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# WINTER DISTRIBUTION AND OILING OF COMMON TERNS IN TRINIDAD: A FURTHER LOOK

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Little information exists on the winter ecology of the Common Tern (*Sterna hirundo*), Roseate Tern (*S. dougallii*), and Least Tern (*S. antillarum*). Recent preliminary work in Trinidad, Guyana, and Suriname suggests that Common Terns appeared to be in poor physical condition, that mostly young birds concentrate in these areas, and that terns rely heavily on human fishing activity to survive (Blokpoel et al. 1982, 1984). Earlier, Nisbet (1976, 1981, 1984) suggested that market hunting of terns, at least in Guyana, may account for low adult survivorship and declining populations of Roseate Terns in the northeastern United States.

Because of the apparent importance of Trinidad and adjacent waters as a wintering area for terns (Blokpoel et al. 1982, 1984; ffrench 1980; Nisbet 1981, 1984) and the short-term nature of the study conducted by Blokpoel and colleagues, we conducted a follow-up study of the body condition of Common Terns in Trinidad to evaluate the earlier findings. Additional objectives included determining local and regional movements of terns and collecting blood samples and whole specimens to assess physiological condition. Because Trinidad is a major oil producing and refining country, we also examined terns for external contamination.

## METHODS

*Surveys.*—We visited Trinidad twice in the winter of 1985, 17–27 January and 11–19 March. We focused our field activities in southwest Trinidad, at Icacos Village and San Fernando (Fig. 1) where previous surveys (Blokpoel et al. 1982, 1984; and R. I. G. Morrison, pers. comm.) had located concentrations of terns. We conducted two aerial surveys in January along the west and south coasts, one by helicopter and one using fixed-winged airplane. Surveys were conducted from 0930 to 1230 h on January 23 and from 1030 to 1230 on January 25. Previous surveys had revealed little seabird activity along the rugged north and east coasts, so we omitted these areas. Logistical problems prevented us from completing aerial surveys scheduled in March. Following the procedures used earlier by Blokpoel and Morrison, terns observed from the aircraft were simply identified as "small" (Common, Roseate) or "large" (Royal Tern, *S. maxima,* or Sandwich/Cayenne Tern, *S. sandvicensis*) terns.

Ground surveys were conducted using a 4-wheel drive vehicle. In January, 6 coastal locations were visited from 1 to 6 times, usually between 0600 and 1200 h, from Erin Point to Pointe a Pierre. In March, 7 locations were visited from Icacos Village to Pointe a Pierre. From 10 to 30 min were spent at each location counting birds in the period 0600–1300 h.

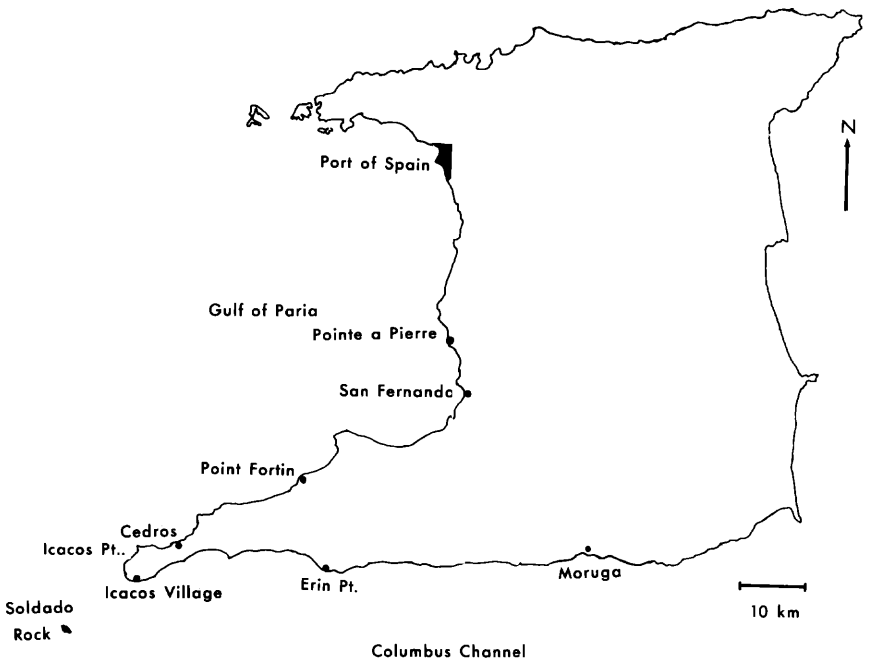


FIGURE 1. Tern survey sites in Trinidad, 1985.

