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Marsh Rice Rat, *Oryzomys palustris*, Predation on Forster's Tern, *Sterna forsteri*, Eggs in Coastal North Carolina

JOHN H. BRUNJES IV[1] and W. DAVID WEBSTER

Department of Biological Sciences, University of North Carolina at Wilmington, Wilmington, North Carolina 28403-3297 USA

[1]Current Address: Department of Range Wildlife, and Fisheries Management, Texas Tech University, Box 42125, Lubbock, Texas 79409 USA

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Nesting success of Forster's Terns (*Sterna forsteri*) was examined on two small islands in the Cedar Island area of North Carolina. Forster's Terns laid an average of 2.1 eggs per nest (n = 50) on Chainshot Island and 2.1 eggs per nest (n = 43) on Harbor Island in clutches that consisted of 1 to 3 eggs. On Chainshot Island every egg (n = 107) was lost to predation. On Harbor Island, 72 of 92 eggs were preyed upon. A trapping program, initiated on both islands, yielded 32 Marsh Rice Rats (*Oryzomys palustris*). Stomach contents of 23 rats were inspected, with 92.3% from Chainshot Island and 70% of the stomachs from Harbor Island containing yolk and feathers of Forster's Terns.

Key Words: Forster's Tern, *Sterna forsteri*, Marsh Rice Rat, *Oryzomys palustris*, eggs, nesting success, predation, North Carolina

Reproductive success of Forster's Terns in eastern North America has been poorly documented. In the prairie region of North America (Bergman et al. 1970; McNicholl 1982) and in Texas (Chaney et al. 1978*), most Forster's Tern eggs were lost to wave action and storm damage. In North Carolina, Parnell and Soots (1979*) attributed loss of some eggs to flooding, but they also described an unknown cause of mortality that left large numbers of dead chicks and broken eggs scattered throughout the colony. In subsequent years, continuing loss of eggs and colony abandonment in North Carolina was thought to be due to the effects of flooding (J. Parnell, University of North Carolina at Wilmington, Department of Biological Sciences, Wilmington, North Carolina, personal communication). Although the threat posed by mammalian predators was considered low due to the small size and isolated nature of the islands on which the birds nest, Forster's Terns nesting in the Cape Hatteras National Seashore in 1987 exhibited low reproductive success due to the apparent heavy predation by Marsh Rice Rats (*Oryzomys palustris*) (Cooper 1988*).

Reports of predation on eggs and chicks of Forster's Terns on the east coast of the United States are scarce; however, Marsh Rice Rats have been implicated in the nest destruction of Marsh Wrens (*Cistothorus palustris*) (Kale 1965) and Seaside Sparrows (*Ammodramus maritimus*) (Post 1981). Marsh Rice Rats, the most abundant mammalian denizen of salt-marsh habitats in coastal North Carolina (Webster et al. 1985), prey primarily on animal matter such as small crustaceans (Sharp 1967). We report heavy egg predation by Marsh Rice Rats in two Forster's Tern colonies in the Cedar Island area of coastal North Carolina.

Study Area and Methods

Field work was conducted from 15 May to 30 July 1992 on Chainshot (34°59'N, 76°14'W) and Harbor (34°59'N, 76°13'W) islands, which are located at the junction of Core and Pamlico sounds in North Carolina. Chainshot Island is a small (<1 ha) natural estuarine island dominated by a Smooth Cordgrass (*Spartina alterniflora*) marsh and is located 2.8 km east from mainland Cedar Island. The wrack used as nesting habitat by Forster's Terns was composed exclusively of dead *Spartina alterniflora* that covered the central portion of the island. Harbor Island is a small (1 ha) natural estuarine island consisting of an upland shrub

