First Description of a Double Clutch, and Interisland Movements of a Pueo (Hawaiian Short-Eared Owl; Asio flammeus sandwichensis) in Hawaii, USA

Article *in* Journal of Raptor Research · May 2024

DOI: 10.3356/JRR-23-66

CITATIONS
0

READS
49

2 authors:

Marie-Sophie Garcia-Heras
University of Hawai'i at Mānoa
20 PUBLICATIONS **181** CITATIONS

SEE PROFILE

Melissa Renae Price
University of Hawai'i at Mānoa
57 PUBLICATIONS **589** CITATIONS

SEE PROFILE

Journal of Raptor Research

Advancing the science, conservation, and understanding of birds of prey

Journal of Raptor Research 58(3):1–5
doi: 10.3356/JRR-23-66

First Description of a Double Clutch, and Interisland Movements of a *Pueo* (Hawaiian Short-eared Owl; *Asio flammeus sandwichensis*) in Hawaii, USA

Marie-Sophie Garcia-Heras[1*] and Melissa R. Price[1]

[1]*Department of Natural Resources and Environmental Management, University of Hawai'i at Mānoa, Honolulu, HI 96822 USA*

KEY WORDS: *Hawaiian Islands*; *double clutch*; *interisland movements*; *GPS-VHF tracking*.

The Short-eared Owl (*Asio flammeus*) is a globally distributed species occurring on almost all continents, with populations found in various combinations of temperate, tropical, continental, and island systems (Holt et al. 1999). In North America and Europe, Short-eared Owls are highly vagrant and nomadic, showing little to no recurring seasonal or annual site fidelity (Johnson et al. 2017, Miller et al. 2022). These populations are suspected to have declined over the last two decades (Booms et al. 2014).

Island-endemic subspecies of Short-eared Owls, such as the *pueo* (Hawaiian Short-eared Owl; *Asio flammeus sandwichensis*) in the Hawaiian Islands may exhibit higher site fidelity than their continental counterparts. Due to suspected population declines, the *pueo* is state-listed as endangered on the island of O'ahu (Department of Land and Natural Resources 2005) and was recently classified as a Bird of Conservation Concern by the US Fish and Wildlife Service (USFWS 2021). Little published information currently exists about the biology and ecology of this emblematic ground-nesting raptor in the Hawaiian Islands; for instance, to date, we do not have a good understanding of how *pueo* use multiple habitats and different islands seasonally. Specifically, we do not know if *pueo* remain within the boundaries of a single island, or if they regularly move among multiple islands.

We documented the events described as part of a larger study on the movement ecology of the *pueo* during breeding and nonbreeding seasons, in which we tagged individuals with battery-powered GPS-VHF tracking devices. We also investigated the owl's breeding ecology on the island of O'ahu, Hawai'i, USA (Garcia-Heras et al. 2022a, 2022b, Wang 2022). This aspect of the study was focused on military-managed land operated by the Joint Base Pearl Harbor-Hickam (JBPHH) at the Lualualei Annex site (JBPHH-LLL) on the leeward side of the island (Fig. 1). Most fieldwork effort occurred within the managed grassland fields of the JBPHH-LLL, as this was where *pueo* hunted and nested in previous years (n =12 nests for the period 2019–2022). As the field and nesting season progressed, some (n = 2 out of 4) of the tagged *pueo* left the JBPHH-LLL. Consequently, we transitioned to driving throughout the island to detect the birds. Although we here describe movements of a single individual, the paucity of anecdotal and published data on this subspecies makes this observation notable for informing future research and conservation of the *pueo* in the Hawaiian archipelago.

