

# TECHNICAL NOTE

USDA NATURAL RESOURCES CONSERVATION SERVICE PACIFIC ISLANDS AREA

## Biology Technical Note No. 17

### HAWAIIAN HAWK HABITAT ENHANCEMENT AND MANAGEMENT\*



**Figure 1.** In Hawaiian culture `Io are regarded as `aumakua or ancestral guardian spirits (Photo USFWS).

#### PURPOSE

To provide an introduction to the habitat requirements of Hawaiian Hawk or `Io and guidance on conservation practices to enhance and manage `Io habitats.

#### INTRODUCTION

The `Io is Hawaii's only resident hawk, and it is found nowhere else in the world. The `Io is a raptor (bird of prey) from the family Accipitridae (hawks, kites, eagles, and allies). Recent studies indicate that `Io is closely related to the Short-tailed Hawk of the Americas with whom it shares a common ancestor; most likely, a South American long-distance migrant, comparable to the Swainson's Hawk, which could reach remote islands. Though similar in appearance, male

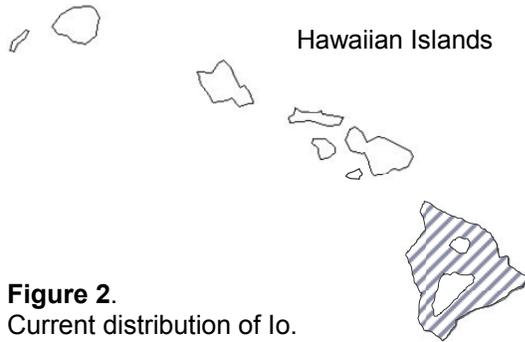
`Io are 13% smaller and 29% less in weight than females (common characteristic of raptors). `Io have two color morphs: (1) **Light** morph adults have a dark brown head and back and white throat, breast, and belly with varying amounts of brown flecking (Fig. 1). Juveniles are similar except the head and breast are orange/white (Fig. 4B); (2) **Dark** morph adults are dark brown all over. Juveniles differ slightly by having mottled (orange/white) mixed with the dark feathers on the head and upper chest. The color of the cere (fleshy area at base of beak) and legs is yellow in adults and bluish-green in juveniles. `Io is a Federal and State endangered species.

#### Species Profile

Hawaiian Hawk, `Io (pronounced "EEoh")  
Federal listing: Endangered  
Scientific name: *Buteo solitarius*  
Length: male 15.5 inches (39.4 cm); female 18.0 inches (45.7 cm)  
Weight: male 15.5 oz (441 g); female 21.4 oz (606 g)  
Range: 0-8500 ft (2590 m) elevation on Hawai'i; rare sightings on Maui, O'ahu, and Kaua'i  
Breeding season: March - August  
Female age at first breeding: 3-4 years  
Clutch size: usually 1 egg (range 1-3)  
Incubation period: at least 38 days  
Age at fledging: 56-63 days  
Nest sites: 30-6200 ft (10-1890 m) elevation, open- and closed-canopy native forests, exotic forests, and agricultural areas with >0.5 ac (0.2 ha) patches of large trees; prefers mature `ohi'a trees for nesting  
Food habits: Carnivorous; majority of diet includes birds, mice, rats, and invertebrates  
Population estimate: 1450  
Longevity: up to 17 years

This information was taken primarily from Griffin et al. (1998), Clarkson & Laniawe (2000), and Klavitter et al. (2003).

## STATUS AND DISTRIBUTION



**Figure 2.**  
Current distribution of ʻIo.

Based on the fossil record, the former range of ʻIo included the islands of Hawaiʻi, Molokaʻi, and Kauaʻi. Today, an estimated 1450 birds are found only on the Island of Hawaiʻi (Fig. 2) with rare sightings on Maui, Oʻahu, and Kauaʻi. ʻIo occur from sea level to 8500 ft (2590 m) elevation (although rarely seen above 5500 ft [1676 m]) in protected areas, developed lands, and agricultural lands. Non-protected areas support about 68% of the population, and most habitats supporting high densities of ʻIo are on private lands; thus, the cooperation of private landowners and availability of private land to ʻIo remains an important aspect in the species' recovery.

