

Native Species Accounts

Hawaiian Goose (Nēnē)

The Hawaiian Goose was only incidentally observed while traveling through the South Flank study area. Four individuals were seen at a catchment pond at the edge of mesic koa-`ōhi`a forest kipuka and exposed lava terrain at 1,890 m elevation. Kahuku was an important former release site for this species.

Hawaiian Hawk (ʻIo)

The Hawaiian Hawk was only observed within the Ka`ū, South Flank and Northwest study areas (Table 2; Figure 5). Occurrence was low ($\leq 2\%$ of stations surveyed), and the number of detections were too low to estimate densities. Detections occurred within a range of habitats including mesic and wet koa-`ōhi`a forest, `ōhi`a-māmane-naio sub-alpine woodland, and open pasture with remnant stands of native forest. However, the Hawaiian hawk is not amenable to VCP surveys (i.e., call playbacks are the method of choice; e.g., see Klavitter *et al.* 2003), and it is likely that the species was more widespread than the study results indicate.

Pacific Golden-Plover (Kōlea)

The Pacific Golden-Plover was only observed within the Ka`ū, South Flank and Northwest study areas (Table 2; Figure 6). Occurrence was low ($\leq 4\%$ of stations surveyed), and the number of detections were too few to estimate densities. The species was observed within the fairly open habitats of `ōhi`a-māmane-naio sub-alpine woodland and open pasture.

Hawai`i `Elepaio

Hawai`i `Elepaio were only observed within the Ka`ū, Honomalino and Northwest study areas (Table 2; Figure 7). With the exception of three individuals in the Northwest study area, all detections occurred outside of Kahuku proper. Whereas the detections at Northwest occurred in `ōhi`a-māmane-naio sub-alpine woodland, `Elepaio only occurred within the mesic koa-`ōhi`a forest at Honomalino and was not found in the woodland directly upslope. `Elepaio in Ka`ū only occurred within wet koa-`ōhi`a forest and were also not found in the woodland. Mean densities were estimated at 0.14, 0.32, and 0.10 birds/ha in the Ka`ū, Honomalino, and Northwest study areas, respectively (Table 3).

It is notable that `Elepaio observations in the Ka`ū study area were entirely limited to the northern half of the forest reserve below 1,800 m elevation. Although, much of the south Ka`ū forest would appear to be suitable habitat, it harbors few, if any, `Elepaio. Moreover, a comparison of observations made during the 2005 survey to that of the 1976 Hawai`i Forest Bird Survey (HFBS) appears to indicate that frequency of occurrence has declined sharply throughout the larger Ka`ū region, and the southern portion of the species' range has contracted northeastward by at least five km (Gorresen *et al.* In prep.). In addition, the current density observed in central Ka`ū above 1,500 m (about 0.3 birds/ha) is significantly less than that recorded during 1976 HFBS (about 0.6 birds/ha).

Some of the differences in occurrence and density between years may be attributable to differences in detection probabilities among seasons (i.e., greater in the summer and lower in the spring when the 1976 and 2005 surveys were conducted, respectively). However, the same general downward trends in `Elepaio occurrence and density are evident in upper and mid-elevation habitat in other central windward areas of Hawai`i Island (specifically, `Ola`a and East Rift; Gorresen *et al.* 2005).

Most `Elepaio records in Ka`u are now restricted to areas in which koa is present. However, the importance of koa as a prey substrate in the foraging ecology of `Elepaio in this region is not known, and koa has been shown to be used less frequently for foraging than expected on basis of their abundance in Hakalau Forest National Wildlife Refuge (VanderWerf 1998).

`Oma`o

`Oma`o were detected in forest habitat throughout the Ka`u study area, with a few additional observations in the upper elevation woodland (Table 2; Figure 8). `Oma`o also occurred in a few areas of the forested pasture between 1,040 and 1,580 m elevation at the South Flank study area. Mean densities of 1.03 and 0.33 birds/ha were estimated for Ka`u and South Flank, respectively (Table 3). There were no detections of `Oma`o in the three study areas on leeward Hawai`i Island. More specifically, `Oma`o were absent from areas (Honomalino and Papa) where a few birds were observed during the 1979 HFBS. However, the 2005 Kahuku survey transects did not extend much above treeline in these areas and may have missed a sparsely distributed `Oma`o population in the upper elevation shrubland.

