

## DISTRIBUTION, ABUNDANCE, AND BREEDING BIOLOGY OF WHITE TERNS ON OAHU, HAWAII

ERIC A. VANDERWERF<sup>1</sup>

**ABSTRACT.**—White Terns (*Gygis alba*) are common in the northwestern Hawaiian Islands, but in the main Hawaiian Islands they are found only on Oahu, where they are listed as threatened by the State of Hawaii. I censused the White Tern population on Oahu from October 2001 to January 2003, and I investigated breeding success and seasonality during monthly visits to four sites. I observed a total of 694 adult White Terns on Oahu, of which approximately 500 (72%) were breeding birds. Active nests were present during all months, but most eggs were laid from January to April (65%), with a peak in egg laying during March (22%). Nest success was 74%, and pairs produced a mean of 0.98 fledglings/year. One pair fledged successive young less than three months apart. The incubation period at one nest was 35 days, and the fledging periods at two nests were 43 and 47 days. The White Tern population on Oahu has increased from a single breeding pair in 1961 to approximately 250 pairs in 2002, a growth rate of 14% per year. White Terns on Oahu exist entirely in urban and suburban areas, and their reproduction is not inhibited by the numerous predators and sources of disturbance. Received 4 March 2003, accepted 15 August 2003.

The White Tern (*Gygis alba*) is a common seabird that nests on many islands throughout the tropical and subtropical Pacific, Atlantic, and Indian oceans (Harrison 1983). White Terns are abundant on some of the atolls and rock pinnacles in the northwestern Hawaiian Islands, but in the main Hawaiian Islands they are found only on Oahu (Harrison 1990, Niethammer and Patrick-Castilaw 1998), where a single pair first was observed nesting in 1961 (Ord 1961). The population on Oahu was estimated to be 50–100 pairs in the mid-1980s (Harrison 1990), and a long term study of the breeding biology was conducted in one area of Oahu (Miles 1985, 1986), but there have been no systematic surveys of their distribution or abundance. The White Tern population on Oahu was listed as threatened by the State of Hawaii in 1986 (Hawaii Administrative Rules, Title 13, Part 2, Chapter 124), presumably based on its limited distribution and small population size. I censused the White Tern population on Oahu from October 2001 to January 2003 to provide more recent and accurate information on their distribution and abundance, and I re-examined the breeding biology in several areas of Honolulu.

### METHODS

I located White Tern breeding and roosting sites in Honolulu (21° 12' N, 157° 30' W) by

observing flying birds or by the distinctive clusters of white droppings that accumulated on the ground. I surveyed each location where terns or their droppings were present on at least two different days, and I counted the numbers of breeding and nonbreeding birds. I counted birds as breeding if they were attending an egg or a chick or if they were perched <1 m from a chick that did not appear agitated. Chicks >1 week old appear agitated when approached by an adult other than their parents (Niethammer and Patrick-Castilaw 1998). I counted birds as nonbreeding if they did not appear to be associated with an egg or chick. I counted recently independent young, which could be recognized by their shorter bill with less extensive bluish coloration at the base and the narrower ring of black skin around the eye (Niethammer and Patrick-Castilaw 1998, pers. obs.), as nonbreeding birds.

I assumed that each nest had two adults, and I calculated the number of birds at each location as twice the number of nests plus the number of nonbreeding birds. I then estimated the total population by adding the largest numbers of birds observed at each location. I conducted surveys within 2 h of sunrise because many terns leave nest and roost areas by that time to forage at sea (unpubl. data). This method may underestimate the total population because an unknown number of nonbreeding birds could have been away at sea and missed on each visit. It also is possible that I missed a few smaller breeding and roosting sites.

<sup>1</sup> U.S. Fish and Wildlife Service, 300 Ala Moana Blvd., Room 3–122, Box 50088, Honolulu, HI 96850, USA; e-mail: eric.vanderwerf@fws.gov

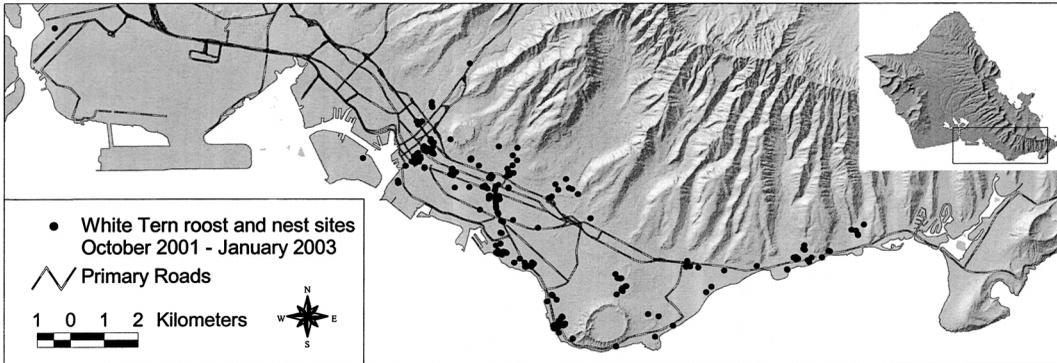


FIG. 1. Distribution of White Tern breeding and roosting sites on Oahu from October 2001 through January 2003. Sites often were loosely aggregated, and all sites were located in urban and suburban areas of Honolulu.