On 12 February 2021, we found an incubating adult female *pueo* with six eggs in one of the grassland fields of the JBPHH-LLL (Fig. 2, 3). We continued to monitor this nest throughout the season until fledging of the young. On 18 March 2021, we found three young (<10 d old) within 9 m of the nest, and we later observed regular prey deliveries by the *pueo* pair to the young in the grasslands, 20–250 m from the nest. On 16 April 2021, the *pueo* young had moved to adjacent scrub and nonnative *kiawe* (*Prosopis pallida*) wooded area with tall grasses, located about 300 m from the nest (Fig. 2b); observers heard at least two

* Corresponding author: ms.garciaheras@gmail.com

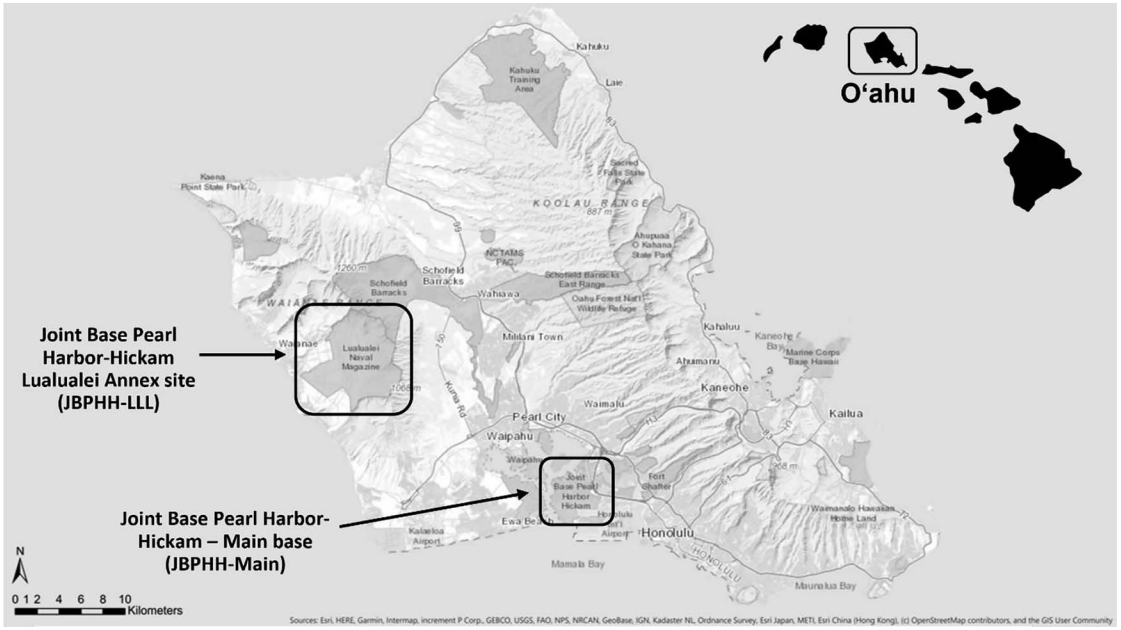

Figure 1. Hawaiian archipelago and study site location at Joint Base Pearl Harbor-Hickam Lualualei Annex site on the island of O'ahu, Hawai'i, USA. The Joint Base Pearl Harbor-Hickam—Main base is also shown as reference.

pueo young begging for food while a third flew nearby. On 5 May 2021 at sunset, we set a dho gaza net near the latter area, with a stuffed *pueo* as a decoy, and we sporadically broadcast *pueo* calls. Within a few minutes, we captured an adult female *pueo*, while the three fledglings circled 2–3 m above our heads, alarm-calling.

We banded the adult female with a US Geological Survey band and an alphanumeric colored visual identification band. We made standard measurements and fitted her with a battery-powered Lotek GPS-VHF-120 Pinpoint transmitter secured with a Teflon-ribbon backpack harness. The total weight of all external accessories was approximately 9 g. The tracking device was programmed to collect one location every 5 hr, covering all times of the day within a 4-wk period. Although team members needed to be within 100–1000 m of the tagged bird to download the data, the signal of the GPS-VHF transmitter could usually be detected within 3–5 km using a Yagi antenna and a Pinpoint Commander receiver. We followed this *pueo* for 211 d until 2 December 2021, with 977 locations suitable for data analyses (only Horizontal Dilution of Precision <5 were retained).

