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‘ELEPAIO

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Non-breeding Season Movements of ‘Akikiki and Other Endangered Endemic Forest Birds on Kaua‘i

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Kaua‘i Forest Bird Recovery Project, University of Hawaii Manoa and Hawai‘i Division of Forestry and Wildlife, Hanapepe, HI, USA

Puaiohi or Small Kaua‘i Thrush (*Myadestes palmeri*)
Photo credit: Lucas Behnke

INTRODUCTION

The Alaka‘i Plateau of Kaua‘i supports high-elevation rainforests that are home to eight native forest birds, three of which are critically endangered: Puaiohi or Small Kaua‘i Thrush (*Myadestes palmeri*), ‘Akikiki or Kaua‘i Creeper (*Oreomystis bairdi*), and ‘Akeke‘e or Kaua‘i ‘Akepa (*Loxops caeruleirostris*). All three of these endemic species have suffered dramatic declines due to habitat loss, predation and disease, and currently each species numbers less than a thousand individuals (Crampton et al, submitted; Paxton et al., in review). This is a dramatic decline from just a few years ago where these species numbered several thousand each (Gorresen et al. 2009). One of the greatest threats facing these birds is the presence of avian malaria, to which Hawai‘i’s forest birds have very little resistance (Atkinson et al. 2014). The disease is caused by a parasite (*Plasmodium relictum*) that is spread by non-native mosquitoes (*Culex quinquefasciatus*). Due to cooler temperatures at high elevations, the Alaka‘i Plateau does not currently support large numbers of this parasite or mosquito, creating a small and relatively disease-free refuge for native forest birds (Atkinson et al. 2014, Glad 2014). However, climate change is predicted to diminish these high-elevation refugia as temperatures rise, and the elevation at which mosquitoes can survive increases (Benning et al. 2002, Atkinson et al. 2014, Fortini et al. 2015).

Native forest birds have suffered significant range contractions and population declines as the prevalence of mosquito-borne avian malaria has increased (Atkinson et al. 2014, Paxton et al. in review). In the Alaka‘i, it is not clear if increased disease prevalence is due to upslope movements of mosquitoes or if birds are moving downslope to mosquito-infested areas or both. Furthermore, avian range contractions and declines may also reflect the degradation of much remaining forest bird habitat by invasive plants and animals and the effects of Hurricane Iniki, which struck Kaua‘i in 1992 with long-term negative impacts on much forest habitat (Behnke et al. 2016). With areas of suitable and disease-free habitat shrinking, older birds making normal post-breeding movements and juveniles dispersing from natal areas may move into inferior quality habitats, or sinks, where they are more at risk of disease, predation and starvation (Hart et al. 2011).

The focus of this preliminary study was to document bird movements outside of the breeding season using radio-telemetry both on foot and from helicopter. We were particularly interested in juvenile birds that may make dispersal movements long enough to take them outside the refuge of the plateau and into lower elevation habitat where they are more likely to contract avian malaria. Additionally, since very little is known about space use of these three species outside the breeding season, we sought to increase our general understanding of their natural history by describing movement patterns. Finally, we hoped to refine telemetry techniques, as very few wild individuals of these species have been tracked using radio-telemetry.

STUDY SITE

We conducted our study at our long term study area, Halepa‘akai, in the Alaka‘i Wilderness Preserve of Kaua‘i Island, Hawai‘i. This study site is at about 1300 m elevation, just two km west of