*Capture and processing.*—At two locations, Icacos Village and San Fernando, we captured terns using methods similar to those of Blokpoel et al. (1982, 1984). We used small baitfish to attract feeding terns on the beach, at a pier, and from small fishing boats. Birds were caught with a long-handled fishing net, then held in small bags until processed.

We measured each bird's body weight, length of the tarsus, exposed culmen, and width and depth of the bill (measured at the posterior edge of the nares). We also measured the length of the forearm (radius-ulna) because the primaries were either in molt or so badly worn that conventional wing length measures were meaningless.

An index of external oiling for assessing the extent of oil contamination on captured birds used a method modified from that of Gochfeld (1979). We examined 10 body areas for oil discoloration: head, neck, back, breast, belly, crissum, wings, legs, feet, and tail. The extent of oiling was classified as: 0 = no detectable discoloration; 1 = a trace with spots less than 5 mm diameter; 2 = light oiling covering less than 10% of part; 3 = moderate oiling up to ⅓ of area; 4 = more than ⅓ of area oiled. The total index was the sum of the scores from the 10 body areas. To compare the incidence of oiling of the capture sample with the local population, we examined birds roosting at two locations near San Fernando using binoculars. Under these conditions, we could only confidently include birds with at least "moderate" levels of oiling on the white body areas.

A 1.2 ml blood sample was drawn from the jugular vein of each bird using heparinized equipment, and aliquots were used for hemoglobin concentration and packed cell volume (PCV) determinations. Hemoglobin (Hb) was determined using the cyanmethemoglobin method (Hycel Inc., Houston, Texas) (Reference to commercial names does not imply government endorsement of services or products) and PCVs were determined using the microhematocrit method. The remaining volume of whole blood was centrifuged and the plasma drawn off and stored frozen for later analyses. Plasma enzyme activities and chemistries were determined on a centrifugal auto-analyser (Centrifichem 500, Baker Instrument Corp., Allentown, Pennsylvania). Enzyme activity was determined for aspartate aminotransferase (AST, EC 2.6.1.1), alkaline phosphotase (EC 3.1.3.1), alanine aminotransferase (ALT, EC 2.6.1.2), and lactate dehydrogenase (LDH, EC 1.1.1.27). Other plasma chemistries analyzed were: total protein, uric acid, cholesterol, phosphorus, albumin, calcium, glucose, and triglycerides. Mean values (log transformed if the variance was proportional to the mean) were compared between terns with external traces of oil and those without oil using the Student's $t$-test (Sokal and Rohlf 1973).

Because of logistical constraints on the last day of the January visit, 11 birds could not be measured for all parameters. However, weights and culmen length were recorded and blood samples were taken before the birds were released.

For statistical results, sample sizes, means plus or minus one standard error are presented and statistical significance is assumed at the $P \leq 0.05$ level.

## RESULTS

*Geographic distribution.*—During the aerial surveys, "small terns" (probably mostly Common Terns) were concentrated along the southwestern point area near Icacos and along the Gulf of Paria coastline from Point Fortin to San Fernando (Table 1). The March ground surveys were restricted to a small number of shoreline points, but, nevertheless, suggest an increase in numbers, with a large build-up in the San Fernando area. We feel that our March estimate of 550 terns in Trinidad is an underestimate because we could not survey offshore trawlers in the Columbus Channel south of Icacos, where most terns were seen during the January aerial surveys.

