

# ASSESSING THE BREEDING PHENOLOGY OF THE WHITE-TAILED TROPICBIRD *PHAETHON LEPTURUS DOROTHEAE* ON THE ISLAND OF KAUA'I, HAWAI'I, USING FLEDGLING FALLOUT DATA

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Received 19 June 2019, accepted 26 September 2019

## ABSTRACT

RAINE, A.F., ANDERSON, T., DRISKILL, S. & TIPPIN, T. 2020. Assessing the breeding phenology of the White-tailed Tropicbird *Phaethon lepturus dorotheae* on the island of Kaua'i, Hawai'i, using fledgling fallout data. *Marine Ornithology* 48: 23–26.

Despite being one of the most widespread seabird species in the main Hawaiian Islands, little is known about the breeding phenology of the White-tailed Tropicbird *Phaethon lepturus dorotheae*. This is presumably due to its low conservation concern, coupled with the inaccessibility of most of its nesting sites, meaning that there are an extremely limited number of known nest sites where birds could be monitored directly. To better understand the breeding phenology of this species on Kaua'i, we reviewed data from the Save Our Shearwaters (SOS) program (a Kaua'i-based seabird rescue and rehabilitation program) to analyze when fledgling tropicbirds were recovered. We discovered 313 records of hatch-year birds in the database. Using breeding data from other populations of this species and back-dating the phenology based on these fledging records from the SOS database, we conclude that this species breeds year-round on Kaua'i. However, typically, eggs are laid between March and September (with a peak in June). Chicks hatch between April and October (with a peak in July) and birds fledge between July and January (with a peak in October). The number of tropicbird fledglings handed over to SOS has increased significantly since the program's inception in 1979, to a high of 31 fledglings received in 2016. It is not clear whether this indicates an increase in the population of this species on Kaua'i, an increase in public awareness of seabird conservation on the island, or both. Data from rescue and rehabilitation projects can be an important data resource for studying rare, cryptic, or difficult-to-access seabird species.

**Key words:** tropicbird, fledgling, phenology, fallout, rehabilitation

## INTRODUCTION

The White-tailed Tropicbird *Phaethon lepturus* is a pelagic plunge-diving seabird (Pennycuik *et al.* 1990). It is the smallest and most widespread of the three tropicbird species (the other two being the Red-tailed Tropicbird *Phaethon rubricauda* and Red-billed Tropicbird *Phaethon aethereus*), with a nearly pantropical distribution. It inhabits tropical and subtropical regions of all three of the world's oceans and is absent only from the Eastern Tropical Pacific (Lee & Walsh-Mcgehee 1998, Pyle & Pyle 2017).

The White-tailed Tropicbird has six recognized subspecies, which nest on remote oceanic islands. Only one subspecies, *P. l. dorotheae*, breeds in the Hawaiian Islands. The estimated population in Hawai'i is 1550 breeding pairs, with approximately half of the Hawaiian population breeding on Kaua'i (Pyle & Pyle 2017). However, inaccessibility of many of their cliff nesting sites and low at-sea densities of this species make population estimates difficult to obtain, and estimates are imprecise.

Worldwide, White-tailed Tropicbirds are listed as a species of Least Concern (Birdlife International 2018). While the species is not presently considered to be threatened or endangered, tropicbirds do face significant conservation problems in the South Pacific and the Caribbean. For example, in Bermuda, the White-tailed Tropicbird population is estimated to have declined by 50% since the 1960s (Dobson & Madeiros 2009), with the key causes being urbanization

of coastal areas (directly reducing available nesting habitat), sea-level rise leading to regular flooding of nesting burrows, and depredation by introduced predators such as cats *Felis catus*.

The main Hawaiian Islands are one of the few places where the White-tailed Tropicbird, or koa'e kea, remains near land during non-breeding periods (Harrison 1990). Although populations in Hawai'i appear to be stable, Hawaiian populations face similar threats as those affecting populations elsewhere, including urbanisation, erosion, and mortality caused by invasive predators such as feral cats, rats (such as *Rattus rattus* and *R. exulans*), and the Small Indian Mongoose *Herpestes auropunctatus*. Indeed, the remains of cat-depredated White-tailed Tropicbirds have been found on Kaua'i in multiple locations, including Mount Kahili, the Wainiha Valley, and coastal areas (AFR, unpubl. data). Cats and mongoose are a conservation concern for the closely-related Red-tailed Tropicbird on the neighboring island of O'ahu (VanderWerf & Young 2014). Some White-tailed Tropicbirds nesting in Hawai'i Volcanoes National Park have occasionally succumbed to volcanic eruptions or harmful sulphur emissions (Pyle & Pyle 2017).