‘Akeke‘e or Kaua‘i ‘Akepa (*Loxops caeruleirostris*)
Photo credit: Robby Kohley

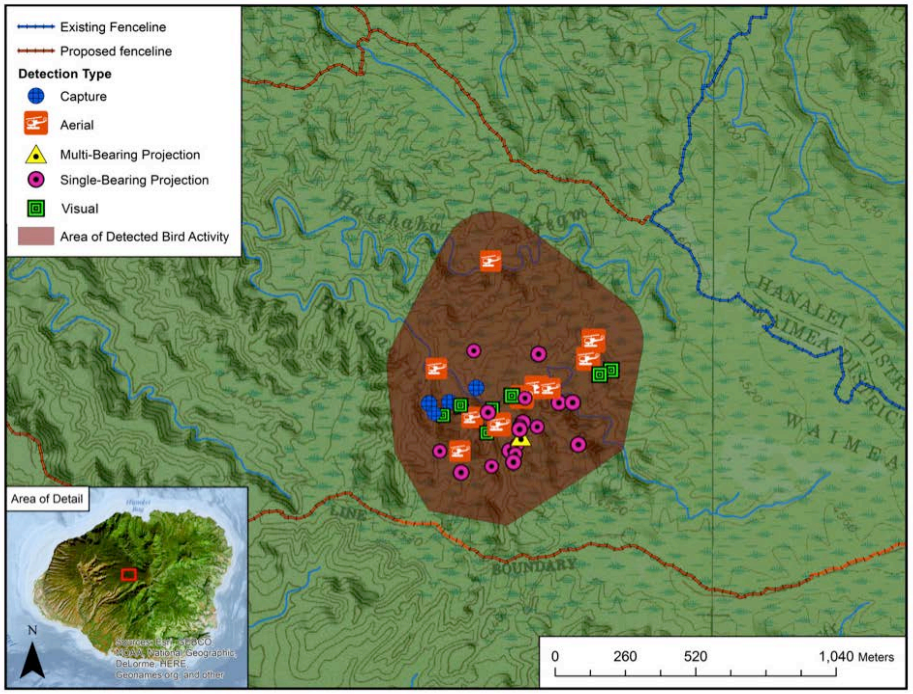

Figure 1. Detections of all radiotagged birds, and combined area that they likely used (brown polygon; based on detection error) at Halepa'akai, Sept-Nov 2014. All detections occurred within the Alaka'i Wilderness Preserve and proposed Halehaha fence; however, birds often could not be detected and may have traveled into private lands south of Halepa'akai (southern red fenceline) where there is a sudden loss of elevation; or into the already-fenced East Alaka'i Unit (blue fence) on the top of the Plateau. Additionally, birds travelling northwest would remain on the plateau, but out of our telemetry search area.

the highest and wettest point on the island, Mt. Kawaikini (1598 m), and receives ~900 cm of rain per year (Giambelluca et al. 2013). The vegetation is wet montane forest dominated by ohi'a lehua (*Metrosideros polymorpha*), with a diverse understory of fruiting shrubs and ferns. Two streams, Halepa'akai and Halehaha, traverse the plateau from east to west, merging to form Waialae Stream west of the study area. The steep cliffs of Olokele Canyon and the Wainiha Pali, which lead to significant elevation drops, are only 1 and 2 km away, respectively.

METHODS

In September and October of 2014, we captured and attached radio-transmitters (with surgical glue) to three Puaiohi, two 'Akikiki, and one 'Akeke'e. This 'Akeke'e was the first of its species to receive a radio-transmitter, but wild Puaiohi and 'Akikiki had previously been tracked using radio-telemetry. Four Puaiohi were tracked in June-October of 2011, and three Puaiohi in June-July of 2012 (DOFAW, unpubl. data). Four 'Akikiki were tracked in January-February of 2012 (L. Behnke, unpubl. data). 'Akikiki and 'Akeke'e transmitters used for this project had battery lives of 2-3 weeks. The Puaiohi transmitters we used were slightly larger, and had battery lives of a month or more.

