20–30 m to their side of the boundary, and the N crows—the more aggressive group—did the same. The two groups then walked slowly toward each other for 10–15 min, foraging as they went. When they were about 15 m apart, the N crows took wing and swooped down within 15–20 cm of the leading S crow, which sometimes squatted on the grass with wings outspread. When the N crows returned to the ground, the two groups turned to walk back the way they had come. Intrusions (N = 5) were seen in the fall of 1983 when an N crow alighted 12–16 m inside the S group's territory while the two other N birds remained at the boundary. The single N crow clashed with the nearest S crow. On 11 and 15 December the N crows occupied the vicinity of the boundary with similar positions for 10–20 min at the start of the day, before the S crows appeared.

Other behavioral patterns included "aerial melees" (N = 17), "bunching" (N = 5), and "pursuits" (N = 5). Aerial melees were spectacular, with all members of both groups swirling into the air for 3–4 sec, with some of them swooping on others. On 19 November 1982, the N and S crows, flying from perches on the elms, had five such encounters in 12 min. When about to fly against opponents, crows of either group sometimes flew to within 15–30 cm of each other. On 8 December 1982 the 3 S crows, after grouping in this manner, repeatedly dove on the N crows, driving them 250 m north of the boundary. This was one of the few encounters in which the S crows initiated the interaction. Territorial behavior also included slow, circular flights (N = 11), in which crows of one group circled a short way over the border, then returned to their own territory, and tree-top sitting (N = 17), in which the crows climbed to the top of the dead elms or other bare trees during the territorial encounters. Displacement activities (Terres, Encyclopedia of North American Birds. Alfred A. Knopf, New York, New York, 1980), which I saw only twice, consisted of exaggerated bill-wiping and bark-pecking. "Wing-tail flicking," which in my experience is sometimes a sign of readiness to attack (Kilham, Fla. Field Nat. 13:25–48, 1985), was seen during most encounters.

Good (1952) found no indications of territoriality, except close to nests, at any season among American Crows in Ohio. Territorial behavior, however, can be missed if an observer does not happen upon a section of boundary where neighboring groups meet. I have observed encounters along boundaries between groups of cooperatively breeding crows (Kilham, J. Field Ornithol. 55:349–356, 1984) in Florida during the breeding season, as well as among crows in New Hampshire in summer, fall, and winter. Other species of *Corvus* defending territories include the Carrion Crow (*C. corone*) (J. K. Charles, Ph.D. diss, Aberdeen Univ., Aberdeen, Scotland, 1972), the Jungle Crow (*C. macrorhynchos*) (Kuroda, Misc. Rep. Yamashina Inst. Ornithol. 44:1–34, 1975), and the Black Crow (*C. capensis*) (Skead, Ibis 94: 434–451, 1952). Tree-top sitting as a form of territorial behavior is well developed in Black Magpies (*Pica pica*) (Moller, Ornis Scand. 13:94–100, 1982).—LAWRENCE KILHAM, *Dept. Microbiology, Dartmouth Medical School, Hanover, New Hampshire 03755.* *Accepted 4 Mar. 1985.*

Wilson Bull., 97(3), 1985, pp. 390–392

The status of the Sooty Storm-Petrel in Hawaii.—The total U.S. population of the Sooty Storm-Petrel (*Oceanodroma tristrami*) is estimated to be less than 10,000, and the species has been designated a "sensitive species" by the U.S. Fish and Wildlife Service (USFWS Regional Planning Manual, 1979). The species has a narrow breeding range limited to North Pacific islands, and in Hawaii it breeds on French Frigate Shoals (Amerson, Atoll Res. Bull.