The patchy distribution of this species, the inaccessibility of most nest sites, and the fact that it is considered low priority due to its 'Least Concern' conservation status has resulted in a general lack of research in Hawai'i on these relatively common seabirds. Indeed, in a recent GAP analysis for the US Fish & Wildlife Service's Pacific Seabird Program, the White-tailed Tropicbird was identified by the

authors as the least monitored seabird in the entire US Tropical Pacific (VanderWerf & Young 2017). Therefore, many biological aspects of the White-tailed Tropicbird remain unknown or are poorly understood. To better understand the breeding phenology of this species on Kaua'i, and given the extremely limited number of known nest sites where breeding birds could be monitored directly, we reviewed records from the Save Our Shearwaters (SOS) program to obtain fledging records.

SOS is a public conservation effort that was initiated by the Division of Forestry and Wildlife (DOFAW) in the late 1970s, created primarily to facilitate the rescue and recovery of Newell's Shearwater *Puffinus newelli* fledglings (that are grounded due to artificial light attraction) and adults (that succumb to powerline collisions or light attraction). The SOS program is housed at the Kaua'i Humane Society and is currently funded by the Kaua'i Island Utility Cooperative, with additional funds from the US Fish & Wildlife Service and the State of Hawai'i. While the program focuses primarily on threatened and endangered seabirds (particularly the Newell's Shearwater and the Hawaiian Petrel *Pterodroma sandwichensis*), all native birds are rehabilitated by the program, including White-tailed Tropicbirds. We used records of downed fledgling tropicbirds (listed as hatch-year birds) to project the breeding phenology of this species on Kaua'i.

## METHODS

We reviewed the entire SOS database on the island of Kaua'i (the northernmost island in the Main Hawaiian Islands; Fig. 1) for White-tailed Tropicbird records. For each record, the age of the individual was noted. We used only birds that were identified as hatch year (HY) for the analysis; we ignored adults (listed in the database as AHY) and those listed as "unknown".

We then used data on White-tailed Tropicbird phenology from other, better-studied populations to estimate the breeding phenology of the

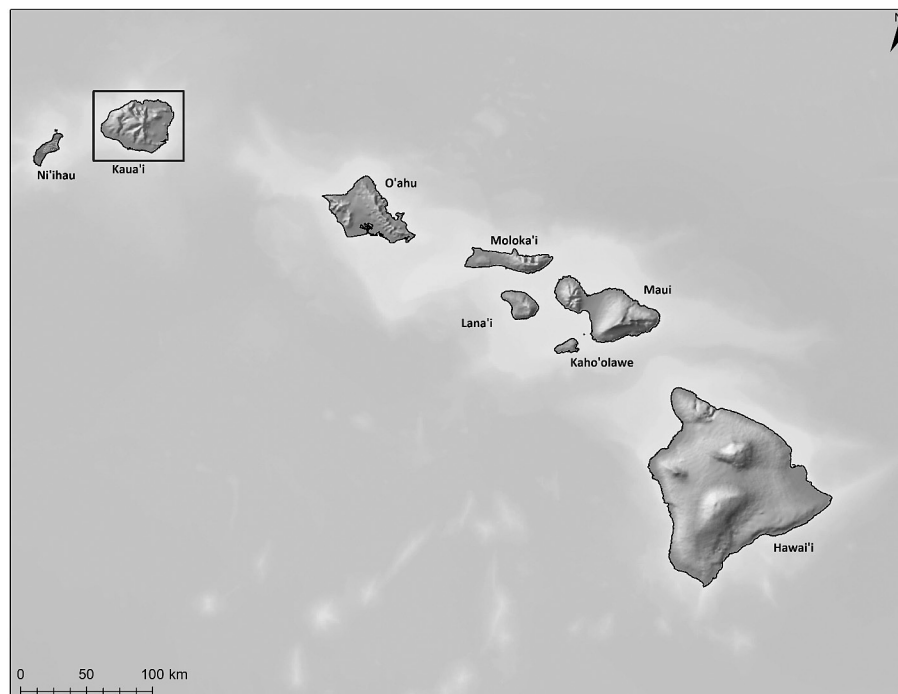
species on Kaua'i. Specifically, the incubation period was set at 41 d based on work conducted by Phillips (1987), Harrison (1990), and Schaffner (1991). The chick phase was set at 75 d based on averaging data from Puerto Rico (Schaffner 1991), the Seychelles (Phillips 1987), and Ascension Island (Stonehouse 1962a).