We banded all birds with a FWS numeric band and a unique color band combination, and took several morphological measurements. All Puaiohi and 'Akikiki were determined to be either juvenile (hatch-year) or young adult (second-year) birds, based on plumage characteristics. The 'Akeke'e was of unknown age, as we do not have reliable ageing techniques for this species. We could not determine the sex of any birds. After release, we attempted to relocate birds using aerial telemetry approximately twice a week from 6Oct14 to 13Nov14, with the exception of the week of 12Oct-18Oct when storms prevented us from accessing the field site. From helicopter, we monitored two directional antennas simultaneously during telemetry flights above the study area. Flights were conducted in spiral circles radiating out from Halepa'akai camp, followed by transect lines across the plateau. We cycled through the frequencies of all birds with active transmitters. If we detected a signal, we interrupted our survey pattern to ascertain the location of the bird, then resumed the transect. Bird locations were determined as the point where a transmitter signal was of equal strength from both antennas.

We conducted ground telemetry with handheld antennas as personnel were available, usually 2-3 times per week, to supplement aerial telemetry. We tried to detect every bird's frequency multiple times throughout ground tracking days (i.e. multiple tracking attempts were made for each bird on a single tracking day). When we detected a radio signal but did not see a bird, we estimated its location using a single-bearing projection or multi-bearing projections. Single-bearing points were obtained when one person picked up a signal on the ground, took a bearing of direction of the signal and then estimated the distance of the bird based on signal strength. Multi-bearing points were obtained when more than one person picked up a signal at approximately the same time, and the bird's location was estimated as the point where the two bearings from both points intersected (i.e. triangulation). We calculated maximum range axes as the longest distance that could be drawn across a single bird's area of activity, which was a polygon based on the bird's detection points and approximate detection error around the points in ArcGIS 10.1.

RESULTS

We detected Puaiohi on average 75% of 16 tracking days. Puaiohi moved up to 425 m between detections (x=168.3 ±171.6 m; Table 1). All three Puaiohi moved upstream towards a similar location (Figure 1). One Puaiohi was found dead, possibly killed or scavenged by a rat or owl. The other two removed their transmitters, so we have limited data on this species and do not know where they went after moving to this general upstream area. Maximum range axes for Puaiohi were 610.5 m (Puai081), 796.6 m (Puai121), and 836.7 m (Puai105).

We detected 'Akikiki on average 33% of 27 tracking days. 'Akikiki made movements up to 522 m between detections (x=209.7 ±154.4 m; Table 1) and rarely stayed in the same spot

Individual	Capture date	Total days transmitter active	# Days telemetry attempted	# Days detected	Average distance from previous detection	Max distance from previous detection	Max range axis	Individual fate at last detection
Akik658	10/6/14	18	14	4	329.1	522.1	985.1	UNKNOWN
Akik760	10/22/14	19	13	5	161.9	320.1	760.6	ALIVE
Puai081	10/29/14	10	6	4	176.6	425.4	610.5	DEAD
Puai121	10/27/14	11	6	5	95.3	248.1	796.6	TRANSMITTER DETACHED
Puai105	9/21/14	17	4	3	264.9	73.6	836.7	TRANSMITTER DETACHED
Akek253	10/27/14	17	12	5	198.2	335.9	781.1	UNKNOWN

Table 1. Summary telemetry data for all birds tagged at Halepa'akai in fall (Sept-Nov) 2014. Maximum distances from previous detections do not include the week of October 12th-18th, when weather prevented access to field site. All distances are reported in meters.

long enough to be visually detected (Figure 1). Maximum range axes for the 'Akikiki were 985.1 m (Akik658) and 760.6 m (Akik760). We were able to put a transmitter on a third 'Akikiki, however, this bird's transmitter died or stopped transmitting for unknown reasons within 24 hours of attachment. This was confirmed when visual detections of the bird were made, but no transmitter signal was detected. For this reason, this bird's movements were not included in our analysis.

Of total days tracked, we detected the 'Akeke'e an average of 41% of 12 tracking days. The 'Akeke'e made movements up to 335 m between detections (x=198.2, ±113.3 m; Figure 1). Maximum range axis for the 'Akeke'e (Akek253) was 781.1 m (Table 1).

