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Recent Surveys Indicate Rapid Decline of Palila Population

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INTRODUCTION

Recent surveys have revealed that the Federally endangered Palila (*Loxioides bailleui*), Hawaii's most thoroughly studied and monitored forest bird species, is rapidly declining in number. Palila were once found in lowland habitats on several islands (Olson and James 1982, Burney et al. 2001), but historically they are only known from the Island of Hawai'i. In the late 19th century they lived in mixed forests of māmane (*Sophora chrysophylla*) and naio (*Myoporum sandwicense*) trees ranging from the upper slopes of Mauna Kea to the northwestern slope of Mauna Loa, and probably the southern and eastern slopes of Hualālai (Fig. 1; U.S. Fish and Wildlife Service 2006).

Today, Palila are restricted to subalpine forests of Mauna Kea in an area comprising less than 5% of their historic range (Fig. 1). Palila have suffered from habitat destruction, predation by non-native mammals, disease, and other threats that have decimated Hawaiian forest birds generally, but their dependence upon the seeds of māmane trees for 90% of their food increases their vulnerability (van Riper et al. 1978, Scott et al. 1984, Pratt et al. 1997, USFWS 2006). About 96% of the Palila population lives in a small area (less than 30 km^2) on Mauna Kea's western slope (Banko et al. 2002), hereafter termed the "core" area.

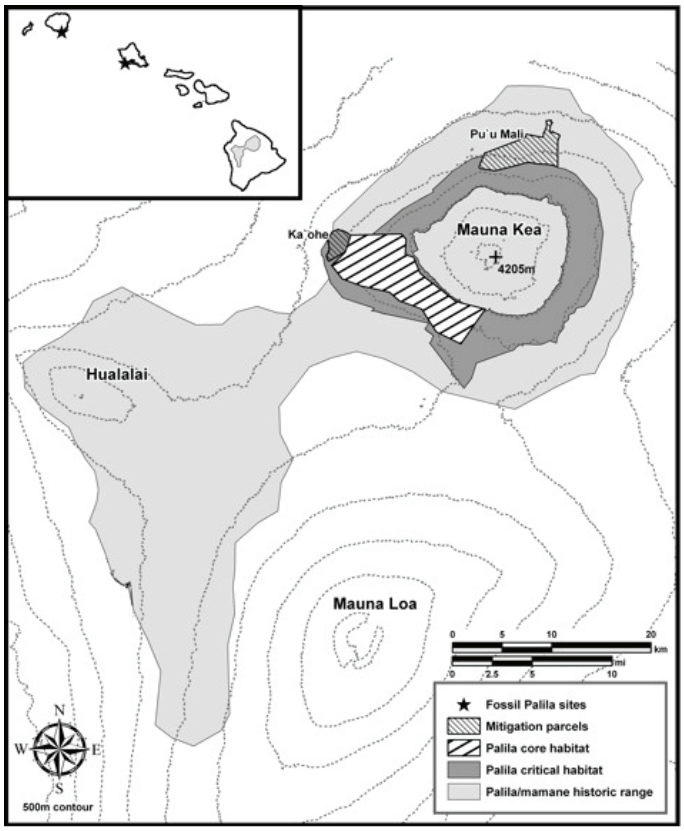

FIGURE 1. Palila *(Loxioides bailleui)* and māmane historic range on the Island of Hawai'i as well as their critical habitat as designated by the U. S. Fish and Wildlife Service and core habitat (see text for details).

A male Palila *(Loxioides bailleui)* feeds from a māmane tree. This finch-billed endemic and endangered Hawaiian honeycreeper has a yellow head and breast, gray back, yellowish wings, and grayish-white underparts. Palila feed primarily on immature seed pods of the māmane tree, as well as insects, naio berries, and māmane buds, flowers, and young leaves.

Photo by Tom Dove.

For over 200 years, ungulates have been degrading Palila habitat (Hess et al. 1999). Because of the species' dependence on dwindling māmane forests, critical habitat for the species was designated in 1977 (U.S. Fish and Wildlife Service 1977). Federal and state court rulings in the late 1970s and 1980s mandated the removal of all goats (*Capra hircus*), sheep (*Ovis aries* and *O. musimon*) and hybrids (*O. aries* x *musimon*) from critical habitat because Palila were being harmed by the loss and degradation of their habitat (Johnson et al. 2006, U.S. Fish and Wildlife Service 2006). Goats have been eradicated, but feral and mouflon sheep, as well as hybrids, remain, although their numbers have been reduced sufficiently to allow māmane regeneration in some areas (Hess et al. 1999). This effort has been hampered by the expense and difficulty of removing and excluding these animals over such a large area, as well as the difficulty of resolving land-use conflicts (Juvik et al. 1992).