## ANNUAL CYCLE

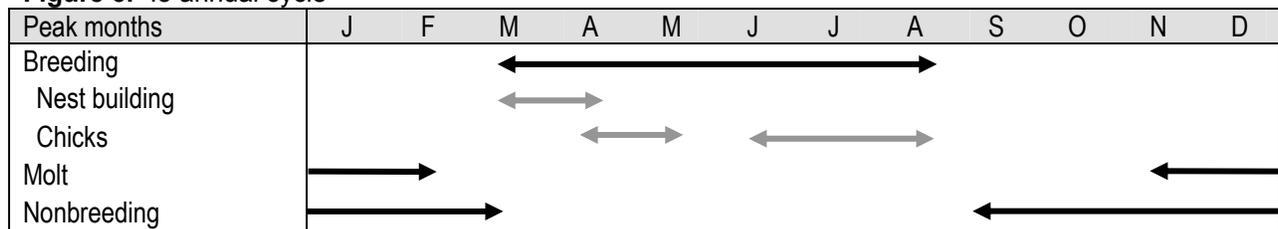
Mate and site fidelity is high in ʻIo (pairs typically remain together in the same territory throughout the year). Nests may be reused during consecutive breeding seasons or vacated for a year or more before reuse. Courtship and aerial displays, such as mutual soaring, diving, and foot-touching, are observed year-round, but more often prior to breeding. ʻIo breed during the spring and summer (the majority of breeding occurs March to August). Most nest building occurs

March to April and egg laying April to May. Chick activity is greatest June to August (Fig. 3). Both sexes contribute to nest building which begins several weeks prior to the laying of usually a single egg. The female does most of the incubating (although this is variable) and takes breaks to stretch, preen, and receive food from the male. The chick is altricial (born with little to no down, immobile, and totally dependent on its parents for survival). After hatching, the female is primarily responsible for brooding (protecting and warming the chick), feeding, other rearing activities, and the male is responsible for capturing food for the young.

The chick is fed several times per day, and over a 10-week period the average feeding rate is 0.9 oz/h (25.2 g/h; equal to about one House Finch per hour). The chick develops rapidly and ventures out of the nest to adjacent branches ready to fly at 8-9 weeks of age. There's a peak in fledging activity (chicks taking their first flight) in mid-August. The parental care period for ʻIo is among the longest recorded for its genus (*Buteo*) and up to 10 times longer than temperate-zone raptors. The juvenile receives food from adults 6-10 months after fledging, but in the next year the juvenile will depart from its parents and start a life of its own.

*An important job of a wildlife manager is to provide new, improved opportunities for at-risk species to survive, reproduce, and maintain sustainable breeding populations. If existing conditions are unsuitable, alternative treatments are recommended which are often manipulations needed to meet landowner and NRCS conservation goals guided by the ʻIo Recovery Plan. If existing conditions are suitable, the landowner and NRCS may decide to forego manipulations, maintain existing conditions, and protect the area from disturbance.*

**Figure 3.** ʻIo annual cycle



Adapted from Clarkson & Laniawe (2000)



**Figure 4. A:** Two-week-old `lo chick with dark and light morph parents (Photo © J. Jeffrey); **B:** Light morph juvenile `lo in mature `ōhi`a forest (Photo J. Klavitter).

## HABITAT REQUIREMENTS

`lo occur in almost every vegetated landscape with some large tree component. It's easier to describe what is *not*, rather than what is, `lo habitat. `lo rarely use māmane-naio forest, lava fields, orchard monocultures, and urban areas. Primary habitats include native forests with a grass understory, fallow sugarcane fields, and orchards with structural diversity (e.g., tree hedgerows, forest edges). **Of these, large areas of mature `ōhi`a forest are most important for the perpetuation of `lo.** Habitats include:

- Forest
  - Native
  - Native – exotic
  - Exotic
- Agricultural lands
  - Fallow sugarcane
  - Orchards
  - Grazing lands
- Developed
  - Rural
  - Suburban/Exurban

**Food.** Prior to human contact, the `lo diet consisted primarily of native birds and insects. Today, `lo prey on native species but their diet consists mostly of nonnative mammals, birds, and invertebrates, showing lo's ability to adapt to a changing prey base. `lo hunt from perches, but will also use aerial pursuits. Prey is taken from the ground or tree branches or intercepted in mid-air.