'Akikiki or Kaua'i Creeper (*Oreomystis bairdi*)
Photo credit: Robby Kohley

DISCUSSION

During this study, we often did not detect radio-telemetered birds – from the air or on foot – and detections were usually several days apart. During periods when birds were not detected, they may have 1) moved into drainages or other features of the study area that impaired our ability to detect them, 2) temporarily vacated the study area, or 3) made movements to other parts of the plateau outside of our regular search area. It is likely that birds use different parts of the landscape in the non-breeding season than they do in the breeding season, especially young birds who could be making large dispersal or exploratory movements (Greenwood and Harvey 1982). Additionally, small transmitters, which can have poor transmitting ranges, sizeable errors, and short battery lives, may have added to our detection issues (but see below for different results with similar size transmitters). We estimated our potential error associated with aerial telemetry to be as large as 150 m, based on aerial detections of a transmitter in a known location (aforementioned deceased Puaiohi). However, this was the maximum known error. In other instances, detections were much closer to known locations of transmitters, sometimes within 30 m. Future efforts should take this variation in detection error into account, and test transmitters at various types of landscape features (drainages, valleys, beneath varying vegetation heights, etc.) to determine if detection is dramatically affected. This effort would greatly increase our confidence in bird locations, and help determine if birds are leaving the study area.

We cannot say definitively that birds were leaving the plateau, but we were surprised at how little we detected them during aerial telemetry sweeps across the plateau. In a previous study that tracked captive-bred Puaiohi released into the Alaka'i, detection rate from helicopter was about 73% given that the bird had not left the initial search area (Pratt et al. 2002). During this release, two birds dispersed far greater distances than could be tracked on foot, and were considered to have left the regular search area, but were nonetheless tracked by helicopter. These birds were not considered in calculating the aforementioned detection rate of birds in a known area (Pratt et al. 2002). Considering the plateau from Halepa'akai to Koia'e to be the regular aerial search area for our study, we expected to detect telemetered birds at a higher rate if they were present in that search area. Birds also could have moved to different areas of the plateau that did not fall within our aerial transects. Our low detection rates could indicate movement into low-elevation areas, but this possibility would need to be confirmed with additional telemetry efforts surrounding the plateau.

Furthermore, in a previous telemetry study following 'Akikiki during the spring breeding season, observers were able to confirm all telemetry locations with visual observations of the birds, and often got many detection points per day for each bird (L. Behnke, pers. comm.). While our sample size was small, we often could not visually confirm bird locations when tracking on foot, suggesting that birds may have been moving more frequently or using different parts of the landscape than during the breeding season. Our tracking effort was also not as concentrated as this previous project, which had at least one individual devoted to tracking the birds each day. During our study, we had to divide our time between tracking birds and our mist-netting efforts to capture more birds. Additionally, this project used transmitters from a different manufacturer than we did in 2014. While it is worth noting the differences of detection between these studies, a direct comparison of bird movements is tricky because of our small sample size and differences in methods and materials.

Though we cannot say for sure where these birds were when they went undetected, the possibility that they had left the plateau is not unfounded, as it would take just a short flight for birds to reach lower elevation areas. In some cases, this distance to lower-elevation areas is shorter than the distance to other parts of the plateau. If these birds flew north or west for 1000 m, they would

still be in the upper elevation forest of the plateau, in areas scheduled to be enclosed within ungulate-proof fences in the next five years; but if they continued further, they would lose elevation rapidly into degraded habitat. If they flew 1000 m east-northeast, they would move into a very well protected fenced area with no ungulates, but if they continued, within 2000 m they would fly off the pali into the low-elevation Wainiha Valley, which is rife with mosquitoes and other invasive species. To the south, within 500 m they fly into private land, which we believe is relatively well managed for native plant species. However, within 1000 m there is a dramatic elevation loss, and birds could come into contact with mosquitoes in those canyons. We could not rule out the possibility that on days we failed to detect birds during telemetry efforts they had flown down to these low-elevation areas. Our concern is that if birds are moving into lower elevation sites, they will be more likely to come into contact with mosquitoes, and thereby malaria. Telemetry projects such as this can help us gain a better understanding of bird movements throughout the year, so that we may identify certain times and areas of high-risk for these already endangered birds.