Despite the possibility of low numbers of `Oma`o in open sub-alpine `ohi`a shrubland (Scott *et al.* 1986), the arid and exposed landcover extending along the South Rift Zone may act as a barrier to the reestablishment of the species into the leeward side of the island. `Oma`o are major seed dispersers (Wakelee and Fancy 1999), and the translocation and establishment of populations in leeward forests where they once occurred could expedite recovery of native forests that have been altered by cattle ranching.

Hawai`i `Amakihi

Hawai`i `Amakihi were found at all five study areas (Figure 9), and were the most abundant bird species in all areas except Ka`u and the South Bank (Table 2). The species was observed at comparatively low densities in the more mesic and wet habitats of the windward sites: 1.65 birds/ha at Ka`u and 0.83 birds/ha at South Flank (Table 3). However, the leeward study areas had fairly high bird densities: 4.53 birds/ha at Honomalino, 4.71 birds/ha at Papa, and 4.72 birds/ha at Northwest. The high densities of Hawai`i `Amakihi observed in leeward Kahuku are comparable to those found at other sites throughout the Kona and Hualālai regions of Hawai`i Island (Camp *et al.* In prep.).

Hawai`i `Amakihi were fairly ubiquitous in the open pasture with small stands of trees at South Flank, an observation in keeping with their generalist behavior (Lindsey *et al.* 1998). The species also was recorded at fairly low elevations in this study area

(minimum 725 m), a pattern similar to that observed in dry forest, woodland and shrubland in the Kīlauea section of Hawai'i Volcanoes National Park (Turner *et al.* 2007) and low elevations elsewhere in Puna (Woodworth *et al.* 2005).

'Akiapōlā'au

'Akiapōlā'au were only detected in the northeastern portion of the Ka'ū forest between 1,525 and 1,950 m elevation (Table 2). Two detections were made within the boundaries of Kahuku (Figure 10), and thus the acquisition of the unit adds the species to HAVO. The species was estimated to occur at a mean density of 0.19 birds/ha for the portion of the study area coincident with its 5,555 ha range in Ka'ū (Table 3). Given the above density and range, the population in Ka'ū was estimated at 1,073 birds (95% confidence interval [CI] = 616 – 1,869 birds). This mean density is considerably larger than that of previous studies. The 1976 HFBS yielded a population estimate of 533 (95% CI = 214 – 852) individuals (Scott *et al.* 1986). A 1993-1994 survey along many of the same transects resulted in a population estimate of only 44 individuals (95% CI = 0 – 94 birds; Fancy *et al.* 1996).

'Akiapōlā'au have a very low reproductive rate, usually producing one chick per year (Pratt 2001). Therefore, it is not possible for the population to show the magnitude of increase within a decade indicated by the observed 1993-1994 density. The differences among estimates may instead be a reflection of sampling error rather than changes in population size. Unlike other Hawaiian birds, it is difficult to predict the beginning of the breeding season and to target surveys for when 'Akiapōlā'au are most vocal. We were fortunate that the Ka'ū population was vocal during our surveys, thereby allowing us to produce a robust population estimate. The very different population estimates demonstrate the need for caution when comparing 'Akiapōlā'au density and population estimates over time.

Hawai'i Creeper

Hawai'i Creeper were only detected in the northeastern half of the Ka'ū study area (Table 2; Figure 11). The detections within the boundaries of Kahuku now add the species to HAVO. All observations occurred within forest habitat between 1,525 and 1,950 m. The species was estimated to occur at a mean density of 0.35 birds/ha for the portion of the study area coincident with its 6,418-ha range in Ka'ū (Table 3). Given the above density and range, the population in Ka'ū was estimated at 2,268 birds (95% CI = 1,159 – 4,438 birds).

The above mean population size and density is fairly close to that of the $2,102 \pm 540$ birds and 0.24 birds/ha estimated by Scott *et al.* (1986) from the 1976 HFBS. The 2005 mean density is also similar to the 0.27 birds/ha observed in 1993, but is much lower than the 1.23 birds/ha recorded in 2002 (Camp *et al.* In prep.). As with 'Akiapōlā'au, the estimates derived from surveying rare species are prone to high levels of uncertainty (Gorresen *et al.* 2005).

Although the Hawai'i Creeper was not observed in the Northwest study area, the species conceivably may be present and further surveys may be warranted. The area surveyed is

only about five km northeast from recent occurrence records of Hawai'i Creeper within the Kona Forest Unit (KFU) of the Hakalau Forest National Wildlife Refuge (HFNWR).