In part because of the court rulings, Palila are one of the best monitored birds in the world, and have been surveyed annually since 1980. Johnson et al. (2006) analyzed mountain-

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wide surveys from 1980 to 2004, and although there were large fluctuations in the estimates, they detected no statistically significant trend in the population since the late 1990s. Although basic methods have remained consistent, responsibility for surveys has changed over time. From 1980 to 1995, the Hawai'i Division of Forestry and Wildlife (DOFAW) and U.S. Fish and Wildlife Service (USFWS) conducted censuses jointly. From 1996 to 2006, the U.S. Geological Survey (USGS) led surveys. DOFAW assumed responsibility for monitoring in 2007 and will continue to conduct annual surveys into the foreseeable future. Here we present results from the January 2005, 2006, 2007 surveys as well as preliminary results from the 2008 Palila counts, and analyze them in the context of previous population estimates.

METHODS

We surveyed the entire māmane- and naio-dominated woodland (1,800 – 3,000 meters in elevation), approximately 250 km^2, on Mauna Kea for Palila in January of 2005, 2006, 2007, and 2008. General survey methods and data analyses followed Gray et al. (1999) and Johnson et al. (2006). We surveyed 32 transects each year using the variable circular plot (VCP) method. On the western slope, where most Palila are found, we surveyed nearly the same number of stations (387-404) and transects (12-13) each year (Table 1). All birds seen or heard were recorded, and the horizontal distance between the bird and the observer was estimated to the nearest meter. Density and population estimates were calculated following Johnson et al. (2006). Five transects were added to the core habitat area in 1998 to increase the precision and accuracy of population estimates. In order to compare the pre-1998 population numbers with the improved, later figures we calculated the 1998 – 2007 populations with and without the new transects. We then used a regression estimator on the two sets of numbers to adjust the pre-1998 numbers to the same scale as the superior post-1997 estimates. We present a preliminary result from the 2008 survey, but this estimate was not included in any of the formal analyses.

RESULTS

Data from the 2005 – 2007 annual surveys resulted in population estimates ranging from a high of 5,337 birds in 2005 to a low of 3,862 birds in 2007 (Table 1). Preliminary analysis of data from 2008 indicates that the decline has continued with the most current population estimate being 2,640. These estimates were for the core area and were based upon a total of 878 observations of Palila from 1998 to 2007 from 402 stations on 12 transects (Fig. 2). An additional 340 stations on 20 transects were surveyed outside the core population, where we detected 20 Palila, all at the site of the re-introduced sub-population on the northern slope. The 2007 estimate is the fourth consecutive year in which the Palila population decreased (Fig. 3); the preliminary 2008 estimate extends the decline to five years. A similar period of decline has not occurred since surveys were initiated 27 years ago, and this is the first decline that has been statistically significant (least squares regression: $F_{1,3} = 124$, $P < 0.01$, $R^2 = 0.98$). From 2003 to 2007, the estimated number of Palila in the core population has declined by 58%.

DISCUSSION

Over the 27-year survey period, the estimate of Palila abundance has varied considerably, from approximately 1,300 to 6,900 individuals. For example, population estimates dropped over 40% from the preceding year in 1981, 1990, 1991, 1996, and 1999. Despite this variation, the only statistically significant decline began in 2003 and continued through the 2007 survey. Such a consistent and prolonged population decline has not

TABLE 1. Summary of Palila surveys conducted during January of 2005 - 2007 on the western slope of Mauna Kea, Island of Hawai'i.

Year	Population Estimate	95% Confidence Interval	Palila Observed	Stations Surveyed	Transects Surveyed
2005	5337	4259 – 6467	338	404	13
2006	4601	3671 – 5556	304	397	13
2007	3862	3134 – 4750	236	387	12
2008	2640	2154 – 3264	197	385	12

