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## SANDWICH TERN MORTALITY CAUSED BY VEHICLE COLLISION ASSOCIATED WITH HURRICANE ERIN

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Published accounts of seabird mortality away from breeding colonies during and in the aftermath of the passage of tropical cyclones are scarce in the southeastern United States (Wiley and Wunderle 1994 and references cited therein; Post 1992). This study provides evidence of mortality of non-breeding seabirds, particularly Sandwich Terns (*Sterna sandvicensis*), associated with a tropical cyclone of modest strength (gale to strong gale) at Apalachicola, Florida, in early August 1995. This onshore mortality consisted of collisions with vehicles along bridge sections of the Gorrie Causeway, and was low compared to the number of roosting and foraging birds in the area. I estimated that 2% (11/550) of the Sandwich Terns—the principal species affected—were killed.

The eye of Hurricane Erin came ashore at Fort Walton Beach, Okaloosa County, about 160 km W of Apalachicola on 2-3 August 1995. Maximum sustained winds at Apalachicola reached gale or strong gale force (66-80 km/hr; maximum gust: 120 km/hr) for seven and one-half hours during the evening and morning of 2-3 August (weather data from automated weather station located along the St. George Causeway). Large numbers of seabirds, including at least 150 Sandwich Terns, occurred over the extensive marshes along the Apalachicola River on 3 August, when strong onshore winds (S-SE) and storm surge associated with Hurricane Erin almost covered these marshes. On 4 August, at least 40 Sandwich Terns were seen foraging in Apalachicola Bay by the Gorrie Causeway, which is also an unusually large number at this site.

I found 15 seabird casualties of four species from 3-5 August 1995 on bridge sections of the Gorrie Causeway at Apalachicola (none on the St. George Island Causeway), as well as one dead juvenile Common Moorhen (*Gallinula chloropus*). Casualties included nine Sandwich Terns (one flattened adult not salvaged), four Laughing Gulls (*Larus atricilla*) (1 ad., 3 juv.), an adult Sooty Tern (*S. fuscata*; deposited at Tall Timbers Research Station, TTRS 3953), and a juvenile Black Skimmer (*Rynchops niger*). In addition, I salvaged two fresh Sandwich Terns on 8 August from a dredged-material island located 1 km beyond the mouth of the Apalachicola River, where seabirds roosted. Four of the eleven (three of five adults) Sandwich Terns were alive but had broken wings. Two of the dead Sandwich Terns also were visibly damaged (broken wing or neck).

The median masses of these adult (169.3 g, range 128.1-180.1 g,  $n = 4$ ) and juvenile (142 g, range 102.4-160.6 g,  $n = 6$ ) Sandwich Terns (mean mass for all birds = 146.9 g  $\pm$  24.6 SD) are the lowest body masses recorded in either North America or Europe (see Clapp et al. 1983:434-435, Dunning 1984, Cramp 1985:61). Only the heaviest adult contained remains of food, a few fish bones. Visual inspection of dissected birds killed in this study revealed that none had any visible subcutaneous, abdominal, or cardiac fat. Furthermore, the pectoral muscle mass had atrophied to varying degrees on all birds; the most extreme cases were the pectoral muscle masses on the entire keel of the sterna of the two lightest birds (juveniles) which had wasted away to a veneer of tissue covering the bone.

Published information on body masses of Sandwich Terns is scarce for any of the three subspecies; only *S. s. acufilavida* is found in North America which is smaller than the nominate race *S. s. sandvicensis* of the Old World. The only information I found for the North American subspecies were the mean masses of breeding adults collected in Texas (197.5 g,  $n = 11$ ; Maedgen et al. 1982 in Clapp et al. 1983) and Virginia (208.5 g,  $n = 10$ ; Dunning 1984), both higher than the median mass of adult birds killed at Apalachicola, Florida.

In early August, the juvenile Sandwich Terns at Apalachicola were probably about 3-4 weeks-old post-fledging (see Clapp et al. 1983, Rodgers et al. 1996) (flattened wing length: median = 273 mm, range 256-283; the juvenile wing is not full-grown until about three months; Cramp 1985:61). No evidence of seabird mortality occurred along the Gorrie Causeway during tropical cyclones Opal or Josephine in early October 1995 and 1996 when Sandwich Terns were even more numerous (>800 birds roosted at the dredge-material island; McNair, unpubl.). Weather conditions at Apalachicola during Opal were similar to Erin, which included onshore winds (SE to SW) of similar strength (gale force) and a somewhat greater storm surge. Large numbers (200+) of Sandwich Terns foraged along the Apalachicola River and over the extensive river marshes during Opal. By early October—the month when Opal occurred—juvenile Sandwich Terns would be fully grown, approximately 3 months old, and not as dependent upon adults for food, although family groups remain together away from breeding colonies once the young have fledged (see Cramp 1985). The fully grown wing of juveniles in early October compared to less developed birds in early August would greatly strengthen their ability to avoid collisions with vehicles during moderately strong storms (gale to strong gale). I speculate that adults are also less susceptible to collisions in early October because they are less attentive toward juveniles and not as vulnerable to collisions. The large numbers of birds in conjunction with a high proportion of dependent juvenile Sandwich Terns at Apalachicola (ca. 50%; D. McNair, unpubl.) may have increased the susceptibility of both age classes to collisions associated with Hurricane Erin.

In summary, I documented seabird mortality from collisions with vehicles along the Gorrie Causeway associated with Hurricane Erin in early August 1995 at Apalachicola, Franklin County, Florida. Most casualties were Sandwich Terns. Strong onshore winds and storm surge caused unusual concentrations of Sandwich Terns along the Apalachicola River and over the extensive river marshes. Both age classes crossed over bridges in flying to and from Apalachicola Bay or returning to a roost site (dredge-material island) located just beyond the mouth of the Apalachicola River. No seabird mortality occurred under similar weather conditions during Hurricane Opal in early October 1995, when Sandwich Terns were more numerous but when juveniles were two months older. The low body masses of Sandwich Terns killed in this study are the lowest published in North America.

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