Hawai'i `Ākepa

Hawai'i `Ākepa also were only detected in the northeastern half of the Ka`ū study area (Table 2; Figure 12). The detections within the boundaries of Kahuku now add the species to HAVO. All observations in Ka`ū occurred within forest habitat between 1,550 and 2,200 m elevation. The species was estimated to occur at a mean density of 0.32 birds/ha for the portion of the study area coincident with its 7,958 ha range in Ka`ū (Table 3). Given the above density and range, the population in Ka`ū was estimated at 2,556 birds (95% CI = 1,340 – 4,876 birds). As with Hawai'i Creeper, Hawai'i `Ākepa occur in the KFU and have the potential to be found in the Northwest study area.

We witnessed groups of Hawai'i `Ākepa foraging in sub-alpine woodland in the Ka`ū study area. Our observations support those of Scott *et al.* (1986), in which high densities of this species were also detected in this habitat. Hawai'i `Ākepa forage almost exclusively on insects located in the buds and the new flush of `ōhi`a foliage (Hart 2000). Because the sub-alpine habitat is open and trees are widely spaced, terminal leaf buds are not relegated to the canopy but can extend down to the base of the tree, and this greatly increases the surface area available to foraging `Ākepa (Figure 3a).

Hawai'i `Ākepa are believed to nest exclusively within tree cavities and to require large trees for nesting (Hart 2000). Although suitable nesting trees do not occur in the sub-alpine woodland, potential nesting trees do occur a little more than a kilometer down slope in the mature montane forest. The absence of nesting cavities leads us to believe that the Hawai'i `Ākepa in Ka`ū are perhaps either making daily or seasonal foraging movements more of than one kilometer, or there are individuals in this population that exhibit a different nesting behavior. That is, this population perhaps may build cup nests similar to the Kaua'i `Ākepa or `Akeke`e (*Loxops caeruleirostris*, Lepson and Pratt 1997). Most of our knowledge of Hawai'i `Ākepa biology comes from the windward population in HFNWR, and there is little sub-alpine woodland habitat directly above the mature montane forests of the refuge, perhaps precluding nesting in strata other than mature tree cavities. The Ka`ū population needs further research to determine whether it exhibits foraging and nesting behavior the same or different from that of the Hakalau population.

As with the Hawai'i Creeper, the Northwest study area does have the potential to harbor Hawai'i `Ākepa despite the lack of detections. The area surveyed is only about 5 km northeast from recent occurrence records of Hawai'i `Ākepa within the KFU of the HFNWR.

`Iiwi

`Iiwi were observed in the Ka`ū, Honomalino and Northwest study areas (Table 2; Figure 13). In Ka`ū and Honomalino, nearly all detections were within mesic and wet forest habitat, whereas in Northwest, `Iiwi were recorded in the dry sub-alpine

woodland. Densities in Ka`ū, Honomalino and Northwest were 0.99, 0.39 and 0.61 birds/ha, respectively.

High elevation forest and woodland are extremely important for `I`iwi as this species is very susceptible to introduced diseases that are prevalent in mid and low elevation habitats (Atkinson *et al.* 1995). The presence of `I`iwi in the Northwest study area within dry sub-alpine woodland during September underscores the fact that this species will seasonally migrate to exploit blooms at high elevations. Although this species does make seasonal use of habitat in which avian malaria is present, it is not likely to survive in areas with little or no high elevation habitat, and the integrity of high elevation forests are critically important for `I`iwi.

In July 2005, `I`iwi were incidentally observed in the upper portions of forested pasture in Kahuku. The absence of `I`iwi in this habitat at the time of the VCP surveys may have been the result of seasonal movements rather than a reflection of habitat quality or the presence of avian malaria.

`Apapane

With the exception of the South Flank, `Apapane occurred at all stations in each of five study areas (Table 2; Figure 14). At South Flank, `Apapane were fairly common in the forested pasture above 1,100 m, and there were a few birds detected as low as 820 m. Mean densities were estimated at 7.98 birds/ha in Ka`ū, 0.92 birds/ha in South Flank, 3.48 birds/ha in Honomalino; 3.64 birds/ha in Papa, and 2.80 birds/ha in Northwest (Table 3). `Apapane are currently the most abundant native bird species in Kahuku. Surveys elsewhere have previously reported densities as high as 30 birds/ha in forest habitats on the major Hawaiian islands (Camp *et al.* In prep.).

