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Forest Bird Inventory
Kalaupapa National Historical Park

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ABSTRACT

A survey for forest birds was conducted in Kalaupapa National Historical Park in 2005 to determine presence-absence and abundance. Forest bird surveys were conducted using the variable circular plot method. Survey stations were established 140 m apart along six transects of variable length. Stations were surveyed for birds from March – May 2005. Also included in the analysis are data from a Hawaii Forest Bird Survey in 2004 for two transects located in the park. Of the nine native species that once inhabited the island, only three remain: We detected the Apapane (*Himatione sanguinea*), Iiwi (*Vestiaria coccinea*) and Maui Amakihi (*Hemignathus virens wilsoni*). As on other islands, Molokai now supports a number of non-native birds including: the Barn Owl (*Tyto alba*), Black Francolin (*Francolinus francolinus*), Common Myna (*Acridotheres tristis*), House Finch (*Carpodacus mexicanus*), Japanese Bush-warbler (*Cettia diphone*), Japanese White-eye (*Zosterops japonicus*), Northern Cardinal (*Cardinalis cardinalis*), Nutmeg Mannikin (*Lonchura punctulata*), Red-billed Leiothrix (*Leiothrix lutea*), Skylark (*Alauda arvensis*), Spotted Dove (*Streptopelia chinensis*), and White-rumped Shama (*Copsychus malabaricus*). The results from the survey will be used to develop comprehensive monitoring and management plans for avian species in Kalaupapa National Historical Park.

INTRODUCTION

Most of Molokai's native birds have been extirpated or are extinct. Habitat destruction, introduced predators, and avian disease have been identified as leading causes for population declines and extinctions across the Hawaiian Islands and these factors certainly contributed to the demise of Molokai's native birds (Ralph and van Riper 1985). Historically, nine native species inhabited Molokai, yet within the last 20 years, only three species have been detected (Reynolds and Snetsinger 2001). In order to develop comprehensive monitoring and management plans for avian species, it is necessary to first determine which species are extant in Kalaupapa National Historical Park (KALA).

Bishop's Oo (*Moho bishopi*) is endemic to Molokai, and was last recorded there in 1904, though there were unconfirmed reports into the 1980s (Gorresen et al. in press; USFWS 2006). Once common and widespread in the main Hawaiian Island, the Ou (*Psittirostra psittacea*) was extirpated from Molokai by the early 1900s, as was the Akohekohe (Palmeria dolei; Gorresen et al. in press). On Molokai, the Akohekohe was once found at 1,200 m on the high forested plateau between Wailau and Pelekunu valleys (USFWS 2006). The Black Mamo (*Drepanis funerea*) has not been sighted since 1907, and is considered extinct (Scott and Kepler 1985). Kakawaihe (*Paroreomyza flammea*), or Molokai Creeper, common in the early 1900s at high and low elevations, was last seen in 1963 in the Puu Alii Natural Area Reserve (NAR) area (Pekelo 1963). The Olomao (*Myadestes lanaiensis*), or Molokai Thrush, was abundant into the early 1900s (Perkins 1903), but populations began declining by 1930 (Munro 1944). Three Hawaii Forest Bird Survey (HFBS) sightings were recorded in The Nature Conservancy's (TNC) Kamakou Preserve, adjacent to Puu Alii NAR in 1980 (Scott et al. 1986). These were the last well documented sightings of the Olomao. The native forests of Puu Alii NAR, upper Waihanau, and Hanalilolilo possess the best possible remaining habitat for these species.

