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EGGSHELL THICKNESS CHANGES IN PACIFIC OCEAN PHAETHONTIDAE AND SULIDAE

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Pesticide-induced eggshell thinning and associated reproductive problems have been documented in several species of the Pelecaniformes. Numerous populations of Brown Pelicans (*Pelecanus occidentalis*) and Double-crested Cormorants (*Phalacrocorax auritus*) have been adversely affected by pesticides, especially DDE (Anderson et al. 1969, Stickel 1973, Blus et al. 1974). However, the effects of pesticides on eggshell thickness and reproductive success in tropic-birds (Phaethontidae) and boobies (Sulidae) have not been analyzed. As the first step in such a study, I report here an investigation of eggshell thickness changes in tropic-birds and boobies.

Eggs of four species from Pacific Ocean localities collected before DDT use (pre-1947) were compared to eggs collected from 1948 to 1968 (Table 1). The length and breadth of blown eggs were measured (nearest 0.01 mm) with dial vernier calipers and weighed (nearest 0.001 g) on a Mettler Model P120 balance. A "shell thickness index" was calculated for all eggs (Ratcliffe 1967). The thickness index is closely correlated with actual shell thickness (Anderson and Hickey 1972). Clutch size was consistently one egg in all species except the Brown (*Sula leucogaster*) and Blue-faced (*S. dactylatra*) boobies, whose clutch ranged from one to two eggs; mean thickness index of the clutch was used as the unit of measurement in these species. As shell thickness may change during incubation (Kreitzer 1972, Blus et al. 1977), only those eggs collected early in incubation were studied.

The shell thickness index for all four species collected from 1948 to 1968 ranged from 2.6 to 7.8% less than pre-1947 norms (Table 1). However, the differences in thickness means were significant ($P < 0.05$) only for Brown and Blue-faced boobies.

Further studies are needed to determine if pesticides have caused the decreases in thickness index and influenced reproductive success.

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TABLE 1. Eggshell thickness indices of tropic-birds and boobies.

Species and location	Period	n	$\bar{x} \pm SD$	Percent change
Red-tailed Tropicbird (<i>Phaethon rubricauda</i>) Hawaiian Islands	Pre-1947	21/21 ^a	2.00 \pm 0.1999	
	1965-68	17/17	1.92 \pm 0.1772	-4.0
Brown Booby (<i>Sula leucogaster</i>) George Island, Gulf of California	Pre-1947	25/50	2.42 \pm 0.1504	
	1948-50	2/4	2.26 \pm 0.1273	-6.6
	1953-55	3/6	2.26 \pm 0.0600	-6.6 ^b
	1961	7/11	2.23 \pm 0.1544	-7.9 ^b
Blue-faced Booby (<i>S. dactylatra</i>) Hawaiian Islands	Pre-1947	9/14	2.67 \pm 0.1548	
	1966	13/15	2.51 \pm 0.1773	-6.0 ^b
Red-footed Booby (<i>S. sula</i>) Hawaiian Islands	Pre-1947	15/15	1.91 \pm 0.1425	
	1951-65	5/5	1.86 \pm 0.0856	-2.6

^a Total number of clutches/total number of eggs within clutches.

^b $P < 0.05$; *t*-test.