There are at least 15 bird and 6 mammal species known to be eaten by `lo. The most common foods delivered to `lo chicks in nests were rats, mice, the Japanese White-eye, Common Mynah, and House Finch. Native birds consumed by `lo include Pacific Golden-Plover, `Apapane, Common `Amakihi, `I`iwi, and the endangered Hawaiian Crow or `Alalā. `lo will also take Kalij Pheasant (which weighs more than `lo), domestic chickens, and mongooses as well as scavenge feral cats. Cockroaches, spiders, hawk moths, dragonflies, and other invertebrates supplement the diet. As with other native predators, `lo play an important role in controlling rodents, nonnative birds, and insects.

**Cover (nesting).** Nests are located in trees of native, mixed native-exotic, and exotic forest and agricultural areas. Canopy cover varies greatly from closed, `ōhi`a-dominated forests (60-85%) to open, mixed forests (20-60%) to scattered `ōhi`a and koa in pasture (<20%). Both native and exotic trees are used for nesting, but the majority of nests are built in mature `ōhi`a trees. Other nest trees include lama, koa, kōlea, eucalyptus, common ironwood, Christmas berry, coconut, macadamia nut, and mango (See Appendix A for native species list).

**Cover (foraging).** Varies widely, but generally consists of a patchwork of tall trees and open grassy fields that supports bird and mammal populations (Fig. 5). Snags (standing, dead or dying trees; Fig. 6) or other trees with exposed limbs are important for scoping and hunting.



**Figure 5.** `lo nesting and foraging habitat in **A**: open-canopy native forest with a grass understory (‘ōhi‘a; Photo K. Uyehara) and **B**: mixed native-exotic forest and pasture (o‘hi‘a-guava, ironwood; Photo B. Shontell).



**Figure 6.** At this koa forest and plantation on `Umikoa Ranch in Hamakua, koa snags were intentionally left to provide perching sites for `lo (Photo K. Uyehara).

Grazing lands offer unique opportunities to enhance `lo habitat. Pasturelands with forested gulches, mature windbreaks, and remnant forest or adjacent to a forest reserve or tree plantation provide better foraging habitat than pastures with few or no large trees. Many of these areas could be improved by simply protecting `lo roosting and nesting areas and increasing habitat diversity.

**Water.** Foods presumably meet water requirements. `lo are frequently observed soaring above or perched in trees in the vicinity of wetlands and riparian zones.

**Minimum habitat size.** `lo is a wide ranging species capable of high altitude and interisland flight. Adults defend their territory year-round, but do so more aggressively during the breeding season. Adults will attack and chase intruders and soar over the defended territory. Home range, which varies by habitat type, averages 1134 ac (459 ha). Thus, `lo require large protected areas and landscapes that encompass multiple landowners.

Home range by habitat type	Size - ac (ha)
Closed-canopy `ōhi`a forest	1300 (526)
Open-canopy `ōhi`a forest	1134 (459)
Open-canopy `ōhi`a forest (S. Kona)	292 (119)
Mid-elevation pasture	1196 (484)
Papaya-guava orchard	119 (48)

Clarkson & Laniawe (2000), Klavitter (2000)

**Breeding.** `lo nest from 30-6200 ft (10-1890 m) elevation in native and exotic forests and pasture and orchards with large trees. Nests are bulky structures made of sticks (~0.25 x 12 inches [0.6 cm x 30 cm]), twigs, and leaves, with a cup at the center. Nest cups are lined with green-leaved twigs, fresh `ōhi`a leaves, koa leafstalks, fern fronds, or other greenery. Nests are built on stable platforms on bird's nest ferns, trunk crotches, or where branches meet the trunk (Figs. 7-8).

**Nonbreeding.** Little is known about the nonbreeding or subadult habitats of `lo. Subadults may congregate in lowland exotic forests and agricultural areas prior to first breeding. Observations of `lo in atypical habitats suggest a seasonal change in distribution.