Here we present the results of surveys that were conducted in these areas, along with all forested lands under jurisdiction of Kalaupapa National Historical Park (KALA). Maui Amakihi (*Hemignathus virens wilsoni*) and Apapane (*Himatione sanguinea*) are extant in higher-elevation native forest. Based on the HFBS conducted on Molokai in 1979, the Amakihi population is estimated at approximately 2,000 individuals, whereas Apapane is estimated at about 39,000 individuals (Scott et al. 1986). Recent detections at low elevation (<250 m) may indicate that some individuals are surviving infection and acquiring immunity to avian malaria (Atkinson and LaPointe in review). Iiwi (*Vestiaria coccinea*) are rarely seen on Molokai, but have been sighted in the native forest of Puu Alii NAR as reported by Aruch (2006). The most recent surveys conducted on Molokai, in 1988 and 1995, detected only two and one birds, respectively (Reynolds and Snetsinger 2001; Gorresen et al. in press). The objective of this inventory was to determine species presence-absence and abundance in KALA. Although portions of KALA have been surveyed for forest birds, a comprehensive survey has not been conducted in the park before. The data from this survey will be used to make recommendations and provide baseline information for future inventories and for the development of comprehensive monitoring and management plans for avian species.

Habitat Description

Located on the island of Molokai, KALA is 4,553 ha in size and encompasses Kalawao County (Fig. 1). This county includes the Kalaupapa peninsula and settlement of the same name, adjacent cliffs and valleys, and submerged lands and water out to one-quarter mile from shore. The park's terrestrial landscape consists of wet and mesic forest, dryland forest and coastal lowlands. The wet and mesic forests range from intact native forests dominated by ohia (*Metrosideros polymorpha*) and tree ferns at high elevation, to non-native dominated java plum (*Syzygium cumini*) and guava (*Psidium cattleianum*) forest in the lowlands. These non-native forest types typically have dense understories, with Christmasberry (*Schinus terebinthifolius*) in the valleys and lantana (*Lantana camara*) thickets on the peninsula. The ground cover within high elevation native forests consists of native ferns, herbs and grasses with scattered non-native vegetation. Dryland forest is less densely vegetated than wet and mesic forests, and usually is dominated by non-native plants.

Figure 1. Aerial photo of Kalaupapa Peninsula looking eastward, Kalaupapa National Historical Park, 2005.

METHODS

We surveyed six areas of KALA (Fig. 2). Few biological transects existed at KALA prior to this survey, thus we established several new transects across a range of elevations and plant communities. At Waihanau Valley and Waikolu Valley both upper and lower transects were set up; in each of the other areas only one transect was established. Portions of these transects (except for the Kalaupapa Cliff Trail) were also used for the 2005 small mammal inventory (Marshall et al. in review). In addition two existing HFBS transects were inventoried.

- Waihanau Valley is the westernmost valley on Molokai's northern shore. The lower Waihanau transect runs north-south along the valley's narrow floor, proximal to the intermittent stream, and is dominated by non-native vegetation and has a non-native understory. The upper Waihanau transect follows Puu Kauwa Road in the Molokai Forest Reserve, and is a mixed native/non-native forest with a non-native understory. The transect overlooks Waihanau Valley and Kalaupapa Peninsula (Fig. 3).
- Kauhako Crater is the highest natural point on the peninsula at 100 m (Fig. 4). The transect runs along the crater rim, descends, and follows along the plateau above the lake. Kauhako Crater is dominated by non-native vegetation, with a non-native understory.
- Waikolu Valley lies east of Waihanau (Fig. 5), and has been a water source for Molokai since the early 1900s. The lower Waikolu transect runs north-south, along an old aqueduct pipe. The vegetation is entirely non-native including a non-native understory. HFBS transect 3 covers the upper Waikolu rim area along the Hanalilolilo trail. The vegetation is wet montane forest with a native ohia canopy and native understory.
- In Puu Alii NAR HFBS transect 4 was utilized. The transect begins at Puu Alii, elevation 1200 m, and dissects the NAR finishing on the rim of Waikolu in the north western most corner of the plateau. The vegetation consists of wet montane forest with a native ohia canopy and very few understory weeds.
- Kukaiwaa is a small peninsula east of Waikolu Valley, lying close to the offshore islets (Fig. 6). The Kukaiwaa transect runs along a 250 m predator fence transecting the peninsula east-west, then wraps around to the open coastal area. The vegetation is mixed native/non-native, with a non-native understory.
- Kalaupapa Cliff Trail is a historical trail used to enter the park by foot. The trail runs from sea level to 480 m in elevation. The transect began at the top of the trail and went down to just past switchback 26. The Cliff Trail is dominated by non-native vegetation including a non-native understory.