At times, terns seem attracted to man-made structures and commercial fishing activity in Trinidad (Table 2). Our experience at Icacos, information from local fishermen, and the findings of Blokpoel et al. (1982, 1984), suggest a distinct daily activity pattern. At night, terns roost mostly offshore on the numerous platforms and buoys in the southern Gulf of Paria and on fishing boats, from small dories to large commercial trawlers. From about 0500 to 0600, they leave the roosts and fly along the beaches of the fishing villages, looking for shoaling baitfish that enter the shallows in the early morning. They readily "parasitize" the seine catch-

TABLE 1. Distribution of "small terns" (Common and Roseate) in south and west Trinidad during surveys in January and March 1985.

| Area | Number of birds estimated | | |
|---|---|---|---|
| | Aerial | | Ground[a] |
| | Jan 23 | Jan 25 | March 12–18 |
| Port of Spain to Pointe a Pierre | 50 | 0 | not surveyed |
| San Fernando | 0 | 5 | 500 |
| S. San Fernando to Point Fortin | 0 | 35 | 5 |
| So. Point Fortin to Icacos Pt. (incl. Saldado Rock) | 30 | 1 | 1–20 (Cedros) |
| Icacos Pt. to Erin Pt.[b] | 270 | 260 | 15–50 |
| Erin Pt. to Moruga | 0 | 0 | not surveyed |
| Total | 350 | 301 | 500–550 |

[a] Ground survey only of 7 shore locations from Icacos Beach to San Fernando. Ranges given for Cedros ($n$ = 3) and Icacos Point ($n$ = 4) surveys.

[b] The two aerial survey estimates recorded all birds offshore either resting on trawlers or feeding pelagically. The March (ground) estimate was based on counts of birds passing the beachfront at Icacos on morning (0600–0800) visits.

es of local fishermen. By mid-morning, the terns move offshore to follow shrimp and fishing trawlers. When not actively feeding behind the boats, they loaf on the rigging and gunwales.

Eleven of the 89 birds we captured had been previously banded at nesting colonies on Long Island, New York ($n$ = 4); St. Lawrence River, New York (1); Connecticut (3); and Massachusetts (3). All were young fledged in 1984 and were, therefore, 6–9 mo old.

*Morphological measures and body condition.*—The weight ranges we found are similar to those reported earlier (Blokpoel et al. 1982, 1984). In January, 33 terns averaged 99.0 ± 1.4 g; in March, 56 terns averaged 104.0 ± 1.1, a significant difference ($t$ = 2.86, df = 87, $P < 0.01$). Overall, Common Terns weighed 102.2 ± 0.88 g ($n$ = 89). Means (±1 SE) of other measured body parts were: culmen = 34.7 ± 0.2 mm ($n$ = 89); forearm = 70.3 ± 0.2 mm ($n$ = 78); bill width = 4.0 ± 0 mm ($n$ = 56); bill depth = 7.2 ± 0.1 mm ($n$ = 68); tarsus = 22.8 ± 0.2 mm ($n$ = 72).

Some of the birds appeared to be in rather "ragged" condition because of ongoing molt, but there was little evidence to suggest that many birds were starving or in poor condition as reported by Blokpoel et al. (1984). Only one of the 89 birds was captured by hand on the beach and appeared to be very weak. All the birds we processed (measurements and blood sample) and released survived at least initially.

*Oiling.*—Oil was present on 39 (50%) of the 78 birds we captured and examined for external oiling; 11 (14%) of the birds had at least "moderate" oiling on one or more of the three white body areas. The index scores ranged from 0 to 12 ($\bar{x}$ = 2) (maximum score = 40). At a small moorage for fishermen at South San Fernando, 13 of 113 terns (12%)

TABLE 2. Association of Common/Roseate terns with human activities or structures in southwestern coastal Trinidad, 1985.

| | Activity | | | |
|---|---|---|---|---|
| | Foraging | | Roosting | |
| Aerial survey date | Following boats | Over open water | On natural structures/ substrate | On artificial substrates[a] |
| 23 January | 50 | 150 | 0 | 30 P<br>120 B |
| 25 January | 120 | 21 | 0 | 120 B<br>40 P |

[a] Substrate: P = oil or navigation platforms, pipelines; B = boats.

roosting on fishing dories were at least moderately oiled on the white body areas. At the wharf in San Fernando, 8 of 100 (8%) birds were similarly oiled. These figures are similar to the 14% figure from the capture sample.

Oiling did not appear to affect the condition of the terns. Using body weight as an indicator of condition, weight differences between oiled and unoiled birds (oiled $\bar{x} = 101.7 \pm 1.3$ g, unoiled $\bar{x} = 102.8 \pm 1.2$ g) were not significant ($P > 0.05$). Regression of weight against oiling index failed to yield a significant relationship ($r^2 = 0.05$, $t = 1.91$, $P > 0.05$).