**Figure 7.** `lo nest constructed of small branches in an `ōhi`a tree (Photo J. Klavitter).

Nest characteristics	Average size
Nest diameter	25 inches (65 cm)
Nest depth	12 inches (31 cm)
Nest cup diameter	9 inches (24 cm)
Nest cup depth	2 inches (4 cm)
Nest site characteristics	Average size
Nest tree height	52 ft (range 33-79 ft) 16 m (range 10-24)
Nest tree dbh	20 inches (min 4 inches) 50 cm (min 10 cm)
Nest height in tree	31 ft (range 11-59 ft) 9 m (range 4-18 m)

Griffin et al. (1998)



**Figure 8.** Small woody debris from an `ōhi`a tree available to `lo for nest-building (Photo K. Uyehara).

## THREATS

Landowners can also benefit `lo by minimizing the following threats:

- Habitat loss and degradation
  - Conversion of native forest to grasslands, monocultures, large-scale orchards, or urban development
  - Spread of invasive plant species (i.e., guava, Christmas berry) that shade out `ōhi`a and other natives
  - Lack of suitable nesting habitat
- Harassment and direct mortality
  - Disturbance at nest and roost sites
  - Vehicle collisions
  - Birds are occasionally shot or harmed for a variety of reasons which include `lo preying upon pets and domestic chickens
- Potential threats
  - Environmental contaminants
  - Avian diseases
  - Introduced predators (fledglings are occasionally attacked by domestic and feral cats and dogs)
  - Drowning in cattle troughs
  - `Ōhi`a rust (*Puccinia psidii*)

**Habitat loss and degradation.** The primary factor limiting `lo population growth is lack of suitable habitat. `lo are currently restricted to the Island of Hawai`i where they appear to occupy useable habitats covering about 59% of the island. Loss of mature `ōhi`a and `ōhi`a-koa forests to human development, invasive species, fire, disease, and natural die-backs decreases the amount of suitable habitat.

Although Hawai`i's forests have been drastically reduced, `lo is proving to be an adaptable species able to take advantage of forest edges created by logging and grazing and opportunistically feeding on nonnative species. `lo can coexist with moderate levels of forest fragmentation; however, if `ōhi`a-dominant forests continue to decline, the `lo population will likely decline.

**Harassment and direct mortality.**

Although it's against Federal and State law to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect `lo or attempt to engage in any of these activities, an unknown number of `lo are harassed or shot each year. Even if this number is low, such losses could effect the `lo population because adult survival is the most important factor regulating the population.

Harassment of `lo at nest sites can alter normal feeding and breeding patterns or result in nest or chick abandonment. Nest disturbance can expose chicks to inclement weather or predators or cause juveniles to leave familiar territory prematurely. Harassment could also be unintentional. For example, loud, irregular, unpredictable activities such as using heavy equipment or building a structure near an `lo nest may cause nest failure. This can be a problem for `lo because pairs may not reneest when their nest fails and may not nest every year.

Greater efforts to raise public awareness about the habitat requirements of Hawai`i's endangered hawk would reduce inadvertent harassment.

**Potential threats.** There is little or no evidence that environmental contaminants (pesticides), avian diseases (avian pox, avian malaria, *Toxoplasmosis gondii*), or introduced predators limit the `lo population. Studies on secondary rodenticide (Diphacinone) poisoning concluded that the threat to `lo is minimal. However, young `lo are vulnerable to cats, dogs, and mongooses, and West Nile Virus, Avian Influenza, and other diseases could devastate the `lo population if they reach Hawai`i. Thus, ongoing evaluation and monitoring is prudent due to changing environmental conditions. We recommend proactive conservation practices to help prevent these factors from becoming a problem for `lo in the future.

**What to do with a sick, injured, or dead lo?**

1. Note the bird's condition, behavior, and exact location
2. Call the Division of Forestry & Wildlife (DOFAW) as soon as possible for guidance (phone numbers below)

## Summary of `lo habitat components

Habitat component	Habitat characteristics
Food	<ul style="list-style-type: none"> <li>Small mammals, birds, and invertebrates (e.g., rats, mice, Japanese White-eyes, Common Mynahs, House Finches, cockroaches, dragonflies)</li> </ul>
Cover – nesting	<ul style="list-style-type: none"> <li>Range in elevation for nesting 30-6200 ft (10-1890 m)</li> <li>Large areas of mature `ohi`a forest are important</li> <li>Mature `ohi`a trees apparently preferred for nesting, but a variety of large native and exotic trees are also used (nest trees average 52 ft [16 m] high and 20 inches [50 cm] dbh)</li> <li>Small woody debris (sticks ~0.25 x 12 inches [0.6 cm x 30 cm] and twigs) and foliage used for nesting materials</li> </ul>
Cover – foraging	<ul style="list-style-type: none"> <li>Range in elevation is 0-8500 ft (2590 m); most birds occur 2000-5300 ft (610-1615 m)</li> <li>Native forest with a grass understory, fallow sugarcane fields, orchards with a tree component (e.g., hedgerow, woodland edge), or other habitats with similar structure that support bird and mammal populations</li> <li>Snags or other tall trees with exposed limbs for perching and hunting prey</li> </ul>
Water	<ul style="list-style-type: none"> <li>Foods presumably provide adequate water in diet</li> </ul>
Minimum habitat area	<ul style="list-style-type: none"> <li>The average home range is 1134 ac (459 ha) per pair, but this varies by habitat type and territories may overlap (see home range table above)</li> </ul>