During 5–26 May 2021, we observed the tagged *pueo* hunting in the grassland fields of the JBPHH-LLL where she was captured, and saw it perched in the adjacent scrub and *kiawe* wooded habitat (Fig. 2b). At least two of her fledglings were also observed nearby over that period of time. Starting on 27 May 2021, the owl's location data points were within a few m of each other. Because an accumulation of locations can suggest mortality or a lost device, on 8 June 2021 we walked toward the centroid of the locations in the grassland, adjacent to where she was originally captured. We found the *pueo* incubating a single egg at a second newly built nest (Fig. 2b, 3), located only 180 m from her successful first nest we had found 104 d earlier.

Although there is a slight chance that we caught and tagged a female who was not the parent of the fledged *pueo*, all our observations and data strongly suggested that this tagged incubating female was indeed the same adult female that had already nested in February and successfully fledged at least three young at the end of April/beginning of May. The initiation of a second clutch shortly after a first failed breeding attempt is not uncommon in raptors and has recently been documented in continental Short-eared Owls from the Netherlands (Kleefstra et al. 2023). However, starting a second clutch after a first successful one appears rare; Calladine et al. (2024) also briefly described a GPS-tagged female Short-eared Owl that may have bred twice in the same year, first in Scotland in April 2018 (where nestlings hatched in April/May), and again in Norway in June 2018 (nest fate unknown). To our knowledge, our sighting would