Hemoglobin concentrations and packed cell volumes were not significantly different between oiled ($n = 33$) and unoiled ($n = 40$) birds ($P > 0.05$). Sample sizes for plasma enzymes and chemistries for unoiled birds ranged from 31 to 38, and from 24 to 30 for oiled birds. None of the plasma chemistries examined differed significantly between oiled and unoiled birds. Of the four plasma enzymes analyzed, only LDH was significantly different between unoiled and oiled birds ($t = -2.10$, df = 61, $P = 0.04$), with oiled birds ($\bar{x} = 1593 \pm 226$ $\mu$/l, $n = 29$) having greater LDH values than unoiled birds ($\bar{x} = 1115 \pm 131$ $\mu$/l, $n = 34$).

## DISCUSSION

Trinidad appears to be an important wintering area for terns based on the number of band recoveries (Blokpoel et al. 1982, 1984, this study; Nisbet 1981, 1984) and aerial survey results (Blokpoel et al. 1982, 1984; R. I. G. Morrison and K. Ross, pers. comm., this study). Aerial surveys conducted in January and February from Venezuela to Argentina revealed very few locations with concentrations of terns (R. I. G. Morrison and K. Ross, unpubl. data). Coastal surveys were flown in 1981 (Venezuela, Suriname), 1982 (Venezuela, Suriname, Trinidad, Guyana, French Guiana, and Brazil) and 1983 (northeast Brazil). For all surveys, Trinidad ranked second overall with 2600 "small terns" seen in 1982; Suriname ranked first with 7000 birds in 1981 (but none in 1982, R. I. G. Morrison and K. Ross, unpubl. data).

The fact that all 11 of our previously banded birds and 4 of 6 banded birds caught by Blokpoel et al. (1984) were young fledged the previous summer suggests that Trinidad and the southern Caribbean may concentrate a disproportionate number of young birds. Haymes and Blokpoel (1978) suggested that juvenile Common Terns from the Great Lakes were recovered more frequently from Florida and the Caribbean Islands, whereas adult recoveries were made more often along the coasts of central and northern South America. We cannot determine whether our capture technique might have been biased in capturing young, inexperienced birds.

As reported earlier (Blokpoel et al. 1982, 1984), the distribution of terns around Trinidad is nonuniform, with the vast majority along the southwestern "leg" of the island. The fishing activities in the southern Gulf of Paria and the western end of the Columbus Channel probably provide favorable feeding areas and the numerous oil platforms, ships, and navigational aids provide abundant safe roost sites. Whereas aerial surveys by Blokpoel et al. (1982, 1984) showed the largest concentration of terns roosting on an oil jetty at Point Fortin, we found few birds using this jetty. We observed the largest concentrations of terns at the wharf area in San Fernando and at moorages near fishing villages. Terns probably move considerable distances within the region but a rather intensive color marking program is required to prove this.

The concentration of terns in a region of intensive offshore oil development and tanker traffic raises concern that oil contamination would possibly increase winter mortality of terns. On both our aerial and ground surveys, and earlier ones (Blokpoel et al. 1982, 1984), sheets of oil were seen on the water near Point Fortin and San Fernando, and many beaches along the southwest had tar deposits. Nonetheless, according to Georges and Oostdam (1983), this beach region of Trinidad is not nearly as oil contaminated as along the east coast of Trinidad, but even there, tar deposit levels are considered only "intermediate" relative to coasts sampled along other major tanker routes around the world (Georges and Oostdam 1983). Half of the terns we captured had at least some evidence of external oiling. Although oiling on most birds was slight and probably not physically detrimental, the 50% prevalence of oiling in our capture sample is an order of magnitude higher than those reported either in the Caribbean region or eastern North America. Blokpoel et al. (1984) found only 3 of 54 terns (6%) with oil in Trinidad. In the Gulf of Mexico, the Robertsons (in Clapp et al. 1983) reported that 2.6% of adult Sooty Terns (*Sterna fuscata*) in the Dry Tortugas were oiled. Gochfeld (1979) and Duffy (1977) reported that fewer than 2% of nesting Common Terns in New York were oiled.