### Limiting Factors

When planning for `lo habitat conservation, properties within the species' range near a protected area or in an area where there is potential to work with multiple landowners should be given priority. Use the table below to subjectively rate the availability and quality of `lo habitat within a planning area, based on the above habitat characteristics. Habitat components absent or rated low are likely limiting `lo habitat quality.

Habitat component	Quality / Availability			
	High	Medium	Low	Absent
Food				
Cover – nesting				
Cover – foraging				
Minimum habitat area				

### Management Recommendations

Management treatments should address the habitat components that appear to limit habitat potential for `lo. Management options are listed below that may increase the quality or availability of each habitat component. NRCS Conservation Practices and various programs that may provide financial or technical assistance to carry out practices are also listed.

Habitat component	General management options for increasing habitat quality or availability	Conservation Practices
Food	<ul style="list-style-type: none"> <li>Preserve snags and other tall trees with exposed limbs (particularly "favorite" trees of `lo) near grassy fields by excluding areas from or minimizing activities related to resource extraction, grazing, or traffic</li> </ul>	382, 472, 528, 643, 645
	<ul style="list-style-type: none"> <li>Plant 1-ac (0.4-ha) patches of `ohi`a and koa trees for `lo to hunt from; increase native species diversity; fence to prevent ungulate damage (also see Cover – foraging below)</li> </ul>	382, 550, 612, 643, 645
	<ul style="list-style-type: none"> <li>Minimize any secondary and tertiary effects (e.g., reduction in prey and prey habitat) of pesticides by developing an integrated pest management plan to reduce use of pesticides; include `lo as a natural pest control agent</li> </ul>	595, 645

Habitat component	General management options for increasing habitat quality or availability	Conservation Practices
Cover – nesting	<p><i>If 'lo is known or suspected to be nesting in area:</i></p> <ul style="list-style-type: none"> <li>▪ Preserve or enhance nest trees and surrounding habitat by excluding areas from or minimizing activities related to resource extraction, grazing, or traffic</li> <li>▪ Minimize activities to manicure lawns and “clean” farms to ensure sticks (~0.25 x 12 inches [0.6 cm x 30 cm]) and twigs are readily available to construct nests</li> </ul>	382, 472, 528, 643, 645
	<p><i>If 'lo is known or suspected to be nesting in area or using but not known to be nesting in area:</i></p> <ul style="list-style-type: none"> <li>▪ Protect, enhance, or restore `ōhi`a-dominant forests and scattered native trees, particularly mature `ōhi`a trees (See Appendix A for other native nest trees)</li> <li>▪ Consult with NRCS Biologist or Plant Materials Center on best sources, spacing, care, and maintenance of plants; when possible strive to restore native plant community structure and function not just native species</li> </ul>	314, 380, 382, 472, 550, 595, 612, 643, 645, 650
	<ul style="list-style-type: none"> <li>▪ Control invasive plants, particularly those that threaten the continued existence of `ōhi`a forests (e.g., Christmas berry shades out native understory plants and prevents recruitment; fountain grass communities can develop high fine fuel loads)</li> <li>▪ In addition to standard treatments, consider girdling invasive trees to maintain, shade, moisture, and erosion control during restoration activities; use an ax or chainsaw to remove a 2-inch ring of bark and cambium layer at base of tree to disrupt nutrient flow; girdle trees that have no native bird nesting activity and are far from human activity (do not create a hazard); spread mulch over root zone to prevent regrowth</li> </ul>	314, 383, 528, 595, 643, 645, 666
	<ul style="list-style-type: none"> <li>▪ Protect `ōhi`a forest and scattered native trees from fire by establishing fuel breaks or from intentional overgrazing by developing a prescribed grazing plan</li> </ul>	382, 383, 528, 643, 645
Cover – foraging	<ul style="list-style-type: none"> <li>▪ Maintain a patchwork of woodland and open grassy fields by mowing or grazing where appropriate</li> </ul>	528, 645, 647
	<ul style="list-style-type: none"> <li>▪ In riparian zones, establish riparian buffers through fencing, planting `ōhi`a and other native species adapted to riparian conditions, selective removal of invasive plants, managing access, removing feral ungulates, and prescribed grazing</li> </ul>	314, 382, 391, 472, 528, 550, 560, 575, 595, 612, 643, 645
	<ul style="list-style-type: none"> <li>▪ In orchards, increase horizontal and vertical vegetative structure by planting shelterbelts that contain `ōhi`a and koa; configure plantings in undulating rows or large, irregularly-shaped patches</li> </ul>	380, 650, 643, 645
	<ul style="list-style-type: none"> <li>▪ In tree plantations, maintain cover by avoiding large clearcuts; consider selective harvest techniques that leave young and middle-aged trees and snags</li> </ul>	314, 645, 666
	<ul style="list-style-type: none"> <li>▪ In marginal pasture, restore `ōhi`a-dominant forest in 0.25–1.0 ac (0.1-0.4 ha), irregularly-shaped patches at 3-5 sites; exclude grazing animals by fencing to ensure future tree recruitment; weed control may be needed 1-2 times per year to allow for tree establishment</li> <li>▪ In addition, consider planting similar-sized patches of faster-growing, noninvasive, nonnative trees to be used for nesting until `ōhi`a-dominant forest stands can support nesting; could also function as windbreaks or shelterbelts (consult with NRCS Biologist or Plant Materials Center)</li> </ul>	314, 380, 382, 550, 595, 612, 643, 645, 650

