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Notes on Brown Pelicans in Puerto Rico.—The biology of 2 races of the Brown Pelican (*Pelecanus occidentalis carolinensis, P. o. californicus*) of coastal United States and Baja California is well known. Few data exist for the nominate race (*P. o. occidentalis*) inhabiting the Caribbean region, especially on breeding distribution, population size and aspects of breeding biology (Wetmore, N.Y. Acad. Sci. Survey of Porto Rico and the Virgin Islands 9:245–406, 1927; Palmer, Handbook of North American Birds, Vol. 1, Yale Univ. Press, New Haven, Connecticut, 1962). A nesting colony on Conejo Cay, a 2 ha rock approximately 30 m high, near Salina del Sur Bay at 65°17′W, 18°7′N, off the southeastern shore of Vieques Island (23 km east of Puerto Rico) is easily viewed from the military operations headquarters on 190 m Cerro Matias hill, about 1 km from the colony. We spent about 15 h observing this colony from this location using a 30× telescope and 8× binocular in April–September and made other observations in Puerto Rico between March and November 1978 on 25 days in the field.

History of nesting on Vieques Island and the reason for this study.—Conejo Cay is 1 km from the impact area for air-to-surface target operations on the United States Marine Base Camp Garcia. This cay is thus subject to overflights by military aircraft on an irregular, but frequent basis and the resulting bombing and shell-fire explosions from these aircraft and from ships off-shore. On a normal bombing run the jet aircraft pass over the cay at about 400 m. We were interested in the reactions of the pelicans to these military activities.

Dr. Cameron B. Kepler first discovered the pelican colony on Conejo Cay from a Navy helicopter on 20 July 1971, and estimated 50 nests present there (Sorrie, Caribbean J. Sci. 15:89–103, 1975). These were the only data for this colony until we began a series of visits in March 1978. Local fishermen reported nesting in former years on nearby Alcatraz Rock, which is usually awash even in moderate seas. However, unless Alcatraz Rock has changed materially in recent years, which seems unlikely, close inspection suggests that it is only suitable as a roosting-loafing site.

Nesting on Conejo Cay in 1978.—Pelicans built nests on top of the island in sea grape (*Coccoloba uvifera*), limber caper (*Capparus flexuosa*), *Ipomoea* sp. and *Opuntia rubescens* from 0.5–2 m above ground. Pelicans nested on the cay from the autumn of 1977 through August 1978 with several "waves" of laying (Table 1). Most nests were established during the winter. An extended nesting cycle, with most nesting in winter, is probably typical of Brown Pelicans in the tropics (Schreiber, Auk 97:491–508, 1980). The colony was abandoned in late August–early September. Although a food shortage may have occurred, human interference probably caused the desertion. A shift in nesting location occurred during the season, with early nests formed in the middle-highest portion of the cay and later nests on the northeast edge. We were unable to determine the exact number of nests existing in the colony during 1977 and 1978. Based on the known productivity of *P. o. carolinensis* (Schreiber, Contrib. Sci. Nat. Hist. Mus. Los Angeles County 317:1–43, 1979) and the number of

TABLE 1

NOTES ON BROWN PELICANS NESTING ON CONEJO CAY, VIEQUES ISLAND, PUERTO RICO, 1978

Date Observer	12 March DWB	18 May BAS	25 May DWB	1 June RWS	23 July RWS	3 Sept. RWS	22 Sept. RWS	20 Oct. RWS
Adults	60	20	26	20	13	5	0	0
Nests								
empty	[a]	0	0	0	2	6	0	0
with eggs	6	3	1	8	6	0	0	0
with naked young	1	1	2	1	0	0	0	0
downy young	1		6	10	0	0	0	0
medium size young	20	54	18	10	5	0	0	0
large young	12		6	12	6	3	0	0
dead nestlings	0	1	0	3	1	2	0	0
Flying juveniles	[a]	25+	[a]	11	19	2	0	0

[a] Present but not counted.

immature birds seen in the area, it seems likely that at least 60 nests existed from March through July; perhaps an equal number existed from November 1977–March 1978.