In order to do so, however, a much larger effort would need to be made to document where the birds are going. Increasing tracking effort through on-the-ground surveys or with automated recording devices could greatly augment our understanding. This is especially important considering the short battery life of small transmitters, which gave us a narrow window of a few weeks to track each bird. It would also be beneficial to apply transmitters to more birds, or recapture and replace transmitters on birds, but considering the rarity of these species, this is a very difficult task. Preliminary projects such as this are helpful in determining the best way to move forward in complicated natural history studies, and we consider this particular issue of bird movements to be a significant one to further examine. As the suitable habitat for these species dwindles with increased disease prevalence, identifying areas to suggest and prioritize mosquito control and other conservation efforts becomes increasingly important.

ACKNOWLEDGEMENTS

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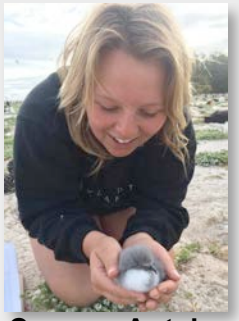

Carmen Antaky
"Reproductive ecology of a cryptic and threatened Hawaiian Seabird."
Hawaiian Band-rumped Storm Petrel, *Oceanodramo castro*

Kayla Bonnette
"Enhanced Banding Program for Kaua'i's Endangered Honeycreepers."

HIKE and LEARN about KFBR Project's efforts to monitor Puaiohi, 'Akikiki and 'Akeke'e (mist netting, banding, sample collection, resighting, rodent control, egg collection to found captive populations). Weather permitting, we will observe mistnetting and banding. *See page 31 for more information.*

Manu o Kū Festival

By Wendy Johnson, HAS Executive Director

Photo: Eric VanderWerf

Photo: Tony Leiggi

Photo: Tony Leiggi

Photo: Tony Leiggi

On May 14, Hawai‘i Audubon Society staff and volunteers participated in the Manu o Kū Festival on the grounds of ‘Iolani palace. The Festival was part of the U. S. Fish and Wildlife Service‘s nation-wide recognition of the 100th anniversary of the Migratory Bird Treaty, which has proven to be an effective mechanism for the protection of bird species that migrate across international borders.

Manu O Kū (White Tern) is a beautiful migratory seabird that is common in the northwest Hawaiian Islands, but does not nest on any of the main islands except O‘ahu. It is readily observed in Honolulu, where its population is increasing. It was named the official bird of the City and County of Honolulu in 2007.

The Festival offered the public a chance to view the Manu O Kū first-hand, and to learn about their distribution, natural history, and role in navigation by Hawaiian voyagers. People of all ages enjoyed a variety of experiences and presentations. These included: music and hula, an awards ceremony, an original Manu O Kū play, a nature costume contest, crafts, and informational displays.

The Hawai‘i Audubon Society was one of over 15 sponsors and cooperators who provided educational resources and activities for adults and children. Hourly birding tours of the ‘Iolani Palace grounds offered great opportunities to spot Manu O Kū and other resident birds on-site. Kids visiting the HAS table were challenged to spot five different birds to earn one of the “stamps” needed to redeem a special prize. Many thanks to organizers Conservation Council for Hawai‘i and USFWS for a wonderful day with wildlife in the city and to our HAS volunteers who led tours, greeted the public, and answered questions at our booth.

Midway Atoll NWR Biology Volunteer Opportunity
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Hawai‘i Audubon Society Kona Pelagic Tour: April 23, 2016

By Lance Tanino, HAS Board Member Hawai‘i Island

Twenty-three participants experienced a spectacular nine-hour pelagic trip aboard Ocean Encounters out of Honokohau Harbor, Kailua-Kona, Hawai‘i Island.

Throughout the majority of the cruise off the Kona coast, we had relatively flat seas while encountering seabird, marine mammal, reptile, and fish species.