One hundred and two stations were surveyed (Table 1). Station locations were recorded with a Global Positioning System (GPS) Garmin GPSmap76 unit, using the Universal Transverse Mercator, North American Datum 1983, Zone 4N.

Table 1. *Transect data for the forest bird inventory at Kalaupapa National Historical Park, conducted March–April 2004 (HFBS transects only) and March–May 2005.*

Transect	Elevation (m)	# of Stations	Vegetation
Kukaiwaa	20-80	6	Mixed: hala (*Pandanus tectorius*) as well as non-natives (java plum, lantana)
Kauhako Crater	40 -100	9	Non-native: java plum, christmas berry, lantana
Lower Waikolu	80-180	10	Non-native: guava spp., kukui *(Aleurites moluccana*)
Lower Waihanau	160-320	12	Non-native: java plum, guava spp.
Kalaupapa Cliff Trail	100-480	7	Non-native: java plum, christmas berry
Upper Waihanau	700-800	8	Mixed: ohia as well as abandoned non-native tree plantations (eucalyptus and pine)
Puu Alii NAR (HFBS 4)	940-1280	31*	Native: ohia, treefern, shrub
Upper Waikolu (HFBS 3)	1000-1280	20	Native: ohia, treefern, shrub

* There are thirty stations along this transect, one of which was surveyed twice.