Clutch-size and egg-size.—Clutch-size in 7 nests on 1 June was 2.6. This figure is somewhat low since several clutches probably were incomplete. On the basis of available evidence it would appear that the clutch-size in this colony closely resembles that found elsewhere in the species (Schreiber 1979).

Eighteen eggs from 7 nests measured on 1 June and 23 July 1978 by RWS had a mean length of 73.00 ± 3.58 mm (range 67.08–79.97 mm) and a mean width of 45.40 ± 3.01 mm (range 35.15–47.90 mm). Most clutches fell within the 72–80 mm × 44–48 mm range, but 1 clutch of 2, noted as small at the time, was 69.90 × 35.15 mm and 67.08 × 44.00 mm. Eggs from Conejo Cay were significantly shorter in length (t = 2.26 and 2.30, df = 56, $P < 0.05$, N = 18, 39) and width (t = 3.77 and 5.45, df = 56, $P < 0.001$, N = 18, 39) than eggs from both the east and west coasts of Florida (Schreiber, unpubl.). They were essentially the same size as the only known preserved eggs of *P. o. occidentalis* (6 eggs in 4 clutches: $\bar{x}$ = 72.26 × 45.86 mm, range = 75.0–68.4 mm × 44.8–47.4 mm), collected from Cacachita Cay, Cuba, in September 1930 by P. Bartsch. The need for egg measurements of pelicans from the Caribbean is obvious.

Observations of the pelican colony.—On 22 July, RWS watched the colony during an air operation involving 14 jet overflights into the target region while several smoke bombs and two 500 lb bombs were exploded. During this time, 10 adults and 9 nestlings were clearly visible through a telescope in the colony. Five adults rested beside nestlings and the others sat on newly constructed nests. Pelicans are most easily disturbed during the courtship-incubation phase of nesting and if air operations were to have a noticeable effect on the adults, it should be readily apparent in these individuals (Schreiber, Ornithol. Monogr. 22, 1977).

Throughout the air operation, the nestlings continued to stand in a relaxed position, gular fluttering (Schreiber 1977). They neither moved from individual nests nor reacted obviously to the jets or bombs. The adults did not respond noticeably either. In fact, 1 pair continued

to perform low intensity courtship activity on their nest throughout the air operation. No birds took flight or moved from their nests. Three juveniles continued to swim on the water between the cay and the target range; washing, bathing and practicing normal bill plunging activities.

We believe that the Brown Pelicans nesting in this colony have acclimated to the intensive air operations. It would appear that the successful nesting during the 9 months of our studies 1977–78 indicates that these military activities have not negatively affected breeding behavior of this population.

Two incidents during our observation period on 1 June, when no jet activity occurred, are instructive. During mid-afternoon a Navy helicopter flew over the nesting island at approximately 50 m elevation. As it passed, 18 of 24 adult pelicans took flight from their nests or perches and flew in a tight circle over the colony. They returned to their nests or perches within 1 min. This response to overflying helicopter and small fixed-wing aircraft also occurs at pelican colonies in Florida (Schreiber 1977). We do not know the long term effect of such disturbance but low overflights of colonies by aircraft should be prevented. Later the same day, a 5.0–5.5 m outboard motor boat with 2 local fishermen approached the cay. Several pelicans flew from their nests or perches and circled over the island as the fishermen approached. The fishermen landed on the cay 25 m east of the nesting area at which time the remaining adults flew from their nests. The birds began to return to the area of their nests only after the fishermen departed and were 200 m from the cay. This type of human disturbance which drives adults from their nests for extended periods, in turn exposing eggs and small naked young to insolation, is precisely what causes major problems in pelican colonies. Fortunately, the naval operations in the region usually prevent such landings by local people on Conejo Cay, minimizing this sort of disturbance. Kepler and Kepler (Living Bird 16:21–50, 1977) noted similar protection by military operations in seabird colonies on Culebra, only about 20 km from Conejo Cay. Because of our study, the U.S. Navy maintains the cay as a 'no entry' zone for all military operations and restricts air traffic over and around it, thus reducing disturbance to the colony except by local fishermen.