Photo Credit: Brad Argue

Photo Credit: Sherman Wing

Seabird species
Hawaiian Petrel (1)
Pycroft/Cook's Petrel (1)
Bulwer's Petrel (45)
Wedge-tailed Shearwater (61)
Sooty Shearwater (2)
Leach's Storm-Petrel (2)
White-tailed Tropicbird (1)
Brown Booby (3)
Red Phalarope (4)
Black Noddy (2)
Brown Noddy (1)
Sooty Tern (2)
Arctic Tern (2)

Marine Mammal Species
Spinner Dolphin (20+)
Pantropical Spotted Dolphin (10+)
Short-finned Pilot Whale (15+)

Reptile
Green Sea Turtle (2)

Fish species
Flying fish sp.
Spotted Eagle Ray

Bird Observations: MARCH - MAY 2016

Submitted by Lance Tanino

Mar 8 - A BLACK-LEGGED KITTIWAKE (adult) was found in poor health at Eastern Island, Midway Atoll N.W.R., Papahanaumokuakea Marine National Monument (Kristina McOmber).

Mar 14-16 - A BONAPARTE'S GULL (first-spring) was seen at PHNWR-Honouliuli Unit and Pouhala Marsh, Waipahu, Oahu (Alika Campbell, Kurt Pohlman).

Mar 21 - A NORTHERN HARRIER (2nd-cycle male) was spotted flying over the aquaculture ponds in Kahuku, Oahu (USFWS - Rachel Rounds, ph. Jackson Letchworth, Sheldon Plentovich, Bill O'Neill).

Apr 3 - A TRISTRAM'S STORM-PETREL was photographed from Kaulakahi Channel, Kauai (David Kuhn, Jacob Drucker).

Apr 20 - A raft of 26 ARCTIC TERNS were counted in a tight flock as they sat on the water about 25 miles off Kailua-Kona coast, Big Island (Lance Tanino, Michael Scott, Richard Wass).

May 21 - A total of 47 BULWER'S PETRELS were counted during a three-hour seawatch from Keahole Point, Big Island

May 31 - A HUDSONIAN GODWIT in breeding plumage was found at Kaunakakai WWTP, Molokai (Arleone Dibber-Young, Richard May).

May 31 - A high count of 145 NEWELL'S SHEARWATERS and 111 HAWAIIAN PETRELS was made during a seawatch at Nawiliwili Lighthouse/Ninini Point, Kauai (Jacob Drucker, Derek Harvey).

Keauhou Bird Conservation Center

Mahalo nui loa to Iwikauikaua Joaquin, Kamehameha Schools, and Bryce Masuda, San Diego Zoo Global, for hosting 19 Hawai‘i Audubon members for a visit to the Keauhou Bird Conservation Center on June 4. Four species are currently being bred at this facility to restore or reintroduce wild populations: *‘Alalā* or Hawaiian Crow (considered extinct in the wild), *Palila*, *Kiwikiu*, and *Akikiki*. Lance Tanino, our HAS tour leader, participated in field studies on ‘alalā in the early 1990s and told stories of how this gregarious and intelligent bird would pelt the field crew with lilikoi! Our group also enjoyed spectacularly close views of *Puaiohi* (small Kaua‘i thrush) and *Hawai‘i ‘Elepaio*. Four people continued on to Hawai‘i Volcanoes National Park's Kipuka Puaulu (Bird Park) for a 1.5-mile bird walk. We were treated to excellent weather (cool and overcast skies) and many old-growth ‘ōhi‘a in spectacular bloom and 'dripping' with *'Apapane*. Also present were *Chinese Hwamei*, *Red-billed Leiothrix*, *'Omao*, *'Io* (Hawaiian Hawk), and *Kalij Pheasant* chicks.

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Thank you for your concern and commitment to protecting Hawaii's native wildlife and ecosystems.

