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**Belly-soaking by Incubating and Brooding Common Terns.**—Grant (J. Field Ornithol. 52:244, 1981) described belly-soaking behavior by individuals of 3 species of terns, including Common Terns (*Sterna hirundo*), at a colony in North Carolina. Mes et al. (*Limosa* 51:64, 1978) described an earlier case of belly-soaking by Common Terns in The Netherlands. This note reports 3 more cases of belly-soaking by Common Terns, and provides evidence for the context and function of this behavior.

The most striking case occurred on 9 July 1973, at a colony at Yarmouth, Massachusetts (41°43'N, 70°15'W), where I was conducting a detailed study of Common Terns (Nisbet, *Condor* 77:221-226, 1975). This was the hottest day I have experienced in 12 years' study of terns on Cape Cod. The official maximum temperature was 35°C (95°F) at Hyannis Airport, 6 km SW of the colony, but U.S. Coast Guard stations to the west, north, and east of the colony reported temperatures between 37° and 39°C (according to 3-h weather summaries broadcast by local NOAA radio stations). The heat was exacerbated by clear skies, intense insolation, windless conditions, and an early afternoon low tide which minimized the cooling influence of the sea. Although I could not measure the temperature of the sand surface, it was uncomfortable to walk on it even in rubber-soled sneakers. There was a massive fish kill in nearby Barnstable Harbor as the sand-flats heated up after low tide. Large numbers of American sand lance (*Ammodytes americanus*) which had burrowed into the sand on the falling tide emerged onto the hot sand surface or into shallow warm water, either dying within a few seconds or being eaten by Herring Gulls (*Larus argentatus*). By counting the rate at which representative gulls ate fish, I estimated that more than 400,000 sand lance were killed during the afternoon.

My colleagues and I arrived at the tern colony about 15:00 and immediately entered a blind overlooking an open study-plot containing about 120 pairs of Common Terns. Most of the pairs had eggs or chicks under 9 days old. Most of the adult terns were standing over their eggs and chicks without sitting tightly on them; many of the chicks were sheltering under the partly spread wings of their parents. The adults appeared stressed by the heat, panting vigorously and shifting weight from one foot to the other. For about 2.5 h, most of the pairs in the open sandy areas alternated brooding duties continuously. At 40–60 sec intervals, one member of the pair would fly in to the nest, and its mate would fly off immediately ahead of it, leaving the eggs and chicks uncovered for only 1–2 sec. The departing birds omitted the stereotyped behavior of shifting nest material that is normally given by birds leaving the nest. The birds that left flew either to a nearby tidal channel, or to a tidal pool in the adjacent salt-marsh, dipped their bellies and feet into the water, and flew directly back to the nest. Most birds approached the water in a shallow glide, often with feet dangling, and dipped their bellies and feet into the water for 1–2 sec without interrupting their glide; some dipped their bellies again or drank the second time they descended. During the afternoon, each bird brooding in the open area must have flown to and from the water and wet its belly and feet at least 75 times.

About 15 pairs had chicks that were too large (9–17 days old) to brood. Most of these chicks were concealed in fairly dense clumps of beach grass (*Ammophila arenaria*) around the edge of the study plot. The parents of these chicks also alternated in their attendance, although less frequently than those on the open sand; at least 2 of these parents were seen to dip their bellies and feet into the water, even though they were not brooding. The chicks spent most of their time hidden in or under clumps of grass, but occasionally one emerged and ran to another clump, or to its parent in an attempt to be brooded.

Although moribund fish were abundant close to the colony, very few terns took them. Only a few fish were brought to the nesting area and offered to the chicks, and almost all of these fish were refused by the chicks.

As the sand cooled after 17:00, we checked the nests and chicks in the study plot. Most of the older chicks were dead or dying. Including a few chicks that had died on the previous day (see below), all but 2 of the chicks older than 10 days died. Autopsies conducted by Dr. George Faddoul at the Suburban Experiment Station, University of Massachusetts, confirmed that these chicks had died of dehydration. Almost all of the chicks younger than 9 days survived, but most lost weight; the average weight loss over the 2 days was 7.3 g (Nisbet 1975). Many of the survivors had scorched feet, and in the weeks until they fledged their webs resembled yellow parchment traversed by dark red blood vessels. The eggs were all intact, and subsequently more than 88% of them hatched, despite nocturnal chilling (Nisbet 1975).