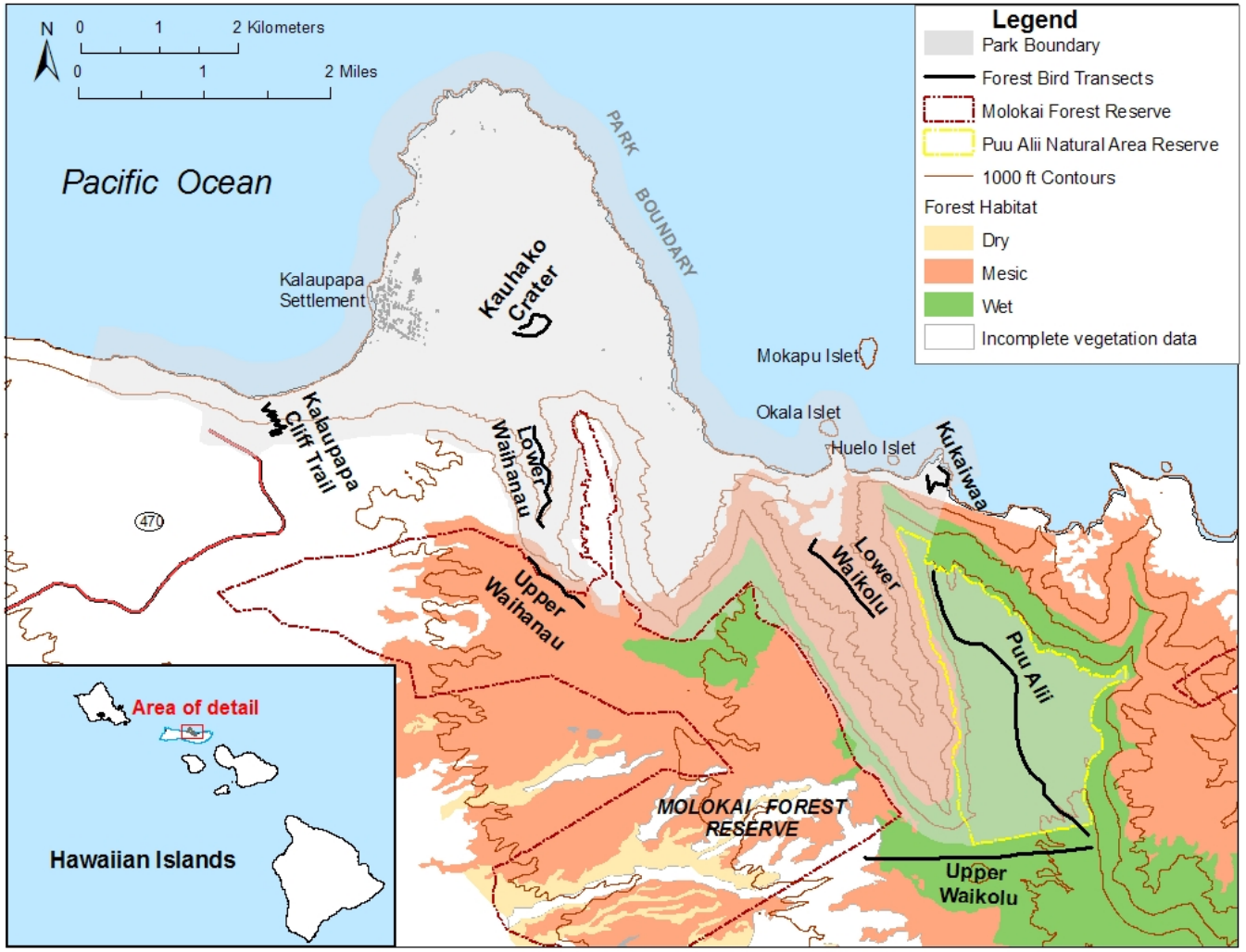

Figure 2. Forest bird inventory transects, Kalaupapa National Historical Park, March–April, 2004 and March–April 2005.

Bird Survey

The survey was completed over the course of six days, March–May 2005. Data collected for the 2004 (March and April) Molokai Forest Bird Survey were obtained from the Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) and included in the analysis. Two HFBS transects within Kalaupapa National Historical Park were censused during the 2004 survey. HFBS transect 3 and 4 are located in the Upper Waikolu Valley and Puu Alii NAR areas, respectively.

Forest birds were surveyed using the variable circular plot (VCP) method utilized by HFBS (Scott et al. 1986). This is the same method that is used in annual forest bird surveys across the state by a variety of state and federal agencies and organizations, including DOFAW, the US Fish and Wildlife Service (USFWS), and the US Geological Survey (USGS). Standard methodology on station spacing, diurnal timing of surveys, and length of count period were consistent with the HFBS. Stations were established every 140 m along the transects, surveys were conducted during morning hours before 11:00 am, since bird detectability from counts after 11:00 am may be biased due to diminished bird activity. Before the start of each count, weather data were recorded, including cloud cover (estimated to the nearest 10%), wind (according to the Beaufort scale) and rain (based on a 0–4 scale), and the date, observer name and start and end time for each count were also recorded. All birds seen or heard during an eight–minute count period were recorded with the detection type (audio, visual, or combined detection) and the distance to the bird when first detected, estimated to the nearest meter. Data were recorded in standard forest bird survey books.

At each station a primary surveyor recorded forest bird observations. The primary surveyor was an experienced observer trained to recognize all Molokai birds. Training included calibration for estimation of the distance to the birds detected. No secondary surveyors served during this inventory.

Data Analysis and Data Management

All field data were entered into the Avian Monitoring Entry Form (AMEF) Access database program from the Hawaii Forest Bird Interagency Database Project (HFBIDP). The AMEF program calculates summaries of bird detections. The number of birds per station (BPS) and percent of occurrence were calculated and presented here as a baseline. According to the AMEF manual (January 2004), the number of BPS is calculated by dividing the number detected by the number of stations surveyed, and the percent occurrence (% occurrence) is calculated by dividing the number of stations occupied by birds by the number of stations surveyed.