Other observations on Vieques.—During more than 40 days on Vieques in March–September 1978 we frequently visited places along the coast where pelicans would be expected to roost and loaf. Only 2 locations were consistently used by the birds: a set of pilings on the north coast near Mosquito Pier and bushes on "Green Beach" on the west end. Both of these sites are inside the military restricted area. On most of our visists to the civilian villages we saw few or no pelicans and those birds seen were unusually wary of approach by people. We suspect this absence of pelicans and their wariness is caused by persecution and harassment of the birds by local people, either intentional or naive.

The age-class distribution of the pelicans in the loafing areas on 11 observations had a mean of 43% adults (range 38–62%), 30% subadults (range 6–38%) and 27% birds less than 1 year old (range 13–62%) (based on plumages, Schreiber, unpubl.). An age-class distribution of this composition, with a high percentage of young birds, probably indicates a stable population. We estimate that although the pelican population of Vieques comprises fewer than 200–250 birds, it is healthy and stable.

Other colonies in Puerto Rico.—Raffaele (Puerto Rico Environ. Quality Board, 1972) summarized historical records of pelicans nesting in Puerto Rico and reported that the colony on Conejo Cay was the only then known viable colony in Puerto Rico. He stated that other colonies, on islands near La Parguera and near Humacao, had recently been abandoned, apparently because of an increase in boat traffic near the islands. He noted that 4 colonies were known in the past but does not name the fourth. Perhaps it was at Caballo Blanco off Port Mulas, Vieques, mentioned by Wetmore (Auk 33:403–419, 1916). No pelicans nest on Culebra or Monito (Kepler and Kepler, 1977; Kepler, Condor 80:72–78, 1978).

Roger Zimmerman reported a colony of pelicans in Montalva Bay, near La Parguera on the southwest coast of Puerto Rico that he found on 11 February 1977 (Zimmerman, in litt.). On that date he found 25 adults on nests and 20 young ranging from 6 weeks old to fledging age, on a small mangrove island. He noted this as the only colony he found during extensive work along the southwest coast. The Montalva Bay colony apparently constitutes the only known nesting of pelicans in Puerto Rico between Kepler's 1971 aerial sightings and our 1978 observations on Conejo Cay.

Observations of the Montalva Bay colony.—RWS found 27 adults, 17 on nests, on 20 September 1978. All had brown necks, 21 had white heads but 6 had full yellow heads, indicating that courtship activity had just begun. One pair, a subadult male and full adult female, copulated while RWS was present and 2 other subadult males and 3 unsexed subadults were associated with nests. Age and sex were determined using plumage and comparative bill size (Schreiber, unpubl.). Sixteen nestlings, 4–10 weeks old were visible in 10 nests and 18 juveniles were in the immediate vicinity. This colony continued nesting activities through the fall after the Conejo Cay colony was deserted. The extended nesting season is also obvious here and the colony appeared to be the same size as was reported in February 1977 by Zimmerman.

Surveys of the pelicans of Puerto Rico.—During aerial surveys for manatees (*Trichechus manatus*) along the entire coast of Puerto Rico during 3 days each in early August, September, mid-October and November 1978, DWB counted 250, 534, 250 and 398 pelicans. These incomplete counts give a conservative estimate of the size of the total population.

A count of the pelicans in San Juan harbor on 30 October 1978, yielded a total of 350 birds, comprised of 26% adults, 7% subadults and 67% birds less than 1 year old. One-third were loafing on the tourist ship docks, one-half were in the *Casuarina* trees on the Coast Guard base, and the remainder were equally divided among the mangrove area on the southeast portion of the harbor, the channel markers and a large feeding flock. It thus appears that the Coast Guard base provides an important roost-loafing site. We suggest that the mangrove areas of the harbor are important habitat for Brown Pelicans and should be carefully protected from development and other human intrusion.

Both the Montalva Bay and Conejo Cay colonies are readily accessible and would make fine study sites for future work on Brown Pelicans in Puerto Rico. Studies on their breeding biology and on non-breeding aspects of population parameters would contribute importantly to our understanding of the marine avifauna of the Caribbean region.

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