150, 1971), Laysan Island (Ely and Clapp, Atoll Res. Bull. 171, 1973), and Pearl and Hermes Reef (Amerson et al., Atoll Res. Bull. 174, 1974). It has been suspected of breeding on Nihoa Island (Clapp et al., Atoll Res. Bull. 207, 1977), Necker Island (Clapp and Kridler, Atoll Res. Bull. 206, 1977), and Lisianski Island (Clapp and Wirtz, Atoll Res. Bull. 186, 1972). King (Smithson. Inst. Bull., 1967) lists the Volcano Islands and the Southern Izu Islands of Japan as breeding sites, along with possibly the Bonin (Ogasawara) Islands. Hasegawa (Yamashina Inst. Ornithol. 10:178–184, 1978) commented that the population "appears to have greatly decreased recently" at the Izu Islands. The limited breeding range of the species suggests that the population center is in Hawaii. Here we report a summary of our field observations of this species from 1978–1983.

Distribution.—We conducted a survey of Nihoa Island from 31 January to 22 February 1981 at which time eggs, and chicks in various stages of growth, were found. Birds were heard calling from burrows in loose rock piles in valleys and in soil at the summit of the island. We estimated the number of calling pairs from these colonies; then, based on the amount of similar habitat, we estimated that Nihoa might support approximately 2000–3000 breeding pairs. In 1981 and 1983, several specimens were collected. They were identified and deposited at the U.S. National Museum of Natural History in Washington, D.C. (USNM 507668) and at the B. P. Bishop Museum in Honolulu, Hawaii (BPBM 1983.338). We observed a chick, almost fully-feathered with some down remaining on its belly, on 21 May 1979 on Necker Island confirming that Sooty Storm-Petrels breed there. In June 1982, a mummified chick of the same age was collected and deposited in the Bishop Museum. Further nocturnal surveys are needed during the winter to determine the size of the population on Necker Island. East and Whale-Skate islands within French Frigate Shoals are breeding locations for as many as 10–15 pairs. Burrows of Sooty Storm-Petrels have been found on Whale-Skate Island at the base of albatross nest mounds (Eilerts, pers. comm.).

We estimated that between 500 and 2500 pairs may breed on Laysan Island in several scattered colonies around a hypersaline lake. Burrows were found at night by locating calling birds. Daytime surveys determined burrow occupancy and vegetation associations. Burrows were found in sandy loam substrate beneath beach morning glory (*Ipomoea pes-caprae*) and in piles of guano rock. The lack of intensive winter field work rendered such estimates imprecise. Mummified Sooty Storm-Petrels were collected on Lisianski Island in 1979, 1980, and 1982. Burrow searches for Bonin Petrels (*Pterodroma hypoleuca*) were conducted in May 1981. During that search, no Sooty Storm-Petrels were found. Consequently, we concluded that storm-petrels may breed there but that the population is small. Based primarily on information reported by Amerson et al. (1974), we estimated that 300 to 500 pairs breed on Pearl and Hermes Reef. Visits to this atoll on 10–11 May 1979 failed to reveal significant numbers of young. Burrows were found under clumps of beach grass (*Eragrostis variabilis*) and in coral rubble. Despite numerous trips to Midway Atoll between 1979 and 1983, we never observed any evidence of breeding Sooty Storm-Petrels. However, Grant ('Elepaio 43:1, 1982) found a dead adult male with enlarged testes (USNM 577154) and an unsexed adult (USNM 598525) in 1981. No nests were found. The introduced black rat (*Rattus rattus*), which has greatly reduced the nesting success of Bonin Petrels, would probably render the storm-petrel efforts unsuccessful. There have been no recent observations of Sooty Storm-Petrels nesting on Kure Atoll, but it is possible that a few pairs occur there despite the presence of Polynesian rats (*R. exulans*). Some nesting occurred there in the 1960s while rats were present (Woodward, Atoll Res. Bull. 164, 1972).