All raw data are housed at Kalaupapa NHP. Copies of field data sheets, project logs, summary data, reports, databases and GIS layers were sent to the Pacific Island Network (PACN) office at Hawaii Volcanoes National Park (HAVO). The HFBIDP stores copies of all VCP counts for the state and was provided copies of the databases and field books. Species presence data from this inventory were entered into NPSpecies, the National Park Service Biodiversity Database.

Figure 3. Photo of Kauhako Crater and Kalaupapa Peninsula from Upper Waihanau, Kalauapapa National Historical Park, 3 May 2005.

Figure 4. Aerial photo of Kauhako Crater and Waihanau Valley. Kalaupapa National Historical Park, 2005.

Figure 5. Photo of lower Waikolu Valley and Okala Islet from Waikolu Overlook, Molokai, 2005.

Figure 6. Aerial photo of Kukaiwaa Peninsula, Kalaupapa National Historical Park, 2005.

RESULTS AND DISCUSSION

Three native bird species and 12 non-native bird species were detected during the surveys (Table 2). The native species present were the Apapane, Maui Amakihi, and Iiwi. All of these species have previously been observed in the park. The non-native species present were Barn Owl (*Tyto alba*), Black Francolin (*Francolinus francolinus*), Common Myna (*Acridotheres tristis*), House Finch (*Carpodacus mexicanus*), Japanese Bush-warbler (*Cettia diphone*), Japanese White-eye (*Zosterops japonicus*), Northern Cardinal (*Cardinalis cardinalis*), Nutmeg Mannikin (*Lonchura punctulata*), Red-billed Leiothrix (*Leiothrix lutea*), Skylark (*Alauda arvensis*), Spotted Dove (*Streptopelia chinensis*), and White-rumped Shama (*Copsychus malabaricus*). Iiwi was the only rare native species observed. Japanese White-eye was the most abundant species, and Iiwi, Barn Owl, and Skylark were the rarest species (Table 3).

Table 2. *Summary of forest bird detections for individual transects at Kalaupapa National Historical Park for surveys conducted March–April 2004 and March–May 2005.*

	Species		Kukaiwaa	Kauhako Crater	Lower Waikolu	Lower Waihanau	Kalaupapa Cliff Trail	Upper Waihanau	Puu Alii NAR	Upper Waikolu
	Common Name	**Scientific Name**								
Native	Apapane	*Himatione sanguinea*			✓	✓	✓	✓	✓	✓
	Iiwi	*Vestiaria coccinea*								✓
	Maui Amakihi	*Hemignathus virens wilsoni*			✓				✓	
Non-native	Barn Owl	*Tyto alba*			✓					
	Black Francolin	*Francolinus francolinus*		✓			✓			✓
	Common Myna	*Acridotheres tristis*	✓	✓	✓		✓			
	House Finch	*Carpodocus mexicanus*	✓	✓			✓	✓	✓	✓
	Iiwi	*Vestiaria coccinea*								✓
	Japanese Bush-warbler	*Cettia diphone*	✓	✓	✓	✓	✓	✓	✓	✓
	Japanese White-eye	*Zosterops japonicus*	✓	✓	✓	✓	✓	✓	✓	✓
	Northern Cardinal	*Cardinalis cardinalis*	✓	✓	✓	✓	✓	✓	✓	✓
	Nutmeg Mannikin	*Lonchura punctulata*	✓						✓	
	Red-billed Leiothrix	*Leiothrix lutea*							✓	✓
	Skylark	*Alauda arvensis*					✓			
	Spotted Dove	*Streptophelia chinensis*		✓	✓	✓	✓	✓	✓	✓
	White-rumped Shama	*Copsychus malabaricus*	✓	✓	✓	✓	✓			

Table 3. *Forest bird detection data for Kalaupapa National Historical Park for surveys conducted March–April 2004 and March–May 2005.*