## RESULTS

SOS received a total of 386 White-tailed Tropicbirds between 1981 and 2017, of which 313 (81.1%) were identified as hatch year birds. The majority (87.7%) of hatch year birds were received and processed by SOS between July and December, with the peak month being October (32.9% of all records) followed by November (18.4% of all records) (Fig. 2). Based on this data, it is apparent that, while this species does breed year-round on Kaua'i, there is a clear peak of breeding activity. Taking October as the peak fledging month, the average fledge date in that month was 17 Oct  $\pm$  0.87 d. Back-dating from the fledgling data, a bird fledging in that month would hatch on 03 August from an egg that was laid on 24 June.

Based on this fledging data, the general breeding phenology of White-tailed Tropicbirds on Kaua'i is as follows: eggs are typically laid between mid-March and mid-August, with a peak in mid-June; eggs hatch between the beginning of May and the end of September, with a peak in early August; and birds fledge between July and December, with a peak in October (Fig. 3). Nevertheless, this species is capable of breeding year-round.

The number of fledglings received by SOS was also analyzed each year to assess if there was any trend over time. A linear regression showed a strongly significant increase in the number of fledglings received by SOS over the years ( $y = 0.5752x - 1141.3$ ,  $R^2 = 0.59$ ,  $F = 49.84$ ,  $P < 0.05$ ), the peak year being 2016 with 31 fledglings (Fig. 4).



**Fig. 1.** Map of Kaua'i in relation to the main Hawaiian Islands.

**DISCUSSION**

The population of White-tailed Tropicbirds in Hawai'i is relatively small, estimated at 1550 breeding pairs (Pyle & Pyle 2017), mainly breeding within the main Hawaiian Islands (breeding records from the northwestern Hawaiian Islands are very sparse). Given that approximately half the Hawaiian population breeds on Kaua'i (Pyle & Pyle 2017), identifying the breeding phenology of this species on the island is an important facet of its life history that can directly inform conservation strategies and efforts to monitor the population status of White-tailed Tropicbirds elsewhere in the Hawaiian Islands.

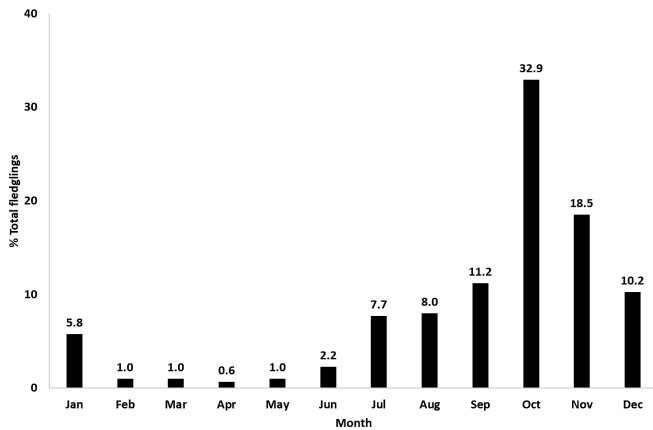
From the SOS database, it is apparent that White-tailed Tropicbirds breed year-round on Kaua'i. This is similar to findings for White-tailed Tropicbird populations breeding on Cousin Island (Phillips 1987), Ascension Island (Stonehouse 1962), and Aldabra Atoll (Prys-Jones & Peet 1980). However, there is a definite peak breeding season on Kaua'i; June marks the peak egg-laying period, while chick hatching peaks in early August. Finally, the peak fledging period occurs in October (although in the last three years the peak month was September, perhaps representing a recent shift to slightly earlier fledging dates). Anecdotally, a White-tailed Tropicbird nest near Shipwrecks Beach (which is located near Poipu on Kaua'i) that was monitored for three consecutive years fell within the range of peak breeding phenology as identified by this analysis (AFR, pers. obs).