I monitored breeding success by conducting monthly surveys from October 2001 to January 2003 in four areas. Two of these areas contained large concentrations of terns (Kapiolani Park and Kalakaua Avenue), and two areas contained only a few pairs (Beretania Street and Niu Valley). Some pairs in the study areas probably nested more than once per year, based on observations of pairs simultaneously caring for eggs and fledged young and on repeated use of the same nest sites in rapid succession. At Tern Island, French Frigate Shoals, 75% of pairs used the same site for re-laying attempts and in subsequent years (Niethammer and Patrick-Castilaw 1998), and 81% of pairs used the same breeding site two years in a row at Ascension Island (Dorward 1963). At my study areas, none of the birds were marked, so it was not possible to determine with certainty whether some nests were re-laying attempts. The numbers of birds and breeding attempts in months that were surveyed twice (October to January) are presented as means.

## RESULTS

I observed a total of 694 adult White Terns and 221 nests on Oahu from October 2001 through January 2003. Based on observations from intensively monitored sites, approximately 72% of the population, or 500 birds, were breeders (see below). All terns were found in urban and suburban areas of Honolulu on the southern shore of Oahu (Fig. 1); no terns were found in other parts of the island. Terns were scattered around many parts of the city, but they often occurred in loose

aggregations. In areas where tern density was low, each tree usually contained a single pair, but in more densely populated areas up to four pairs and several nonbreeding birds used a single large tree. Nests occurred as close as 4 m apart.

In the four sites that were monitored monthly, I observed a total of 184 terns and 88 nests. These nests appeared to have been made by 66 pairs, or 1.33 attempts/pair/year by 72% of the population. Sixty-five of the 88 nests were successful (74%), for a mean of 0.98 fledglings/pair/year. There was no significant difference among the four study sites in success of nests (ANOVA:  $F_{3,59} = 2.00$ ,  $P = 0.12$ ). In Niu Valley the incubation period at one nest was 35 days, and the fledging periods at two nests were 43 and 47 days. One pair was observed simultaneously incubating an egg and feeding a recently fledged chick that still had wisps of down. The eggs in those nests were laid in February and May, and the young fledged <3 months apart. In several cases, independent young continued to roost near pairs that began nesting in the same site that just had been used.

Active nests were present during all months, but most eggs were laid from January to April (65%), with a peak in egg laying during March (22%; Fig. 2). Breeding and nonbreeding birds were present all year, but the number of birds was highest during the peak nesting period from February to July, and the fewest birds were present from November to January (Fig. 3).

More than 31 tree species were used for

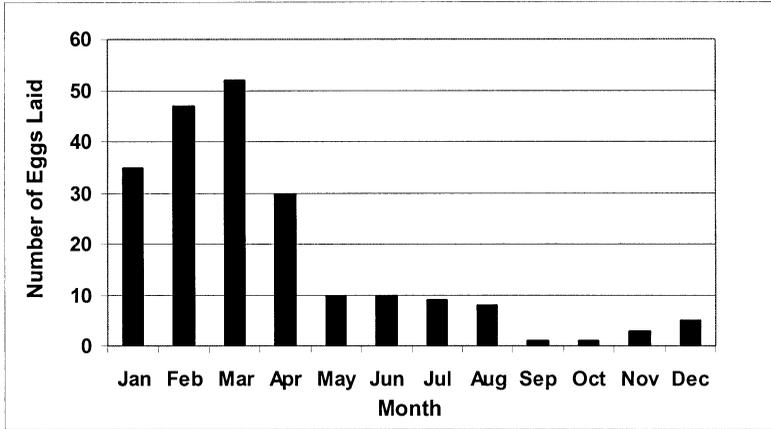


FIG. 2. Seasonality of White Tern breeding on Oahu from October 2001 through January 2003. Most eggs were laid in March, but active nests were present during all months.

nesting and roosting, but banyans (*Ficus* spp., 22%), monkeypod (*Samanea saman*, 13%), mahogany (*Swietenia mahogany*, 13%), and kukui (*Aleurites moluccana*, 10%) were used most often. Banyans and monkeypod are very common in Honolulu, so their frequent use is not surprising, but mahogany and kukui are uncommon and may be preferred by terns. Most trees used by White Terns were among the largest in the area, and White Terns seemed to select larger trees for roosting and nesting.