	Species	Number of Transects Occupied	Number of Detections	Percent of Occurrence	Birds per Station
Native	Apapane	67	223	66	2.2
	Iiwi	1	1	1	0.0
	Maui Amakihi	12	20	12	0.2
Non-native	Barn Owl	1	1	1	0.0
	Black Francolin	11	21	11	0.2
	Common Myna	10	23	10	0.2
	House Finch	19	53	19	0.5
	Japanese Bush-warbler	84	310	82	3.0
	Japanese White-eye	96	452	94	4.4
	Northern Cardinal	46	128	45	1.3
	Nutmeg Mannikin	2	5	2	0.1
	Red-billed Leiothrix	35	85	34	0.8
	Skylark	1	1	1	0.0
	Spotted Dove	26	47	25	0.5
	White-rumped Shama	29	64	26	0.6

Table 4 summarizes the inventory data by elevation strata. All three native bird species were found at the high elevation sites, all of which contain native vegetation. Ohia-dominated forest remains in high elevation Puu Alii NAR and Waikolu Valley, and the adjacent Upper Waihanau area has a mixed native/non-native forest. The one Iiwi detection was at the high elevation Waikolu site, which is consistent with where Iiwi are most often detected: in closed canopy, high stature ohia forest above 1500 m (Gorresen et al. in press). Three Iiwi were detected during the 1979 HFBS as well, on the Puu Alii NAR transect (Scott et al. 1986).

Apapane were detected most frequently at high elevation sites (92% occurrence and 3.2 BPS) forests. Percent occurrence and BPS for Apapane for just the two upper elevation HFBS transects that were also surveyed in 1979 were 94% and 3.14. The percent occurrence for the 1979 HFBS was similar at 100%, but the BPS was twice as high at 6.4. At mid and low elevations Apapane were detected much less frequently (35 detections). At low elevations they were found in lower Waikolu Valley (22 detections) and at three stations in the back of Waihanau Valley (eight detections). Apapane are believed to forage up and down the valley wall, thus are detectable at the upper and lower Waihanau Valley transects.

At lower elevations Maui Amakihi were detected exclusively on the Waikolu Valley transect, which is dominated by non-native vegetation (17 detections). Percent occurrence and BPS for Maui Amakihi were 23% and 0.4 for the lower elevation transects. Curiously, only three (five percent occurrence, 0.1 BPS) Maui Amakihi were detected at the high elevation site of Puu Alii, which is dominated by native vegetation. The percent occurrence and BPS were 6% and 0.03 for the two HFBS transects (Puu Alii NAR and Upper Waikolu). In comparison, the percent

occurrence and BPS for the 1979 HFBS were similar to the 2005 results of the low elevation transects. It should also be noted that a female Maui Amakihi was seen nest-building in Waikolu Valley at an elevation of 100 m.

Avian malaria (*Plasmodium*), of which the non-native mosquito *Culex quinquefasciatus* is a vector, is one of the factors responsible for the reduction in native bird populations in Hawaii (Warner 1968). However, recent studies in the Puna district of Hawaii Island have shown that Amakihi populations have increased (Woodworth et al. 2005). Atkinson and LaPointe (in review) report that detections of Amakihi at low elevations may indicate the development of resistance to avian malaria that can be passed to their offspring, thereby facilitating the repopulation of low elevation areas. Molokai's highest point reaches 1,515 m; therefore, the entire island lies within the elevation range of mosquitoes. As a result, all native avifauna are exposed to mosquitoes and, consequently, to avian malaria and pox. The presence of Maui Amakihi and Apapane at the low elevation sites in Kalaupapa may be evidence of resistance to disease.

Non-native birds were present throughout the inventory transects. Of the non-native bird species, only Barn Owl, White-rumped Shama, Skylark, and Common Myna were absent from high elevation stations. Red-billed Leiothrix were absent from low and mid elevation (200-500 m) stations.

The Japanese White-eye and Japanese Bush-warbler were the most common non-native bird species detected during the survey and were found at all elevations. Introduced to the Hawaiian Islands in the early 1900s, Japanese White-eye occurred on all transects sampled in our inventory. The percent occurrence of Japanese White-eye estimated for the two HFBS transects for this inventory (88%) remain close to that of the 1979 Molokai HFBS (100%), but the BPS in 2004 (2.36) was lower than in 1979 (7.34; Scott et al. 1986). Japanese White-eyes are omnivores and forage mostly on fruit, nectar, and insects from the understory (Scott et al. 1986). This forage behavior may impact native birds, such as the Maui Amakihi, that use similar food resources (Mountainspring and Scott 1985).