The number of White-tailed Tropicbird fledglings brought to SOS has significantly increased since 1981. It remains unclear whether this indicates an increase in the population of this species on Kaua'i, whether citizens are simply better informed and more actively participating in seabird conservation efforts and the

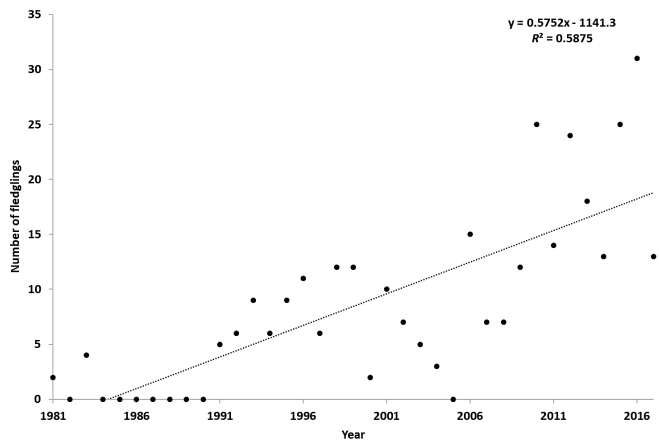
SOS program, or both. It may reflect an increasing population, as Newell's Shearwater fledglings handed in to the program have significantly decreased during the same period (Raine *et al.* 2017), suggesting that increased public awareness may not be a factor. However, further study is needed to confirm the underlying reason for this trend.

The White-tailed Tropicbird is one of the least studied seabirds in the main Hawaiian Islands, despite its relative abundance. Obtaining better breeding and distribution data throughout the main Hawaiian Islands is necessary to inform conservation needs and the population status of this species. On Kaua'i, the White-tailed Tropicbird breeds widely, including on the high cliffs of the Na Pali coast and Waimea Canyon; on exposed rock faces within heavily vegetated valleys such as Wainiha, Lumahai, and Hanalei; on exposed rock faces along heavily vegetated ridges such as Kahili; and on the rocky coasts of the south, east, and north of the island (AFR, pers. obs). This species is vulnerable to a wide range of threats, including depredation by introduced predators, urbanization, collision with infrastructure (several dead White-tailed Tropicbirds have been found under powerlines spanning Hanapepe Valley; M. Travers, pers. obs.), and potentially issues such as climate change and a declining food supply. Until more detailed studies begin to examine the habitat and ecology of this species in Hawai'i, it will be difficult to characterize its vulnerabilities and its greatest conservation needs.

One important aspect of this analysis should be kept in mind: the majority of fledgling tropicbirds that are received by the SOS program are in poor body condition. This could mean that they fledged a week or so later than they should have, that they developed at a slower pace because of a lack of available nutrition, or that there were issues with the breeding pair (such as the loss of an adult, or new breeders). These factors could shift



**Fig. 2.** Percentage of total number of White-tailed Tropicbird fledglings received by SOS in each month ( $n = 316$ ) from 1981 to 2017.



**Fig. 4.** Number of White-tailed Tropicbird fledglings received by SOS each year, from 1981 to 2017.

Breeding Phase	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
<i>Incubation</i>	---	---	---	---	---	---	---	---	---	---	---	---
<i>Chick rearing</i>	---	---	---	---	---	---	---	---	---	---	---	---
<i>Fledging</i>	---	---	---	---	---	---	---	---	---	---	---	---

**Fig. 3.** Pooled data from 1981 to 2017, indicating the breeding phenology of the White-tailed Tropicbird on Kaua'i; dashed lines indicate periods of low breeding activity and bars indicate peak periods of breeding activity.

the observed fledging date and plotted phenology of the overall breeding population, with the true dates occurring slightly earlier than predicted by this analysis. However, these factors would not change our overall results. Furthermore, without these data, the breeding phenology of White-tailed Tropicbirds on Kaua'i would, by necessity, be relegated to a handful of burrow records, making them far less accurate than the current analysis. Therefore, data on fallout tropicbird fledglings from the SOS program represents an important data resource for studying rare or cryptic seabird species on Kaua'i. It follows that data from similar rescue and rehabilitation programs could be used to assess the breeding phenology of other poorly known seabirds elsewhere.