Habitat component	General management options for increasing habitat quality or availability	Conservation Practices
Minimum habitat area	<ul style="list-style-type: none"> <li>▪ Allow at least 300-1300 ac (120-525 ha) per pair; area requirements vary by habitat type and territories may overlap (see home range table above)</li> <li>▪ Consider relationship of planning area to habitat components on neighboring lands</li> </ul>	643, 645
Human impact	<ul style="list-style-type: none"> <li>▪ Maintain a no-activity buffer, 300 ft (100 m) or more, around nest trees during the breeding season (Mar-Aug)</li> <li>▪ Minimize human disturbance near nest trees (Mar-Aug); for example, schedule major construction activities during the nonbreeding months (Sep-Feb)</li> <li>▪ Reduce or disallow recreational use near nesting areas during the breeding season</li> <li>▪ Keep domestic cats and dogs away from nest trees, especially when chicks are fledging</li> <li>▪ Control feral cats and mongooses around nest trees; plan layout of traps or bait stations such that pets and predators are not lured to nest trees by baits</li> <li>▪ Remove mosquito breeding sites (e.g., old tires) to prevent the spread of mosquito-transmitted bird diseases</li> <li>▪ Cover cattle tanks or float a 3-ft (1-m) section of 2 x 6 inch board in them to prevent accidental `lo drowning</li> <li>▪ Avoid cutting `ōhi`a for firewood or fence posts; instead use fast-growing nonnative species such as eucalyptus, guava, or ironwood</li> <li>▪ Avoid conflicts with `lo by confining young chickens and small pets (i.e., kittens) to protect them from `lo predation</li> </ul>	472, 528, 560, 595, 568, 575, 643, 645

**Conservation Practices:** **314** Brush Management, **380** Windbreak/Shelterbelt Establishment, **382** Fence, **383** Fuel Break, **391** Riparian Forest Buffer, **472** Use Exclusion, **484** Mulching, **528** Prescribed Grazing, **550** Range Planting, **560** Access Road, **568** Recreation Trail and Walkway, **575** Animal Trails and Walkways, **595** Pest Management, **612** Tree/Shrub Establishment, **643** Restoration and Management of Rare or Declining Habitats, **645** Upland Wildlife Habitat Management, **647** Early Successional Habitat Development/Management, **650** Windbreak/Shelterbelt Renovation, **666** Forest Stand Improvement (More info: [http://efotg.nrcs.usda.gov/efotg\\_locator.aspx?map=HI](http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=HI))