Photo Credit: Mitch Walters

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Upcoming Events, Field Trips, & Volunteer Opportunities

For full descriptions of our Events, Field Trips and Volunteer Opportunities, go to our website: http://www.hawaiiaudubon.org/

EVENTS

Hawai‘i Island Festival of Birds
September 24-25, 2016, Kailua-Kona, Hawai‘i Island
https://hawaiibirdingtrails.com/
Saturday’s highlights: workshops and booths by local artists and photographers, silent auction, children’s activities, gala dinner, and speakers including a panel on the status of Hawaii’s endemic birds, Chris Farmer with American Bird Conservancy, Noah Gomes and Sheila Conant on traditional Hawaiian featherwork, and Brian Sullivan with ebird.org, along with keynote speaker Dr. Sam Gon’s presentation on the cultural and biological significance of Hawaii’s unique bird life. Sunday field trips to sites along the trail or pelagic birding by boat.

FIELD TRIPS

Welcome Home to Our Shorebirds
Paikō Lagoon Wildlife Sanctuary
Saturday, September 17, 2016, 9:00 – 11:00 am, East Honolulu
Tour Leader: Alice Roberts, HAS Board member
Enjoy fall at Paikō! Let‘s welcome our unique and beautiful migratory shorebirds as they return from their extensive travel to enjoy the Hawaiian islands for the fall and winter months. Please RSVP to Alice with your name and phone number at 808-864-8122.

Alaka‘i Boardwalk: KFBRP Hike and Learn
Na Pali Kona Forest Reserve, Kaua‘i
Tuesday, October 11, 2016, 9:00 am
Hike and learn about Kaua‘i Forest Bird Recovery Project‘s efforts to monitor Puaiohi, ‘Akikiki and ‘Akeke‘e (mist netting/banding/sample collection/resighting, rodent control, egg collection to found captive populations). Weather permitting, we will observe mistnetting and banding. **RSVP by SEPT 29** to hiaudsoc@pixi.com, subject line: Alaka‘i Tour.

Campbell National Wildlife Refuge
Saturday October 22nd 2016 3:00 pm – 5:00 pm
Saturday October 29thd 2016 3:00 pm – 5:00 pm
Leaders: Richard (Dick) May & Tony Leiggi
- Tour size limited to 20 people. *HAS Members & ‘Elepaio Subscribers have first preference for this program.*

Participants will see Hawaiian Duck, Hawaiian Stilt, the Hawaiian race of the Common Gallinule, Hawaiian Coot, Black-crowned Night-Heron and Bristle-thighed Curlew and more. **RSVP by OCT 13th** to attend to hiaudsoc@pixi.com, subject line: James Campbell Tour.

Pearl Harbor National Wildlife Refuge: Honouliuli Unit
Sunday October 30th 2016 3:00 pm – 5:00 pm
Sunday November 6th 2016 3:00 pm – 5:00 pm
Leaders: Richard (Dick) May & Tony Leiggi
- Tour size limited to 6 people. *HAS Members & ‘Elepaio Subscribers have first preference for this program.*

Join HAS for a guided tour of the Honouliuli Unit of the Pearl Harbor NWR. Participants should be able to see the same species as Campbell NWR plus White-faced ibis, laughing Gull, wintering ducks, Northern Pintail, Northern Shoveler, American and Eurasian Wigeon and Green-winged Teal. **RSVP by OCT 20** to hiaudsoc@pixi.com, subject line: Honouliuli Tour.

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Table of Contents

HAS volunteer Rich Downs leading tours at the Manu o Kū Festival, May 14, 2016 on the 'Iolani Palace grounds.

Non-breeding Season Movements of 'Akikiki and Other Endangered Endemic Forest Birds on Kaua'i..... 25

Manu o Kū Festival..... 29

Kona Pelagic Tour April 23, 2106..... 30

Bird Observations MARCH - MAY 2016..... 30

Keauhou Bird Conservation Center..... 30

Upcoming Events, Field Trips, and Volunteer Opportunities……..……..…… 31