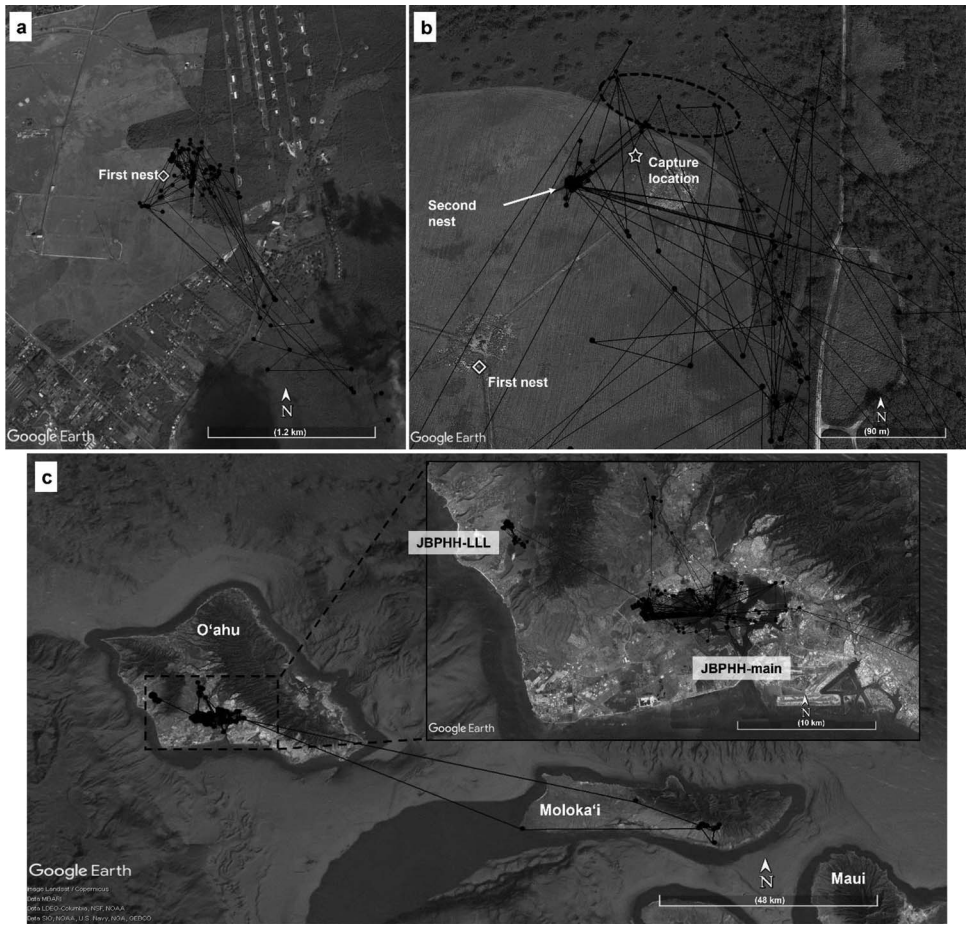

Figure 2. Movement patterns of the adult female *pueo* captured (white star, panel b) on 5 May 2021 and tagged with a GPS-VHF device at Joint Base Pearl Harbor-Hickam Lualualei Annex site on the island of O'ahu, Hawai'i, USA. (a) Movements of this female within the JBPHH-LLL from 5 May to 23 June 2021, including the location of her first nest (white diamond). (b) Enlarged image of the same period of time, showing the location of the second nest (dark circle), and the general scrub and *kiawe* wooded area where at least two *pueo* young were heard begging for food and where one *pueo* chick was observed flying nearby (oval). (c) Overall movements of this female from 5 May to 2 December 2021. After she left the JBPHH-LLL on 23 June 2021, most of her locations were at and near the Joint Base Pearl Harbor-Hickam—Main base (JBPHH-Main), except for a 4-d interisland excursion trip to the neighboring island of Moloka'i, from 30 October to 3 November 2021. The lines represent the movement paths of the tagged *pueo* and the dots represent the GPS locations of the *pueo* from high (Horizontal Dilution of Precision < 5) accuracies.

thus be the second worldwide observation to document a Short-eared Owl's second clutch after a first successful one during the same breeding season.

During 8–20 June 2021, this *pueo* continued to incubate her egg without showing any abnormal behavior. During 20–23 June 2021, she used the adjacent scrub and *kiawe* wooded area more and spent less time at her nest (Fig. 2a, b), until she eventually left JBPHH-LLL and never returned. On 24 June 2021, observers checked the nest and found the single unhatched and abandoned egg. Although the reason for this nest abandonment was unknown, the weather conditions had become very dry and hot at the beginning of June (M.-S. Garcia-Heras and M. Price unpubl. data; https://weatherspark.com/h/d/139/2021/06/24/Historical-Weather), perhaps reducing food resources and driving the female *pueo* to stop incubating and leave the area.

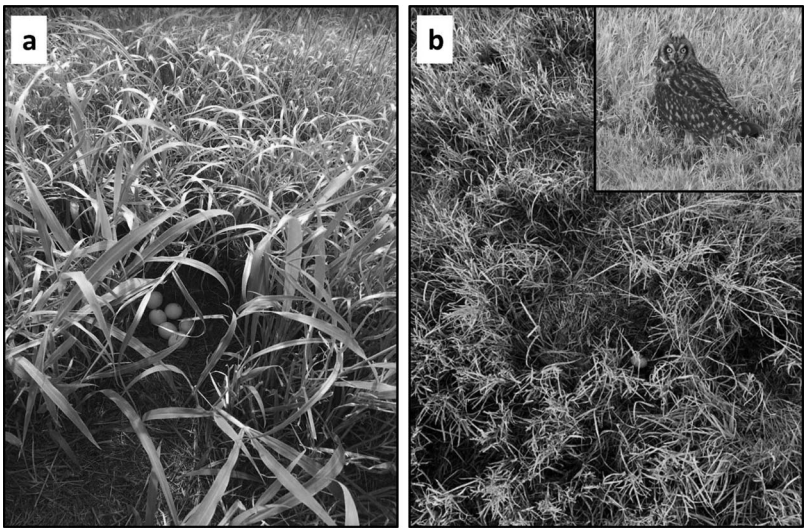

Figure 3. Tagged adult female *pueo* and both nests, at Joint Base Pearl Harbor-Hickam Lualualei Annex site on O'ahu, Hawai'i, USA. (a) The female's first nest was discovered on 12 February 2021 with 6 eggs, in a bowl-shaped depression in the ground surrounded by green luxuriant buffelgrass (*Cenchrus ciliaris*) vegetation. (b) The female's second nest was found on 8 June 2021 while she was incubating a single egg. This second nest was more exposed and open as the surrounding vegetation was much shorter and drier than at the first nest. The nests were 180 m from each other in the same grassland. Photos by Marie-Sophie Garcia-Heras (a) and Chad Wilhite (b).