DISCUSSION

The White Tern population on Oahu, though still relatively small and restricted in range, is increasing and robust. From a single

breeding pair in 1961 (Ord 1961), the breeding population increased to approximately 250 pairs in 2002, a growth rate of 14% per year. This rapid population growth has been possible at least partly because of a high reproductive rate. Despite the many sources of disturbance and numerous predators in urban Oahu, reproduction of White Terns in Honolulu reported in this study (74% nest success, 0.98 young/pair/year) and by Miles (1985; 76% nest success) was higher than at Ascension Island (29% nest success; Dorward 1963) or Tern Island (30% nest success, 0.59 young/pair/year; Niethammer and Patrick-Castilaw 1998). Some areas used by White Terns on Oahu, such as Kalakaua Avenue and Waikiki, experience heavy pedestrian and vehicular

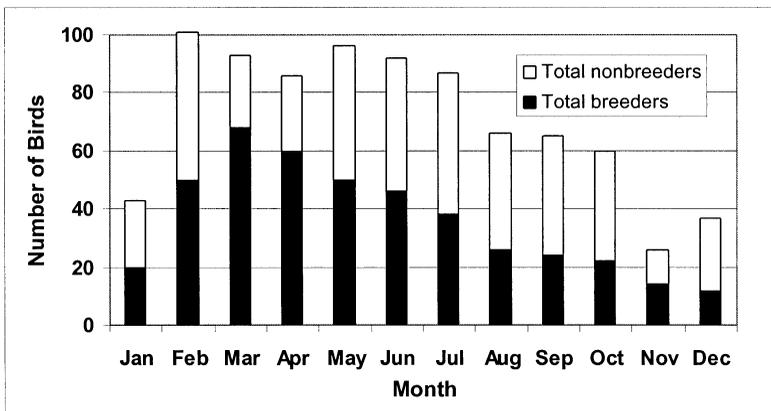


FIG. 3. Seasonal abundance of White Terns at Kapiolani Park and Kalakaua Avenue, Oahu, from October 2001 through January 2003. The peak in numbers of birds coincided with the peak in nesting activity.

traffic virtually 24 h/day, but this does not inhibit reproduction of White Terns, and it is possible that vehicular traffic actually protects tern nests by preventing predators from reaching nest trees. Several times on Kalakaua Avenue I saw dead rats (*Rattus* sp.) and feral cats (*Felis silvestris*) that presumably had been killed by vehicles.

The fledging period on Oahu (45 days) also was shorter than fledging periods reported from Tern Island (53.2 days, Pettit et al. 1984; 48.6 days, Niethammer and Patrick-Castilaw 1998), and Ascension Island (65–70 days; Dorward 1963). Although the rate of development is slower than in some other species, such as Black Noddies (*Anous minutus*; Pettit et al. 1984), White Terns can re-lay rapidly and produce multiple broods per year. Miles (1985) reported White Terns producing broods five months apart and up to three broods per year. During this study pairs raised broods as little as three months apart. The proportion of breeding birds reported in this study (71%) also was higher than that reported from the northwestern Hawaiian Islands (37%; Niethammer and Patrick-Castilaw 1998).

The rapid development, high nest success, high proportion of breeding birds, and consequent rapid growth of the White Tern population on Oahu may be related to food availability near Oahu, the small population size of White Terns on Oahu, and the broad diet of White Terns (Diamond 1982). In the Black Noddy, food abundance is thought to be an important determinant of the number of clutches per year (Gauger 1999). Examination of feeding rates and diet on Oahu might help elucidate the success of this population. The rapid rate of population growth also suggests that survival and site fidelity of juveniles is high, or that there is immigration from other islands, or both.

White Terns currently are found only along the southeastern coast of Oahu, where they breed and roost exclusively in large trees, but on other islands White Terns nest on low vegetation, human structures, and even on the ground (Rauzon and Kenyon 1984, Niethammer and Patrick-Castilaw 1998). On Oahu, White Terns probably are limited to large trees for nesting because they provide relative safety from predators, and the distribution of White Terns on Oahu may be restricted in

some areas by lack of large trees for nesting. No White Terns occur west of Hickam Air Force Base or east of Niu Valley, perhaps because these are the last areas in each direction that have groups of large trees. Nests on low vegetation or on the ground would be very unlikely to survive on Oahu due to the abundance of feral cats, mongoose (*Herpestes erpunctatus*), and rats (Smith et al. 2002). When White Terns were studied in Kapiolani Park by Miles (1985), many pairs nested in ironwood (*Casuarina* sp.) trees, but these trees are now occupied by hundreds of feral pigeons (*Columba livia*) rather than White Terns. If White Terns continue to increase on Oahu, they may spread inland, to other coasts of the island, and to other islands. White Terns have been reported on land several times on Maui, but have not been observed breeding (F. Duvall pers. comm.).

Although White Terns are tolerant of people and noise, tree trimming and construction projects should be conducted during fall and early winter when fewer White Terns are breeding, and in ways that minimize disturbance. White Terns provide an excellent educational opportunity because they are one of few native birds in Hawaii that can be seen easily by people in urban areas. White Terns nest in many schoolyards, and monitoring of their nests could be the subject of outdoor biology projects.

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