Although `Apapane are more prevalent at higher elevations, they are still present within forest habitat at mid and lower elevations where disease transmission is likely to occur. The species may be evolving resistance to avian malaria and recolonizing their former range in lowland native habitats, as has been noted in Puna and elsewhere (Woodworth *et al.* 2005).

Non-native Species Accounts

Chukar

Two Chukar were incidentally observed within dry sub-alpine pūkiawe (*Leptecophylla tameiameia*) shrubland at 1,950 m in the Ka`ū study area. Chukar were notably absent from upland areas such as South Flank and the leeward study areas for which Scott *et al.* (1986) had recorded the species' occurrence.

Erckel's Francolin

Erckel's Francolin was detected in all five study areas, but its occurrence was limited exclusively to the relatively dry and open leeward habitats comprised of `ōhi`a-māmane-naio sub-alpine woodland and open pasture with remnant stands of native forest (Table 2;

Figure 15). The lowest and highest proportions of occupancy were 2% and 56% at Ka`ū and Northwest, respectively. Mean densities were estimated at <0.01 birds/ha in Ka`ū, 0.11 birds/ha in South Flank, 0.10 birds/ha in Honomalino; 0.06 birds/ha in Papa, and 0.17 birds/ha in Northwest (Table 3). The Erckel's Francolin is the most prevalent galliform bird found in dry open habitats.

Kalij Pheasant

Kalij Pheasant occurrence was very low and mostly limited to the wet and mesic forest of Ka`ū (2% of surveyed stations; Table 2; Figure 16), although a single bird was detected in the sub-alpine woodland of the Northwest study area. Mean densities were estimated at 0.09 birds/ha in Ka`ū and 0.01 birds/ha in Northwest (Table 3). However, VCP is not amenable to the survey of the Kalij Pheasant and many birds were likely to have gone undetected; therefore, it is likely that the species actually was more widely distributed and present at higher densities in forest and woodland habitat than the results of the survey indicate. The Kalij Pheasant was the only galliform bird observed in forest habitat.

Common Peafowl

Common Peafowl were incidentally heard calling or were seen below 1,000 m along the eastern South Flank during the late summer breeding season (Thane Pratt and Linda Pratt, pers. comm.). The species appears to be fairly sparsely distributed in the open pasture and edge of forest remnant stands at lower elevations within the study area.

Wild Turkey

Although occurrence was low, Wild Turkeys were recorded in open forest, woodland and grassland habitats at all five study areas (Table 2; Figure 17). The highest incidence of detections were in mesic koa-`ōhi`a forest at Honomalino and Papa (13 observations at 6% of stations surveyed; and three observations at 11% of stations surveyed, respectively). The number of Wild Turkey detections was too low to estimate densities.

Rock Dove

The Rock Dove was incidentally seen in association with lava cavities located in proximity to a residential area (Hawai'i Ocean View Estates) at 850 m elevation along the western edge of the South Flank study area (Linda Pratt, pers. comm.). We suspect the occurrence of Rock Dove in this area to be associated with human settlement.

Spotted Dove

The Spotted Dove was fairly uncommon and only detected at two study areas: South Flank and Northwest (Figure 18). Occurrence and density were 14% and 0.04 birds/ha in the open pasture and forest remnant habitat of South Flank, and 6% and 0.04 birds/ha in the sub-alpine woodland of the Northwest study area (Tables 2 and 3). The occurrence of Spotted Dove at South Flank is likely due to its preference for habitats modified by human activities.

Zebra Dove

The Zebra Dove was only detected in the open pasture and forest remnant habitat at South Flank (Table 2; Figure 19). The species occurred at only 7% of the stations surveyed in the study area, and numbers were too low to estimate density. The species was absent from upland habitats in the leeward study areas at which Scott *et al.* (1986) had recorded moderately low densities. The occurrence of Zebra Dove at South Flank is also likely due to its association with human settlement.

(Eurasian) Sky Lark

Sky Lark were moderately common (29% of stations surveyed and 0.10 birds/ha) in the sub-alpine woodland at Northwest (Tables 2 and 3; Figure 20). A small number were also observed in mesic forest at Honomalino, and a single detection was made in upper elevation woodland at Ka`ū. The species' absence from habitat in the South Flank study area at which it was recorded during the 1978 HFBS (Scott *et al.* 1986) may represent a modest range contraction in the region.