#### ACKNOWLEDGEMENTS

The Kaua'i Endangered Seabird Recovery Project is a Department of Land and Natural Resources, Division of Forestry and Wildlife project, administered through the Pacific Cooperative Studies Unit of the University of Hawai'i. We thank both organizations for their support. From the Pacific Cooperative Studies Unit, we appreciate the support of David Duffy, Linda Hara, Dana Fukata, Michelle Miyata, Chin Lee Nicolaidis, and Lynnette Kinoshita. From the Division of Forestry and Wildlife, we appreciate the support of Sheri Mann, Thomas Ka'iakapu, Afsheen Siddiqi, Katherine Cullison, Jason Omick, and Jim Cogswell. The SOS program was initiated by the Division of Forestry and Wildlife in the late 1970s. The program is now housed at the Kaua'i Humane Society and is funded by the Kaua'i Island Utility Cooperative, with additional funding from the US Fish & Wildlife Service and the State of Hawai'i. We thank all staff working for these entities who have facilitated and processed the funding for this important program. We also thank SOS personnel who have worked tirelessly on this project over the years and have dedicated their time to rehabilitating birds in desperate need of attention. We also thank the members of the SOS Steering Committee who, over the years, have helped guide and enhance this program. Lastly, we would like to thank Craig Harrison and Greg Spencer for their helpful comments on the first draft of this paper.

#### REFERENCES

BIRDLIFE INTERNATIONAL. 2018. *Phaethon lepturus*. The IUCN Red List of Threatened Species 2018: e.T22696645A131756065. Cambridge, UK: International Union for Conservation of Nature. [Available online at: <http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22696645A131756065.en>. Accessed on 19 September 2019.]

- DOBSON, A.L.F. & MADEIROS, J. 2009. Threats facing Bermuda's breeding seabirds: measures to assist future breeding success. In: RICH T.D. (Ed.) *Tundra to Tropics: Connecting Birds, Habitats and People, Proceedings of the Fourth International Partners in Flight Conference*. Texas, USA: Partners in Flight.
- HARRISON, C. 1990. *Seabirds of Hawaii: Natural History and Conservation*. New York, USA: Cornell University Press.
- LEE, D.S. & WALSH-MCGEHEE, M. 1998. 01 Introduction: White-tailed Tropicbird. In A. POOLE & F. GILL, (Ed.). *The Birds of North America Online*. Ithaca, USA: Cornell Lab of Ornithology. [Available online at: <https://birdsna.org/Species-Account/bna/species/whttro/introduction>. Accessed 21 Feb 2018].
- PENNYCUICK, C.J., SCHAFFNER, F.C., FULLER, M.R., OBRECHT, H.H. & STERNBERG, L. 1990. Foraging flights of the White-tailed Tropicbird (*Phaethon lepturus*): radiotracking and doubly-labelled water. *Colonial Waterbirds* 13: 96–102.
- PHILLIPS, N.J. 1987. The breeding biology of White-tailed Tropicbirds *Phaethon lepturus* at Cousin Island, Seychelles. *Ibis* 129: 10–24.
- PRYS-JONES, R.P. & PEET, C. 1980. Breeding periodicity, nesting success and nest site selection among Red-tailed Tropicbirds *Phaethon rubricauda* and White-tailed Tropicbirds *P. lepturus* on Aldabra Atoll. *Ibis* 122:76–81.
- PYLE, R.L. & PYLE, P. 2017. *White-tailed Tropicbird Phaethon lepturus. The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status, Version 2*. Honolulu, USA: B.P. Bishop Museum. [Available online at: <http://hbs.bishopmuseum.org/birds/rlp-monograph/pdfs/03-PHAE-GRUI/WTTR.pdf>. Accessed 21 Feb 2018.]
- RAINE, A.F., HOLMES, N.D., TRAVERS, M., COOPER, B.A. & DAY, R.H. 2017. Declining population trends of Hawaiian Petrel and Newell's Shearwater on the island of Kaua'i, Hawai'i, USA. *The Condor* 119: 405–415.
- SCHAFFNER, F.C. 1991. Nest-site selection and nesting success of White-tailed Tropicbirds (*Phaethon lepturus*) at Cayo Luis Pena, Puerto Rico. *The Auk* 108: 911–922.
- STONEHOUSE, B. 1962. The tropic birds (genus *Phaethon*) of Ascension Island. *Ibis* 103: 124–161.
- VANDERWERF, E.A. & YOUNG, L.C. 2014. Breeding biology of Red-tailed Tropicbirds *Phaethon rubricauda* and response to predator control on O'ahu, Hawai'i. *Marine Ornithology* 42: 73–76.
- VANDERWERF, E.A. & YOUNG, L.C. 2017. *A Summary and Gap Analysis of Seabird Monitoring in the U.S. Tropical Pacific*. Report prepared for the US Fish and Wildlife Service, Region 1, Portland OR. Honolulu, USA: Pacific Rim Conservation.