Of the 14 blood parameters measured and compared between oiled and unoiled birds sampled during January and March, only LDH levels differed, oiled birds having significantly greater levels than those of unoiled birds. Although LDH is a relatively nonspecific enzyme with respect to target organ toxicosis, erythrocytes have been reported to contain as much

as 160 times the levels of LDH found in plasma (Caraway 1962). Oil-induced hemolytic anemia can result in elevated LDH levels in oiled birds, however, hemoglobin and packed cell volumes showed little difference between oiled and unoiled birds. Heinz-body hemolytic anemia occurred in young Herring Gulls (*Larus argentatus*) after exposure to Prudhoe Bay crude oil (Leighton et al. 1983), demonstrating the possible hemolytic effects of oil on birds.

Blokpoel et al. (1982, 1984) claimed that Common Terns in Trinidad were in "poor physical condition." Their opinion appears to be based primarily on mean weights of terns relative to those of breeding adults from North America. Their mean weight of 103 g, and ours of 102 g, certainly are well below mean weights of breeding adults at colonies in northern North America. Mean weight of adults was 120 g at Great Gull Island, New York (LeCroy and LeCroy 1974), 125 g at several Massachusetts colonies (Nisbet 1977), and 125 g ($n = 6$) at a North Carolina colony (Erwin, unpubl. data). Young birds of the year, however, may be significantly lighter than adults when they fledge and may also be lighter during migration and while on the wintering grounds. The weight of young terns, captured in New York in August 1985 (post-breeding, pre-migration), was less ($\bar{x} = 114 \pm 2.3$ g, $n = 11$) than adults ($\bar{x} = 121 \pm 0.9$, $n = 64$) in the same roost ($t = 3.04$, df = 73, $P < 0.01$). Therefore, although winter weights of 102–103 g for young birds may be significantly less than those for summer or fall period birds, the difference may not be as dramatic as suggested by Blokpoel et al. (1984). More data are needed on weights of known-aged birds in different wintering areas.

Seasonal weight differences can have many causes. The first possibility is that Trinidad has low fish populations and migrant terns may be food stressed. Second, if the tern population in Trinidad is primarily composed of young birds, poor fishing technique may exact a high survival cost among first-year birds (Buckley and Buckley 1974). Third, the energetic requirements of molt may result in significant weight loss over several months (Marcstrom and Kenward 1981). Fourth, the weight decline may be a normal occurrence throughout the winter regardless of location. A smaller body mass may be adaptive to reduce absolute energy demand in winter and may provide wing-loading benefits (Mueller and Berger 1968). Therefore, the first two possibilities would suggest that birds may be in poor physical condition, while the last two offer a more benign scenario.

Our finding that March birds weighed more than January birds may have several explanations. Premigratory deposition is the first obvious suggestion; however, if the population is comprised mostly of young birds, no migration occurs the first spring. Perhaps mortality is highest for lighter birds, therefore only relatively heavier birds survived until March. Or, if fishing conditions improved, birds could have had higher feeding success. Alternatively, the Trinidad wintering population may be "open," i.e., birds arrive from other areas occasionally (Blokpoel et al. 1984), and

the January and March capture samples may not represent the same population. Nonetheless, the dependence of birds on human fishing activity and their willingness to feed on stranded, dead baitfish, a feeding behavior not witnessed in numerous breeding colonies in the U.S. (Erwin, pers. obs.), suggests that food shortages may be common.

Before generalizations are made concerning overall physical condition of birds in certain locales and seasons, terns from a number of different locations should be simultaneously sampled to measure several physiological parameters.

## SUMMARY

Common Terns were studied during January and March 1985 in Trinidad as part of a study of wintering terns in Latin America. Eighty-nine birds were captured, 33 in January, 56 in March. Terns averaged 102 ± 0.9 g, with March birds weighing more than those caught in January. This weight is similar to that reported earlier by Blokpoel et al. (1982, 1984) and is considerably less than weights of either premigratory immature or adult Common Terns. Terns in Trinidad appear to be opportunistic, using human fishing for their food source and roosting on boats, oil platforms and other man-made structures. One-half of the captured sample of birds had at least detectable amounts of oil on the plumage. This represents the highest frequency of oiling reported yet for any seabird living under "baseline" (non-spill) conditions in North or Central America. Oiling had no apparent major effect on the condition of birds since oiled birds had similar weights and blood parameters when compared to unoiled birds.

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