Hwamei

The Hwamei (*Melodius Laughing-thrush*) was only detected in the lower portions of the open pasture and remnant forest habitat at South Flank (Table 2; Figure 21). A single detection was recorded at each of three stations (3% of the stations surveyed in the study area), and numbers were too low to estimate density. The species' occurrence at South Flank likely represents a range expansion from the low and mid-elevation habitats in southeast Hawai`i Island noted by Scott *et al.* (1986).

Red-billed Leothrix

Restricted exclusively to the mesic and wet forest habitat of Ka`ū, the Red-billed Leothrix was detected at a density of 0.33 birds/ha at 18% of the stations surveyed (Tables 2 and 3; Figure 22). The species was notably absent from upland areas in the South Flank and the leeward study areas where Scott *et al.* (1986) had recorded low to moderately high abundance. It is unknown to what extent this absence is a seasonal occurrence.

Japanese White-eye

The Japanese White-eye was the most abundant and widespread of all non-native birds. The species occurred in all habitats and within all of the five study areas of the Kahuku region (Figure 23). Its occurrence and density was highest in the pasture and forest mosaic at South Flank (98% of stations surveyed and 3.25 birds/ha; Tables 2 and 3). It also was found in high numbers in the forest and woodland of Ka`ū, Honomalino and Papa (64% and 2.36 birds/ha, 64% and 1.91 birds/ha, 72% and 2.86 birds/ha, respectively). It was also fairly common in the woodland at Northwest (47% and 1.88 birds/ha).

Common Myna

The Common Myna was only detected in the lower portions of the open pasture and forest remnant habitat at South Flank (Table 2; Figure 24). The species occurred at only

7% of the stations surveyed in the study area, and numbers were too low to estimate density. The Common Myna was absent from an area of dry open habitat in the upper mid-section of the Ka`ū study area and was also not observed in upland leeward habitats where Scott *et al.* (1986) had recorded the species' occurrence.

Saffron Finch

A single detection of a Saffron Finch was made at the very lowest extent of the open pasture habitat in the South Flank study area (Table 2; Figure 25). Noted by Scott *et al.* (1986) to have spread along the Kona coast since the HFBS, the species has since spread and occupies suitable habitat (lawns and close-cropped pasture) in South Kona and Ka`ū districts.

Yellow-billed Cardinal

The Yellow-billed Cardinal was incidentally seen within open pasture habitat at 600 m in the South Flank study area (Thane Pratt, pers. obs.). The Yellow-billed Cardinal is common on the leeward coast of Hawai`i Island up to about 700m elevation (Hawaii Audubon Society 1997), and in the past ten years the species has spread into Ka`ū District.

Northern Cardinal

The Northern Cardinal was the second-most abundant and widespread non-native bird species. It was recorded in all five study areas and in almost all habitats, although in lesser numbers than the Japanese White-eye (Figure 26). It occurred at a moderately high abundance throughout nearly the entire Honomalino study area (90% of stations surveyed and 0.83 birds/ha; Tables 2 and 3), and was also common in the neighboring Papa and South Flank study areas (61% and 0.58 birds/ha, 65% and 0.49 birds/ha). The species was uncommon in sub-alpine woodland at the lower portion of the Northwest study area (18% and 0.10 birds/ha) and in the mesic woodland and wet forest of Ka`ū (5% and 0.03 birds/ha). Its occurrence in the Ka`ū study area is notable since Scott *et al.* (1986) had not recorded it in the woodland and forest habitat in upper elevations of this region.

House Finch

The House Finch was the third-most common non-native species and was fairly abundant and widespread in all the study areas besides Ka`ū (Tables 2 and 3; Figure 27). It occurred in both the relatively dry and open habitats found in the leeward study areas, which are comprised of sub-alpine woodland and open pasture with remnant forest stands, as well as in the more mesic forest at Honomalino. The species was most abundant in Honomalino (45% of stations surveyed and 0.74 birds/ha) and South Flank (42% and 0.60 birds/ha). The House Finch was absent from the dry upland habitats in the Ka`ū study area at which Scott *et al.* (1986) had recorded the species' occurrence.

Yellow-fronted Canary

The Yellow-fronted Canary was only detected in the open pasture and forest remnant habitat at South Flank, and was recorded as high as about 1,600 m (Table 2; Figure 28). The species occurred at 11% of the stations surveyed in the study area, but numbers were

too low to estimate density. Absent at South Flank during the 1978 HFBS, its occurrence documents a range expansion in the region, where the species is now widespread.