From 24 June to 2 December 2021, the tagged *pueo* spent most of her time within a 112 km^2 area in and nearby the Joint Base Pearl Harbor-Hickam—Main base (JBPHH-Main), which is located approximately 14 km away from the JBPHH-LLL (Fig. 2c). There, she mostly used wooded patches composed of scrub and *kiawe* during the day (likely roosting) and surrounding agricultural fields and urban areas at night (likely hunting). Interestingly, her telemetry data revealed that between 30 October 2021 at 2000 H and 31 October 2021 at 0100 H, this female *pueo* flew to the neighboring island of Moloka'i, about 70 km away (Fig. 2c). There she spent most of her time in mountain habitats ($n = 16$ out of 18 locations) but also visited a nearby wetland ($n = 1$) and agricultural field ($n = 1$). She returned to O'ahu sometime between 1900 H and midnight on 3 November 2021. Her signal was lost after 2 December 2021 and to date, has not been detected again. We do not have a clear explanation as to why this female *pueo* took this quick interisland trip, except that both of those travel-nights appeared to be clear (no cloud cover), with wind speeds averaging 7.4 km/hr, and a dew point averaging 18°C (so the air was less foggy than usual; https://weatherspark.com/h/d/139/2021/10/30/Historical-Weather); thus, Moloka'i may have been more visible from O'ahu than on other nights.

Our study demonstrates the importance of lightweight, battery-powered GPS transmitters for medium-sized (e.g. <350 g) birds, because they have the potential to reveal previously unknown aspects of the ecology and biology of a species, especially for those whose behavior and habitats could cause solar transmitters to perform poorly. Our documentation of the double clutch and the interisland movements of this single female *pueo* represent a step toward a better understanding of this subspecies' breeding and movement ecology in the Hawaiian Islands. Because of the paucity of data on *pueo*, we do not know if this double clutch was an isolated incident, or a more common, but undocumented occurrence for the subspecies nesting in tropical latitudes. Similarly, interisland movements of *pueo* were suspected particularly among the islands of Maui Nui (Maui, Moloka'i, Lāna'i, and Kaho'olawe) due to their close geographical proximity. In fact, those islands are all located 11 to 28 km apart and are often easily visible from one another, which could encourage *pueo* to conduct interisland movements in search of prey or nesting territories. To our knowledge, our study is the first documentation of an interisland movement in the Hawaiian archipelago and the first documented by tracking device technology for any

island/archipelago-endemic subspecies of Short-eared Owl (e.g., *Asio flammeus galapagoensis* in the Galapagos Islands, *A. f. ponapensis* in Polynesia/Macaronesia, *A. f. domingensis* in the Antilles in the Caribbean, and *A. f. sanfordi* in the Islas Malvinas [Falkland Islands]). However, because our data were derived from a sample size of one, further studies deploying tracking transmitters on additional *pueo* on O'ahu and other Hawaiian Islands are important to improve our understanding of its ecology. Assessing potential interannual and inter-individual variability in *pueo* breeding ecology and determining the frequency and reasons behind the interisland movements will be important to better help conserve and manage habitats that *pueo* rely on throughout their entire life cycle.