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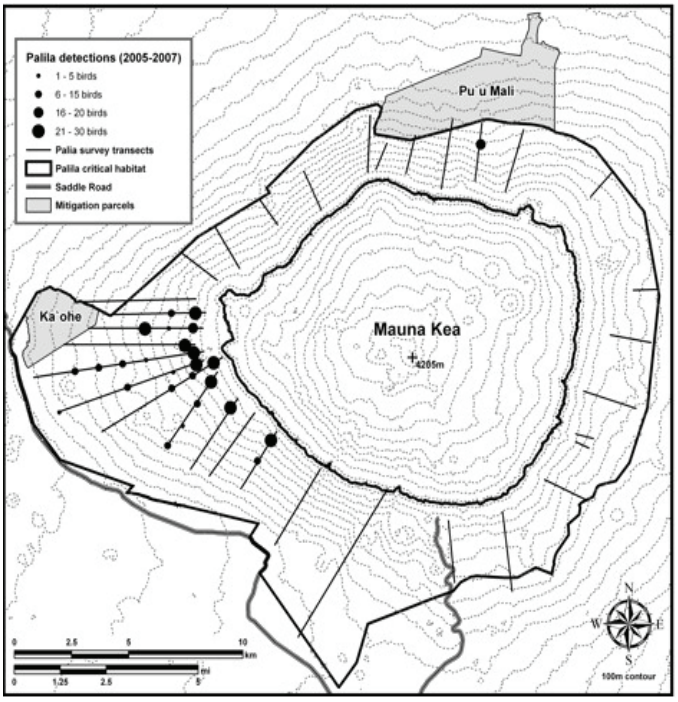

FIGURE 2. Transects surveyed to obtain population estimates of Palila and the number of birds detected during the 2005 – 2007 surveys. Circles denote the total number of birds detected per seven count stations over all three years.

been observed in any previous period of the Palila time series. In fact, if the trajectory continues without change, the species will be extinct by 2013. Although a portion of the variation in abundance is due to the difficulty of surveying this highly mobile species (Johnson et al. 2006), our analysis mitigated the most serious confounding factors by standardizing sampling methodology and analytical techniques. Additionally, abundance estimates were produced from the surveys of the core population sampled under the same protocol, and inference was limited to a consistent and well-defined region. Our survey effort on the western slope was sufficiently consistent that results would not have been affected by the minor drop in the number of stations surveyed over the 3-year period.

The population's four-year, nearly linear decline and the apparent disappearance of Palila from the southern and eastern slopes of Mauna Kea, indicates that their dramatic range contraction (Fig. 1) may be continuing. This reduction is unexpected given that Hess et al. (1999) reported an improvement in Palila habitat following the periodic removal of introduced ungulates. Other factors may be acting in concert with the current drought and the concomitant reduction in māmane seed production (see Gray et al. 1999) to produce the sharp population decline we describe here. Among the factors contributing to bird mortality and habitat loss are *Armillaria*, an invasive tree fungus that may be killing māmane trees (Gardner and Trujillo 2001), alien parasitoid wasps competing with Palila for caterpillars that are fed to nestlings (Brenner et al. 2002, Oboyski et al. 2004), and feral cats (*Felis catus*) depredating nests and adult birds (Pletschet and Kelly 1990, Amarasekare 1993, Pratt et al. 1997, Laut et al. 2003, Hess et al. 2004).

Currently the Division of Forestry and Wildlife and partners are engaged in a variety of efforts to benefit the Palila, including biannual aerial sheep hunts (DOFAW unpubl. data) and feral cat removal (J. Higashino, pers. comm.). As partial mitigation for realigning the Saddle Road through Palila critical habitat, funds were made available to establish and restore two parcels of former cattle pasture, one on the northern slope of Mauna Kea (Pu'u Mali) and the other adjacent to the core population (Ka'ohe; U.S. Fish and Wildlife Service 1998, Federal Highway Administration 1999). Saddle Road mitigation also has funded the reintroduction of Palila to Mauna Kea's northern slope and a small sub-population has been established there by translocating wild Palila (USGS unpubl. data) and releasing captive-reared birds (Lieberman et al. 2006). Although several pairs have bred successfully and their offspring have survived to breeding age, the tiny sub-population is not yet self-sustaining (Leonard and Nelson 2007, DOFAW unpubl. data, USGS unpubl. data). The Zoological Society of San Diego continues to breed captive Palila for future releases to support the sub-population on Mauna Kea's northern slope.

Despite restoration efforts, the Palila population has been declining steadily and significantly over the past four years. This trend is unprecedented and also troubling because there seems to be no overt cause for the decline, although rainfall patterns should be investigated for evidence of a drying trend. Drought can reduce māmane pod production, which may result in lower Palila survival and reproduction (Lindsey et al. 1997). Stopping the decline of the Palila population and preventing another extinction requires at a minimum that known threats to the birds and their habitat are curtailed. Since 1778, 22 Hawaiian forest bird species and subspecies have gone extinct (Banko et al. 2001, U. S. Fish and Wildlife Service 2006). Unfortunately this trend has continued into the 21st century. The Po'ouli (*Melamprosops phaeosoma*) likely vanished in 2004 (VanderWerf et al. 2006), indicating that extinction is a continuing threat to Hawaiian birds.