Japanese Bush-warblers were first detected on Molokai in the late 1970s (Pyle 1979; Conant 1980). During the 1979 HFBS, Japanese Bush-warblers were not detected on the two high elevation HFBS transects that were surveyed in 2004 (Scott et al. 1986). This survey reports percent of occurrence and BPS of 100% and 4.32 at these same transects. Given that this species was only present on Molokai for a couple of years prior to the 1979 surveys, their rapid growth between surveys is not surprising. Berger (1981) typifies the Japanese Bush-warbler as preferring habitat with an abundant understory; they primarily forage for insects, but also eat fruit and nectar.

Red-billed Leothrix was introduced to the Hawaiian Islands in the early 1900s, and by the 1970s was well established on Molokai (Scott et al. 1986). This species forages mostly in the understory on insects and fleshy fruits (Mountainspring and Scott 1985). Red-billed Leothrix was only found at the high elevation HFBS transects, with percent occurrence and BPS of 70% and 1.7 for those two transects. These findings agree with the 1979 HFBS where these birds occurred mainly above 1,100 m elevation, with a percent occurrence of 70% and a BPS of 2.96 (Scott et al. 1986).

Table 4. *Summary of forest bird detections by elevation range in Kalaupapa National Historical Park for surveys conducted March–April 2004 and March–May 2005.*

	Species	Low Elevation (<200m)*			Mid Elevation (200-500 m)*			High Elevation (>500 m)*		
		# Detections	% Occurrence	BPS	# Detections	% Occurrence	BPS	# Detections	% Occurrence	BPS
Native	Apapane	30	26	0.8	5	60	1	188	92	3.2
	Iiwi	0	0	0.0	0	0	0	1	2	0.0
	Maui Amakihi	17	23	0.4	0	0	0	3	5	0.1
Non-native	Barn Owl	1	3	0.0	0	0	0	0	0	0.0
	Black Francolin	5	10	0.1	3	40	0.6	13	8	0.2
	Common Myna	21	23	0.5	2	20	0.4	0	0	0.0
	House Finch	46	33	1.2	3	40	0.6	4	7	0.1
	Japanese Bush-warbler	49	56	1.3	7	60	1.4	254	98	4.3
	Japanese White-eye	222	95	5.7	39	100	7.8	191	88	3.2
	Northern Cardinal	96	87	2.5	10	80	2	22	14	0.4
	Nutmeg Mannikin	4	3	0.1	0	0	0	1	2	0.0
	Red-billed Leiothrix	0	0	0.0	0	0	0	85	59	1.4
	Skylark	0	0	0.0	1	20	0.2	0	0	0.0
	Spotted Dove	35	48.7	0.9	1	20	0.1	11	10	0.2
	White-rumped Shama	57	87	1.5	10	60	1.4	0	0	0.0

* Low elevation: includes all stations on the Kukaiwaa, Kauhako Crater, Lower Waikolu, Lower Waihanau transects and stations 6&7 on the Kalaupapa Cliff Trail transect.
Mid elevation: includes stations 1-5 on the Kalaupapa Cliff Trail transect
High elevation: includes all stations on the Upper Waihanau, Upper Waikolu and Puu Alii transects

Introduced to the Hawaiian Islands in 1929, Northern Cardinals are well established in native and non-native habitats throughout the islands (Scott et al. 1986). Northern Cardinals prefer hedges, thickets, and open woodlands and eat a variety of foods, such as seeds, fruits, and insects (Scott et al. 1986). This species was found at all transects except for the two high elevation HFBS transects. This agrees with the results of the 1979 HFBS which also showed no detections of Northern Cardinals on these transects (Scott et al. 1986).