All activities took place under federal, state, and institutional permits (USGS Bird Banding Lab permit no. 24137 and no. 23395; Hawai'i Division of Forestry and Wildlife Scientific Collecting Permit no. WL9-10 and WL20-05; University of Hawai'i Institutional Animal Care and Use Committee protocol no. 18-2752; and University of Hawai'i Institutional Biosafety Committee protocol no. 18-11-949-01). We thank our collaborators from the Joint Base Pearl Harbor-Hickam at the Lualualei Annex site, especially C. Carnes, A. N. Dunn, J. Hawkins, T. Geelhoed, and we thank the mowing team for their careful work on site. We thank the Joint Base Pearl Harbor-Hickam for the grant funding to this project (Agreement Number: W9126G-20-2-0017). Many thanks to O. Wang, C. Wilhite, W. Naguwa, and K. Acoba for helping with *pueo* captures and data collection, to J. E. Pagel for review comments, and to J. E. Pagel, M. Stuber, and J. Penniman for all their constructive feedback and support, especially while conducting *pueo* fieldwork including trapping and GPS tagging.

LITERATURE CITED

Booms, T. L., G. L. Holroyd, M. A. Gahbauer, H. E. Trefry, A. D. Wiggins, D. W. Holt, J. A. Johnson, S. B. Lewis, M. D. Larson, K. L. Keyes, and S. Swengel (2014). Assessing the status and conservation priorities of the Short-eared Owl in North America. Journal of Wildlife Management 78:772–778.

Calladine, J., G. T. Hallgrimsson, N. Morrison, C. Southall, H. Gunnarsson, F. Jubete, F. Sergio, and F. Mougeot (2024). Remote tracking unveils intercontinental movements of nomadic Short-eared Owls (*Asio flammeus*) with implications for resource tracking by irruptive specialist predators. Ibis. doi:10.1111/ibi.13304.

Department of Land and Natural Resources (DLNR)—Hawai'i (2005). DLNR Fact Sheet: *Pueo* or Hawaiian Short-eared Owl *Asio flammeus sandwichensis*. Hawai'i's Comprehensive Wildlife Conservation Strategy, Honolulu, HI, USA.

Garcia-Heras, M.-S., O. Wang, C. J. Wilhite, K. Stormcrow, and M. R. Price (2022a). Population Size, Distribution and Breeding Ecology of the Hawaiian Short-eared Owl (*Asio flammeus sandwichensis*) on Marine Corps Base Hawaii on O'ahu. Final report prepared for Marine Corps Base Hawaii-Kaneohe Bay, Hawai'i, USA.

Garcia-Heras, M.-S., O. Wang, C. J. Wilhite, and M. R. Price (2022b). Habitat Use and Nesting Biology of Hawaiian Short-eared Owls (*Asio flammeus sandwichensis*) at Joint Base Harbor-Hickam on O'ahu. Final report prepared for Joint Base Pearl Harbor-Hickam, Hawai'i, USA.

Holt, D. W., R. Berkley, C. Deppe, P. L. Enríquez-Rocha, J. L. Petersen, J. L. Rangel-Salazar, K. P. Segars, and K. L. Wood (1999). Short-eared Owl (Strigidae). In Handbook of the Birds of the World (J. del Hoyo, A. Elliott, and J. Sargatal, Editors). Lynx Edicions, Barcelona, Spain. pp. 241–242.

Johnson, J. A., T. L. Booms, L. H. DeCicco, and D. C. Douglas (2017). Seasonal movements of the Short-Eared Owl (*Asio flammeus*) in western North America as revealed by satellite telemetry. Journal of Raptor Research 51:115–128. doi:10.3356/JRR-15-81.1.

Kleefstra, R., J. de Jong, and T. Schaub (2023). Broedende velduilen in Friese velden vol Veldmuizen in 2019. Limosa 95:60–71.

Miller, R., J. B. Buchanan, T. L. Pope, J. D. Carlisle, C. E. Moulton, and T. Booms (2022). Short-eared Owl land-use associations during the breeding season in the Western United States. Journal of Raptor Research 56:273–286. doi:10.3356/JRR-21-19.

US Fish and Wildlife Service (USFWS) (2021). Birds of Conservation Concern 2021. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA, USA.

Wang, O. (2022). Breeding ecology and management of *pueo* (Hawaiian Short-eared Owl, *Asio flammeus sandwichensis*). MS thesis, University of Hawai'i at Manoa, HI, USA.

Received 19 August 2023; accepted 2 January 2024
Associate Editor: Christopher J. Farmer