**NRCS Conservation Programs that apply:** **CREP** Conservation Reserve Enhancement Program (administered by Farm Service Agency); **CSP** Conservation Security Program; **EQIP** Environmental Quality Incentives Program; **WHIP** Wildlife Habitat Incentives Program; **WRP** Wetlands Reserve Program (More info: <http://www.hi.nrcs.usda.gov/programs/>)

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## Common and scientific and names of animals and plants in text

### Animals

Apapane (*Himatione sanguinea*)  
Common `Amakihi (*Hemignathus virens*)  
Common Mynah (*Acridotheres tristis*)  
Hawaiian Crow or `Alalā (*Corvus hawaiiensis*)  
Hawaiian Hawk or `Io (*Buteo solitarius*)  
House Finch (*Carpodacus mexicanus*)  
House Mouse (*Mus musculus*)  
`Iiwi (*Vestiaria coccinea*)  
Japanese White-eye (*Zosterops japonicus*)  
Kalij Pheasant (*Lophura leucomelanos*)  
Pacific Golden-Plover or Kōlea (*Pluvialis fulva*)  
Rat (*Rattus* spp.)  
Short-tailed Hawk (*Buteo brachyurus*)  
Small Indian mongoose (*Herpestes auropunctatus*)  
Swainson's Hawk (*Buteo swainsoni*)

### Plants

Bird's nest fern (*Asplenium nidus*)  
Christmas berry (*Schinus terebinthifolius*)  
Coconut (*Cocos nucifera*)  
Common ironwood (*Casuarina equisetifolia*)  
Eucalyptus (*Eucalyptus* spp.)  
Fountain grass (*Pennisetum setaceum*)  
Guava (*Psidium* spp.)  
Koa (*Acacia koa*)  
Kōlea (*Myrsine lanaiensis*)  
Lama (*Diospyros sandwicensis*)  
Macadamia nut (*Macadamia integrifolia*)  
Mango (*Mangifera indica*)  
Māmane (*Sophora chrysophylla*)  
Naio (*Myoporum sandwicense*)  
`Ōhi`a (*Metrosideros polymorpha*)  
Papaya (*Carica papaya*)

**For more information on lo contact:**

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## Appendix A. Native Hawaiian plants associated with `lo nesting.

Family	Common name (scientific name)	Nests in	Nests on	Nest materials	Elevation - ft (m) <sup>1</sup>	Habitat <sup>1,2</sup>	Source
Trees							
Ebenaceae – Ebony	lama ( <i>Diospyros sandwicensis</i> )	✓			15-4000 (5-1220)	Dry to mesic forest, extends to wet forest	Griffin et al. 1998 Klavitter 2000
Euphorbiaceae – Spurge	mehame ( <i>Antidesma platyphylla</i> )	✓			490-5000 (150-1525)	Mesic to wet forest	Griffin et al. 1998
Fabaceae – Pea	koa ( <i>Acacia koa</i> )	✓		✓	195-6760 (60-2060)	Dry to wet forest	Griffin et al. 1998 Klavitter 2000
Myrsinaceae – Myrsine	kōlea ( <i>Myrsine lanaiensis</i> )	✓			985-7515 (300-2290)	Dry to mesic forest	Klavitter 2000
Myrtaceae - Myrtle	`ōhi`a ( <i>Metrosideros polymorpha</i> )	✓		✓	0-7220 (0-2200)	Dry to wet shrublands, mesic to wet forest	Griffin et al. 1998 Klavitter et al. 2003
Ferns							
Aspleniaceae - Spleenwort	bird's nest fern, ekaha ( <i>Asplenium nidus</i> )		✓		0-2500 (0-760)	Grows on trees or ground in mesic to dry forest	Griffin et al. 1998

<sup>1</sup>Wagner, W. L., Herbst, D. R., and S. H. Sohmer. 1999. Manual of the Flowering Plants of Hawai`i, 2<sup>nd</sup> ed. Honolulu: University of Hawai`i Press.

<sup>2</sup>Dry: <50 inches (1200 mm) annual rainfall, where evaporation exceeds rainfall; Mesic: 50-100 inches (1200-2500 mm) annual rainfall, where evaporation and rainfall are approximately equal; Wet: >100 inches (2500 mm) annual rainfall, where rainfall exceeds evaporation.