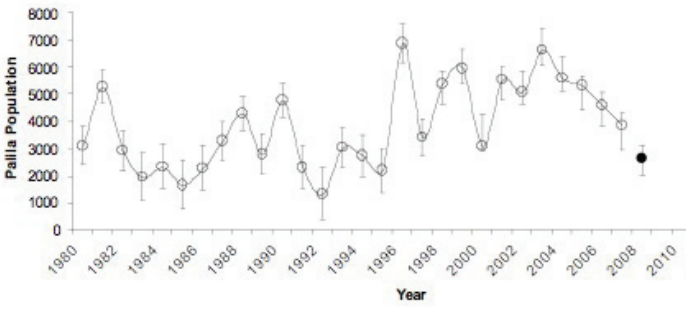

FIGURE 3. Palila population abundance from 1980-2007, error bars represent 95% confidence intervals. Pre-1998 numbers have been scaled to be comparable with the estimates produced after increased survey effort began in 1998. The solid dot represents the preliminary estimate for 2008.

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ACKNOWLEDGEMENTS

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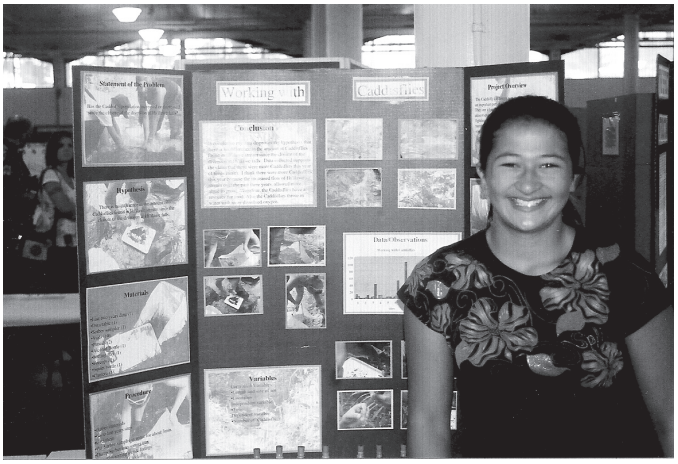
HAS Presents Awards For Student Research

By Wendy Johnson, Education Committee Chair

The Hawaii Audubon Society presented two awards for outstanding research relating to Hawaii's natural history at the 51st Hawai'i State Science and Engineering Fair. In early April representatives of the Hawaii Audubon Society's Education Committee joined other agency judges in studying the exhibits and interviewing students on the subject of their original research.

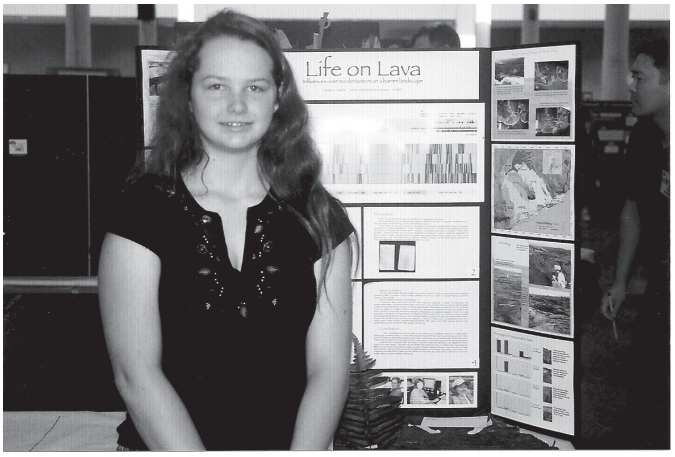
Lei'ohu Santos-Colburn, who is a sophomore at Kanu o Ka 'Āina Charter School on the island of Hawai'i, received the HAS Senior Division Research award for her project entitled "Working with Caddisflies". While Caddisflies are tiny moth-like introduced insects, they are a good food source for the native fresh-water goby, 'o'opu. Lei'ohu conducted a study designed to analyze the changes in caddisfly populations as a result of the of 2004 closure of the Lalakea diversion from Hi'ilawe Stream. The diversion, removing 80% of the stream flow, was constructed in the early 1900s for sugar cane irrigation. Lei'ohu sampled and counted larval caddisflies in the riffles of Hi'ilawe Stream over a three year period and determined that their population has steadily increased since the diversion was closed. She thinks that the increase in water flow and flow rate has improved conditions for caddisfly reproduction and survival, and that these changes also benefit 'o'opu populations in Hi'ilawe Stream.