DISCUSSION

The 2005 bird surveys within and adjacent to the Kahuku Unit of HAVO produced current estimates of the distribution, occurrence and density of ten native and 19 non-native forest bird species. Four of the eight native species found in forest habitat remain common and widespread: `Ōma`o, Hawai`i `Amakihi, `I`iwi and `Apapane. Alarmingly, the Hawai`i `Elepaio is very uncommon and shows evidence of a regional population decline in the Ka`ū region. The two native species using habitat other than forest—Hawaiian Hawk (`Io) and Pacific Golden-Plover (Kōlea)—were rarely detected in the study areas. Although fairly uncommon or rare and restricted in range, the populations of the endangered `Akiapōlā`au, Hawai`i `Ākepa and Hawai`i Creeper in the Ka`ū region are the second largest in the state of Hawai`i. Detection of these species in Kahuku now augments the number of species managed by HAVO. All three species are federally listed as endangered (U.S. Fish and Wildlife Service [USFWS] 1967, USFWS 1975, USFWS 1970), and protected under the State of Hawai`i Endangered Species Law (March 22, 1982). The region's habitat is critically important to the long-term survival of `Akiapōlā`au, Hawai`i `Ākepa and Hawai`i Creeper, and will require intensive efforts to restore and protect it from the impacts of ungulate browsing. Additional surveys at Northwest are warranted because the sub-alpine woodland habitat has the potential to support `Akiapōlā`au, Hawai`i `Ākepa and Hawai`i Creeper, and the area is located in close proximity to populations of these endangered species in the Kona Forest Unit of the Hakalau Forest National Wildlife Refuge. A discussion of the threats facing native birds and available management strategies may be found in Banko *et al.* (2001).

The Japanese White-eye, Northern Cardinal and House Finch were the most abundant and widespread of the non-native species. The remaining non-native species were uncommon to rare and restricted to either the dry leeward or wetter windward sides of Kahuku. Five non-native species were notably absent from habitats where they were recorded during the 1976 and 1978 Hawai`i Forest Bird Surveys (Scott *et al.* 1986): Black Francolin, Japanese Quail, Ring-necked Pheasant, California Quail, and Nutmeg Mannikin. The absence of the galliform birds may be due, in part, to these species' elusive and cryptic behavior and the low probability of detecting birds that occur at low abundances during VCP surveys. We are puzzled by past records of Black Francolin at Kahuku, as this species is otherwise absent from Ka`ū District. The most conspicuous apparent loss is that of the Ring-necked Pheasant, even though ample pastureland habitat remains. The species was not likely to have been missed since the study areas were repeatedly visited both by bird and botany crews. Interestingly, the race represented was the Japanese Green Pheasant (*P. c. versicolor*), and this distinctive green-breasted form occupied Kahuku as one of its last strongholds in Hawai`i. These three species of gallinaceous birds may also have declined as a result of competition with the now widespread and common Erckel's Francolin and Kalij Pheasant. The Nutmeg Mannikin may have been missed by the seasonal and "irruptive" nature of the species' movements. Lastly, we expect Japanese Bush-Warblers, a species that has recently moved into low elevation forests in adjacent Ka`ū Forest Reserve, to soon colonize Kahuku.

The survey transects established in the five study areas could serve as a sampling framework for future monitoring of bird population trends and changes in distribution. This information can provide insight towards those areas requiring management aimed at restoring native habitats and their constituent bird species. However, surveys of bird abundance alone do not fully answer questions pertaining to the viability of these populations. In addition, the variability inherent in the estimated densities of rare species can be very large and preclude assessment of trends in the near-term. In order to determine whether the resident populations are increasing, decreasing, or stable in Kahuku, demographic studies should be considered for tracking the three endangered species and for understanding their requirements for recovery.

ACKNOWLEDGEMENTS

We thank the Division of Forestry and Wildlife for access to the Ka`ū Forest Reserve, The Nature Conservancy – Hawai`i for access and use of cabin facilities, and Volcano Helicopters for safe transport. We especially thank Seth Judge, Katherine McLure, and Dean Sedgewick for the hard work of surveying the bird populations. We thank David Duffy, Unit Leader: the Pacific Cooperative Studies Unit. This project was carried out under a cooperative agreement between the National Park Service, Pacific Island Network and the Pacific Cooperative Studies Unit, University of Hawaii at Manoa (No. H8080040012, task agreement No. J8080040035).