We had observed a less striking display of belly-soaking behavior on the previous day, which had also been unusually hot (max. 32°C at Hyannis). On this date we did not start watching the birds until about 16:30. Until the sand cooled 20–30 min later, about half the birds were wetting their bellies and alternating at the nest, at 1–5 min intervals.

I witnessed a third case of belly-soaking behavior at the same colony on 18 July 1974, when the temperature at Hyannis reached 33°C. However, on that visit I had no blind and left the colony immediately to avoid stressing the birds.

Common Terns often dip their bellies into the water as they leave the colony after a spell of incubation on warm afternoons. However, although I have watched Common Terns on more than 300 afternoons, the 3 cases described above are the only occasions when I have observed substantial numbers of birds wetting their bellies and returning to the nest. Air temperatures higher than 30°C are very infrequent in Cape Cod tern colonies, and the behavior is clearly associated with unusual heat stress.

The following conclusions may be drawn from these observations. (1) Belly-soaking is very infrequent in Common Terns at 41°N latitude. (2) It is associated with air temperatures higher than about 31°C. (3) The birds adopting this behavior show other signs of heat stress. (4) Combined with brooding behavior, it protects small chicks from heat stress that would otherwise be lethal. (5) It is ineffective in protecting chicks older than about 10 days. (6) It may also protect developing embryos from heat stress.

Earlier reports of belly-soaking in Common Terns involved somewhat lower air temperatures (24°–26°C, Mes et al. 1978; 30°C, Grant 1981). The birds observed by Mes et al. (1978) resembled mine in stopping feeding at these high temperatures. In Purple Martins (*Progne subis*), Jackson and Schardien (N. Am. Bird Bander 6:12–13, 1981) similarly found that belly-soaking appeared to be effective in protecting small chicks, but not large chicks, from heat stress. Other references to belly-soaking in Charadriiformes, including terns, were summarized by Grant (1981) and Schardien and Jackson (Auk 96: 604–606, 1981).

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**Automatic Recording of Nest Visits by Burrow-Nesting Birds.**—During a study of the breeding biology of burrow-nesting petrels (Procellariidae) at the Prince Edward islands (46°54'S, 37°45'E) data were required on the frequency and timing of nest visits by adult birds. The nocturnal habits of petrels and their irregular feeding of nestlings dictated the use of an automatic recording system capable of registering the passage of a bird both in and out of the burrow. The system had to be inexpensive, but robust enough

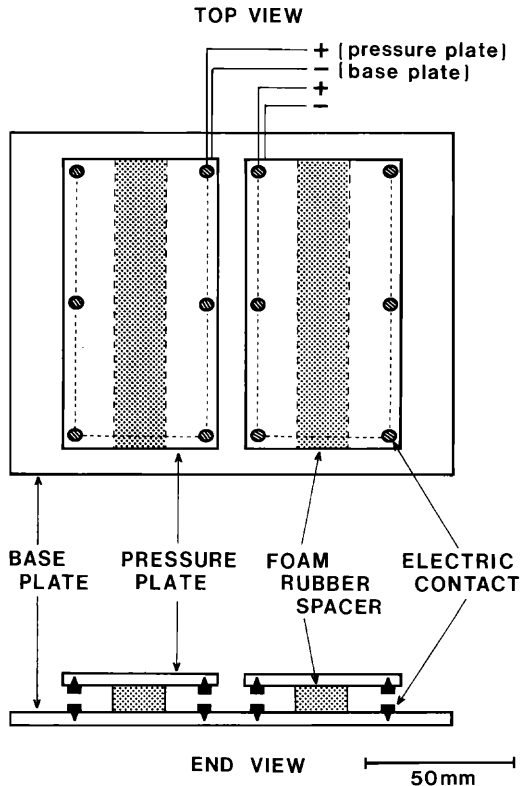


FIGURE 1. Design of a sensor for monitoring the nest visits of burrow-nesting birds.