The HAS award for outstanding Junior Division Research relating to Hawaii's natural history went to a project submitted by Nicolyn Helen Charlot, an eighth grader at Volcano School of Arts and Sciences on the island of Hawai'i. Nicolyn's project entitled "Life on Lava: Influences over recolonization on a barren landscape" involved rigorous field work in the vicinity of Pu'u 'Ō'ō. Nicolyn and a helper hiked over lava flows ranging in age from 2 to 20 years old along a seven mile stretch of the coast between Kalapana and Hawai'i Volcanoes National Park. In each of 727 rectangular transects, Nicolyn recorded the occurrence of vegetation and five factors influencing plant reocolonization on lava flows. She found more plants on the older lava flows, as expected, and also discovered that newer lava flows adjacent to forested area have consistently more vegetation than those near barren areas. Nicolyn recognized that seed distribution is the first step in recolonization.



Lei'ohu Santos-Colburn received the HAS award for outstanding Senior Research relating to Hawaii's natural history. *Photo by Wendy Johnson.*

The HAS award for outstanding research in the Junior Division went to Nicolyn Helen Charlot. *Photo by Wendy Johnson.*



Volunteer Position Available

Honolulu Christmas Bird Count Coordinator

The Christmas Bird Count (CBC) occurs annually from mid-December through early January, taking place throughout Hawai'i and around the world and serving as an important tool for bird conservation. The Coordinator position for the Honolulu area is now available. Duties entail:

- Organizing people into groups to cover various areas within the 15-mile diameter count circle.
- Sending out maps and instructions to each group.
- Receiving the results from each group by mail or email.
- Compiling the data and entering it into the on-line database maintained by the National Audubon Society.

Hawaii Audubon Society staff and former compiler Eric Vanderwerf will assist with training. Interested individuals should contact the HAS office at (808) 528-1432 or hiaudsoc@pixi.com. Special thanks go to Eric Vanderwerf and Arlene Buchholz for their dedicated work as former CBC Compiler and Honolulu Coordinator.

Short-tailed Albatrosses on Sand Island and Eastern Island, Midway Atoll NWR

On the morning of January 1, 2008, Martha Brown and Breck Tyler, UC Santa Cruz, sighted two juvenile Short-tailed Albatrosses (STAL) together on Sand Island in Midway Atoll National Wildlife Refuge (NWR). The two birds were located in the middle of a grassy field between the active runway and the South Beach Road (see Figure 1). One bird is believed to be the same individual that U.S. Fish and Wildlife Service (USFWS) translocated to Eastern Island in March 2007. If one of the juveniles is the same bird, it was banded as a fledgling on Torishima Island in 2003. USFWS did not confirm the identity of either bird by reading their bands, in order to avoid any disturbance.

On the morning of January 2, 2008, the two STALs were seen courtship dancing. This event marked the first time that two STALs have courted on Sand Island since November 19, 1999 when USFWS personnel translocated an 11-year old adult male STAL within 150 yards of a longtime resident adult female (18-year old) on Sand Island near Frigate Point.

The Short-tailed Albatross (*Phoebastria albatrus*) is an endangered species that nest mainly on Torishima Island near Japan. Adults are white with dark brown wings, golden head, white back, and a very large pink bill. With a wingspan of 87 inches, they are larger than Laysan and Black-footed Albatrosses.

Millions of Short-tailed Albatosses were killed by plume hunters on nesting islands near Japan in the late 1800s and early 1900s, and they were eliminated from most breeding colonies. Subsequent conservation efforts have allowed modest population increases, now totaling several hundred birds, and re-establishment of small breeding colonies.