White-rumped Shamas were first released on Oahu in 1940, and by 1960 were established on Kauai (Scott et al. 1986). This species was frequently detected in 2005 with a percent occurrence of 24% and BPS 0.57, but only at the low elevation sites. According to Scott et al. (1986), there were no known records on Molokai for this species when the HFBS were conducted in 1979. This species mainly eats insects (Berger 1981).

Spotted Doves were introduced in the late 1800s, and are widely dispersed among the Hawaiian Islands (Scott et al. 1986). This species was more common at lower elevations, with a percent occurrence of 48.7% and a BPS of 0.9 for low elevation sites. Percent occurrence and BPS for the two HFBS transects in 2004 was very low at 4% and 0.04. The low elevation densities are more similar to Scott et al. (1996) findings from the 1979 HFBS, which showed percent occurrence and BPS to be 34% and 0.88. Spotted Doves mainly forage for insects and seeds on the ground.

House Finches arrived in the Hawaiian Islands before 1870, and became well established by the 1940s (Scott et al. 1986). This species occurs over a broad range of habitats and is most common over a range of elevations in dry woodlands and savannas (Scott et al. 1986). During the 2004 survey, the percent occurrence was 6% and BPS was 0.06 at the two HFBS transects, which is similar to the 1979 survey findings of percent occurrence and BPS of 4% and 0.04.

Introduced from India in 1959, Black Francolins occur on Molokai, as well as Hawaii, Maui, Molokai, and Kauai. This species was not found at either of the two HFBS transects, but was found at the other high elevation transect. With a percent occurrence of 11% and a BPS of 0.2, it was not detected often during the survey. This is not unexpected since highest densities of this species occur in dry shrubland and savanna, with some individuals entering closed canopy forests along roads, clearings, and grassy areas. The 1979 HFBS results did detect Black Francolins at the higher elevation, with a percent occurrence of 20% and a BPS of 0.42. This species consumes plants, insects, and seeds (Scott et al. 1986).

Common Mynas were introduced from India in 1865, are common to abundant in low elevation areas excluding forest interiors, and are predominately terrestrial omnivores (Scott et al 1986). All detections of Common Mynas occurred at low elevation stations in the 2004/05 survey, which is consistent with the 1979 HFBS results, which also showed no detections of Common Mynas.

Nutmeg Mannikins were introduced in the mid 1800s and spread rapidly thereafter (Scott et al. 1986). Only five individuals were detected during this survey, and only one was detected at a high elevation HFBS transect. The HFBS did find that the highest densities of this species in the state were found on Molokai at low to mid elevations (Scott et al. 1986).

Of the last two species detected, the Barn Owl and the Skylark, only one individual of each was detected, neither of them at high elevations. Barn Owls are nocturnal and are not commonly

found in the forest (Scott et al. 1986), which may account for their low detection rate. The Barn Owl was sighted at about 200 m elevation among the non-native trees of the Lower Waikolu transect. No Barn Owls were detected during the 1979 survey at the two high elevation HFBS transects. The single Skylark was detected among the non-native scrub along the Kalaupapa Cliff trail. Skylarks are most common in dry scrub, savanna, and woodland, and also were not detected on Molokai during the 1979 HFBS (Scott et al. 1986).

We make three recommendations to improve future surveys. First, as birds are more vocal during breeding seasons than other times of the year, we recommend that surveys should be conducted during periods of peak vocalization to ensure high detectability. Second, increasing the amount of area covered in future surveys (i.e., surveying additional valleys) is also suggested; this will increase the spatial coverage and increase the sample size. Lastly, Molokai Thrush and Molokai Creeper are thought to possibly be extinct. If they are extant, we would not expect to detect them during VCP counts as this technique is not appropriate for extremely rare species. For surveying these species we suggest following the Rare Bird Search protocol established by Reynolds and Snetsinger (2001; see also Turner et al. 2006) in the intact high elevation forests to confirm whether they are truly absent.

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