubricada*), Masked Booby (*Sula dactylatra*), Brown Booby (*Sula leucogaster*), Red-footed Booby (*Sula sula*), Great Frigatebird (*Fregata minor*), Gray-backed Tern (*Sterna lunata*), Sooty Tern (*Sterna fuscata*), Brown Noddy (*Anous stolidus*), Black Noddy (*Anous minutus*), White Tern (*Gygis alba*), Pacific Golden Plover (*Pluvialis fulva*), Wandering Tattler (*Tringa incanus*), Bristle-thighed Curlew (*Numenius tahitiensis*), and Ruddy Turnstone (*Arenaria interpres*). On Kaua'i, O'ahu, and Maui, four other species of endangered waterbird would benefit from management directed at the Laysan Duck, particularly predator control or exclusion, including the Hawaiian Duck or Koloa (*Anas wyvilliana*), Hawaiian Coot or 'Alae ke'oke'o (*Fulica alai*), the Hawaiian Gallinule or 'Alae 'Ula (*Gallinula galeata sandvicensis*), and the Hawaiian Stilt or Ae'o (*Himantopus mexicanus knudseni*).

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