Breeding phenology.—Crossin (Smithson. Contrib. Zool. 158:154–205, 1974) acknowledged that data on Sooty Storm-Petrels in the Northwestern Hawaiian Islands were inadequate to obtain a clear picture of the breeding cycle, but that storm-petrels were present on the breeding grounds from "at least October to May and that December and January

are the peak egg-laying months." We agree with these findings and add that it is unlikely that many adults are on the breeding grounds in October, April, or May. On 5 November 1980, we could not find any birds during a fairly thorough one-day search of Nihoa, nor did we see any birds offshore. On Laysan, birds were vocalizing in burrows, but no eggs could be found on 16 November 1980. On 26 January 1981, eggs were being incubated on Laysan Island, but no young were found. In February 1981, every stage of development between eggs and fully-feathered chicks was found on Nihoa. Our surveys throughout 1978–1983 indicate that most adults and young are gone from the breeding islands by mid-May.

Morphometrics.—Adult Laysan Island birds ($\bar{x}$ = 93.8 g, SD = 9.8, range = 79–108.5, N = 32) weighed significantly more than adult Nihoa birds ($\bar{x}$ = 86.2 g, SD = 6.0, range = 74–94, N = 23) (ANOVA, $P \leq 0.01$) in January and February. Adult weights on Laysan in April and May averaged 83.6 g (range = 66–105, N = 61). The differences in weight may reflect seasonal and spatial food availability. The following mean measurements are from Nihoa: culmen length 1.86 cm (SD = 0.13, range = 1.64–2.29, N = 23); culmen width 0.94 cm (SD = 0.08, range = 0.79–1.06, N = 13); tarsi 3.03 cm (SD = 0.16, range = 2.71–3.40, N = 23) and wing length 11 cm (SD = 0.64, range = 17.5–19.5, N = 11). The single egg is immaculate white, not with spots as reported by Peterson (1961). Egg measurements were made from 9 eggs on Laysan Island. The mean length was 3.91 cm (SD = 0.11, range = 3.70–4.14) and the mean breadth was 2.87 cm (SD = 0.06, range = 2.77–2.96). Two eggs were measured in Nihoa. The mean length was 3.78 cm (SD = 0.18, range = 2.67–2.92). The egg volumes were calculated according to Stonehouse (Ibis 103:474–479, 1963) to be 16.04 cm^3 and 15.06 cm^3 respectively (ANOVA, $P > 0.01$).

Conservation.—The Sooty Storm-Petrel population is now known to be greater than previously suspected in the Northwestern Hawaiian Islands with the confirmed presence of a large colony on Nihoa Island. Nowhere, however, is this ground-nesting species common. The accidental introduction of rats or cats onto breeding islands could be devastating. Rats were responsible for a population decline at the Izu Islands, Japan (Hasegawa 1978). Additional research is necessary during the winter breeding season to determine the actual size of the colonies. To be effective, thorough surveys require the use of tape recordings of the Sooty Storm-Petrel call to determine the occurrence of birds in their deep burrows. A more accurate status assessment throughout its range will help determine what conservation measures, if any, are needed.

Acknowledgments.—We are grateful to the captain and crew of the NOAA Ship R/V *Townsend Cromwell* for their support of our field studies. A. Newman, E. Knudtson, B. Flint, J. Andre, R. Schulmeister, S. Schulmeister, and R. Ittner made observations that were used in this report. We thank R. B. Clapp and S. L. Olson for indentifying specimens. We also thank the U.S. Fish and Wildlife Service for their support.—MARK J. RAUZON, *P.O. Box 4423, Berkeley, California 94704;* CRAIG S. HARRISON, *46-024 Puulena, #614, Kaneohe, Hawaii 96744;* AND SHEILA CONANT, *Dept. General Science, Univ. Hawaii, Honolulu, Hawaii 96822.* *Accepted 1 Feb. 1985.*

Wilson Bull., 97(3), 1985, pp. 392–395

Vocal imitation in a captive Purple Martin.—Kroodsma and Baylis (pp. 311–389 *in* Acoustic Communication in Birds, Vol. 2, D. E. Kroodsma and E. H. Miller, eds., Academic Press, New York, New York, 1982) list the Barn Swallow (*Hirundo rustica*) as the sole representative of the Hirundinidae known to show vocal imitation. Here, I report vocal