On the morning of January 11, 2008, John Klavitter (USFWS) and Susan Scott (Honolulu Star-Bulletin, USFWS volunteer) observed two Short-tailed Albatrosses together on Eastern Island in Midway NWR in the middle of the STAL decoy plot found there (see Figure 2). The birds were sitting next to each other and preening. In order to prevent disturbance, the band on the juvenile STAL was not read. The adult STAL was banded as a fledgling on Torishima Island in 1988 and has been returning to the same spot on Eastern Island at Midway Atoll each year for most of the breeding season since 1999. This bird is believed to be a male, since it has never laid eggs and is a relatively large bird. In order to attract a potential mate for this albatross, 42 STAL decoys were installed on Eastern Island along with a system to play STAL vocalizations during the 2000-2001 albatross breeding season. This event marks the first time that another STAL has arrived at the decoy plot on its own and has been observed with the male. Immediately after this observation, the site on Sand Island where two juvenile STALs had been together since January 1, 2008 was checked. No STALs were present. This lends some evidence that one of the juvenile STALs from Sand Island is now on Eastern at the decoy plot. Photographs seem to support this as well.

On January 12, 2008 at approximately 10:30 a.m., Marc Romano (USFWS) and USFWS volunteers visited the STAL decoy plot and observed the two STALs together for about 90 minutes. During this time, the birds were dancing, preening, and sitting next to each other. The STAL site on Sand Island was checked afterwards and one juvenile STAL was observed. It is hoped that this magnificent bird will begin breeding at Midway.

Figure 1. Sand Island, Midway Atoll NWR

Figure 2. Two Short-tailed Albatrosses on Eastern Island, Midway Atoll NWR, January 2008. *Photo by Susan Scott.*

Source: U.S. Fish and Wildlife Service, Midway Atoll NWR, January 2008

Excerpts from the Journal of George C. Munro
December 1890 to August 1891

Contributed by Ron Walker

Our series continues with this excerpt from the "Journal kept by George C. Munro while studying and collecting natural history specimens in the Sandwich Islands."

Part 8

Tuesday, April 28, 1891 (Kaua'i)

Mr. Gay has kindly corrected my list of native bird names which I append. Iiwi, formally called Olokele on this island being iiwi on the others, iiwipopolo the immature iiwi, Apapane, Oo, Ou, Kamao, Amakihi sometimes called Aalawi , it & the Anauanii being confounded together under that name but Mr. Gay says that the Amakihi is the proper name, Apekepeke, Elepaio, Akialoa formally Iiwi of this island but on Hawaii the two allied species are Akialoa, Nukupuu, Akikiki, Ouholowai, Kolea, Aeo, this bird Mr. Deveril was positive was kukuluaio but Mr. Gay says that that is the name of wooden stilts meaning built up like an Aeo, but many of the whites on Oahu call the bird by that name. Akekeke, Hunakai, Ulili, Ale ula or koki mudhen, Alae keo keo or more usually Alae kea, Alai awi, brown-headed coot, Aukuu, Iwi or Kiowea, Kaloa, Moha, Mapu, Manuoka? Mr. Gay is not certain that this is the name of the small gull we got at Pokii, as he had not seen the bird before only having the native description of it, but the description tallies with the skin. Koleaaumoku, Koae, Koha, Moa, Pueo, Io.

BIRDS OF KAUAI

Acrulocercus braccatus	Oo male and female
Vesteria coccinea	Iiwi, or olokele
Himatione sanguinea	Apapane
H. styjnegeri	Amakihi 2 females
Hemignathus procerus	Akialoa or Iwi (young) 1 male
H. hanapepe	Nukupuu
Himatione parva	Anauanii male and female
Oreomyza bairdi	Akikiki 1 male, 1 female
Chrysomitidops caeruleirostris	Ouholowai 1 male, 1 female
Psittirostra psittacea	Ou 1 male
Phaornis myiadestina	Kamao, 1 male
Chasiempis dolei	Elepaio 1
C. sciateri	Apekepeke 1 female
Asio accipitrinus	Pueo, owl 1 female
Moa, chicken	
Gallinula sandvichensis	Alae keo keo, coot 1
Himantopus knudseni	Aeo, stilt
Totanus incanus	Ulili, snipe 1
Strepsilas interpres	Akekeke
Caldris arenaria	Hunakai
Anas wyvilliana	Kaloa
Charadrius fulous	Kolea 1 female
Nycticorax nycticorax naevius	Aukuu
Anous melanogenys	Noio, tern

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Calendar of Events

HAS Field Trips

Contact the HAS Office at: (808) 528-1432, hiaudsoc@pixi.com

Saturday, May 31
Paikō Lagoon with Alice Roberts
6:00 a.m. – 8:00 a.m.
A lowtide meander as Alice talks about the many fascinating creatures visible along the shoreline. This is a wonderful treat of a field trip, and one that keiki will particularly enjoy! Wear old tennis shoes or reefwalkers, and bring binoculars, water, sunscreen, and a hat. Call Alice to register, (808) 864-8122.

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