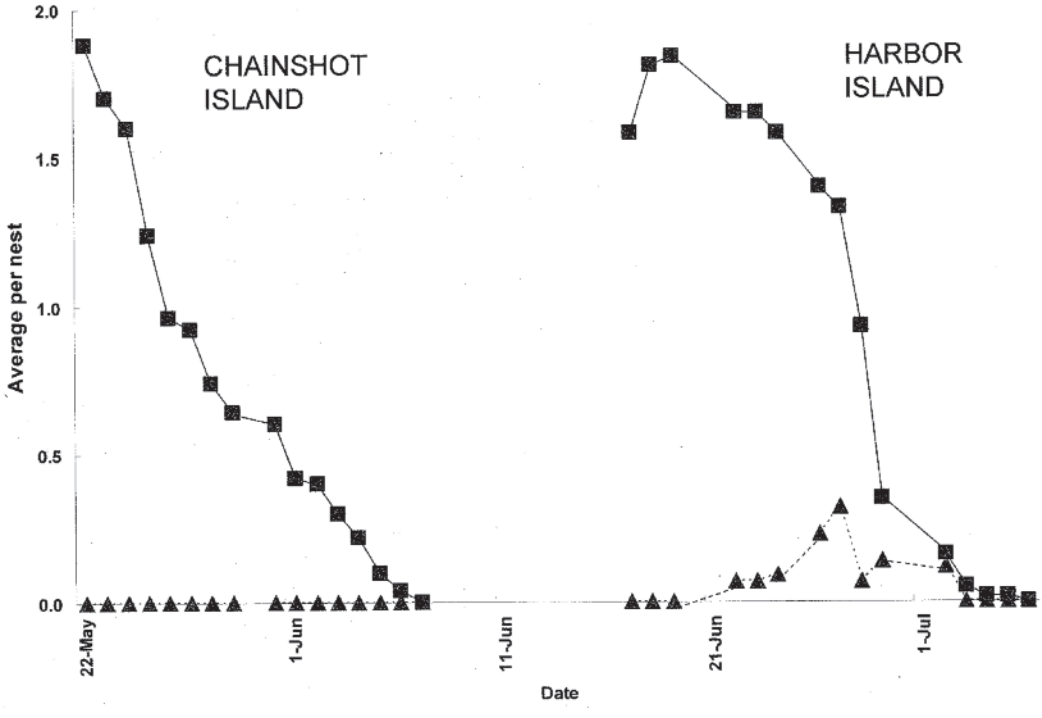

FIGURE 1. Average number of Forster's Tern eggs per nest (squares) and chicks per nest (triangles) throughout the incubation and pre-fledging period at two sites in eastern North Carolina.

thicket and surrounding *Spartina alterniflora* marsh and is located 4.3 km east from mainland Cedar Island. Wrack lines of *Spartina alterniflora* and Eelgrass (*Zostera marina*) were deposited linearly along the edge of the marsh.

An artificial nesting platform (1.5 × 3.7 m) was constructed on Harbor Island in April 1992 in an attempt to improve nesting success by reducing losses due to flooding. The bottom was placed about 0.75 m above the ground and covered with dead vegetative matter similar to naturally occurring wrack on the island; vegetation was pulled through in spots to make it appear as realistic as possible.

On Chainshot Island, fates of eggs in 50 randomly selected Forster's Tern nests (of approximately 100 nests total) were determined during the period between 22 May and 7 June. Nests of 43 Forster's Terns, the total colony, on Harbor Island were monitored during the period between 17 June and 6 July. Nests were identified by mapping positions of nests relative to their placement on the wrack. After allowing several days for initiation of the colony, nest fate was checked in the morning and evenings on each island to determine the relative timing of egg and hatchling loss. All nests were followed to the point of hatching or destruction. Destruction of nests was attributed to predation if evidence of nest predators was present. Nests were usually found abandoned with eggs displaying chewing in the center portion. If predated eggs were not present in the nest, they were usually present on the surrounding wrack or in runways in the surrounding grasses. Eggs that disappeared without evidence of predation were classified as unknown losses. Forster's Terns were the only bird species nesting on either island at the time of this study.

After observing high rates of egg loss, apparently due to Marsh Rice Rat predation, we began a trapping program. Twenty-four Museum Special snap traps were set on Chainshot Island from 22 through 24 June and on Harbor Island from 17 June through 3 July. These traps were scattered irregularly across the wrack used by the nesting Forster's Terns, and baited with peanut butter. Traps were checked twice daily, once just after sunrise and once just before sunset. Captured rats were frozen so that their stomach contents could be examined at the conclusion of the trapping period.

Results

On Chainshot Island, 50 marked Forster's Tern nests contained a total of 107 eggs, with an average

of 2.1 eggs per nest. All but five Forster's Tern eggs were apparently destroyed by predation before hatching (Figure 1). Other egg losses (n=5) were classified as unknown losses. Nests destroyed by predation were abandoned by adults with no attempts to re-nest on Chainshot Island, although these adults, which were not individually marked, may have moved to Harbor Island to renest.

Forty-three nests were marked on Harbor Island, seven of which were on the artificial platform. A total of 92 eggs were laid, with an average of 2.1 eggs per nest. Of the eggs laid, 68 were consumed, 20 hatched, and four were classified as unknown losses (Figure 1). All predation occurred between late afternoon and early morning nest checks. Due to the mobility of hatchlings, it was difficult to monitor their progress, but apparently none survived to fledging as no adults remained on the island long enough to have fledged chicks. None of the eggs laid on the artificial platform survived to hatching.

Thirty-two Marsh Rice Rats were trapped on the two islands, 15 on Chainshot and 17 on Harbor. Densities of the rice rats were estimated at 80 rats/ha on Chainshot Island and 60 rats/ha on Harbor Island using the Hayne (1949) capture-removal method. Marsh Rice Rats were the only mammal captured on either island and all were captured between late afternoon and early morning.

Stomachs of 13 Marsh Rice Rats trapped on Chainshot Island and 10 Marsh Rice Rats from Harbor Island were examined. Twelve of 13 stomachs (92.3%) from Chainshot Island and 7 of 10 stomachs (70.0%) from Harbor Island contained yolk and or feathers. All stomachs contained other plant and animal items.

Discussion

Contrary to what we expected, flooding was not responsible for the loss of any Forster's Tern eggs, despite several days of strong northeast winds that caused high water levels in the Cedar Island area. In this study, predation was the only recognizable form of egg loss. Predation took place nightly with a random pattern of egg loss. Nests of Forster's Terns typically lost one egg at a time, rather than large numbers of eggs being destroyed and stockpiled nightly, a foraging strategy exhibited by introduced European rats (*Rattus* sp.; Austin 1944, 1948).

The Marsh Rice Rat was apparently the only mammal found on Chainshot and Harbor islands, and the stomachs of a majority of the trapped rats contained bird remains. While most eggs were consumed in the nest, a number of eggs were found at the entrances to Marsh Rice Rat runways, suggesting that the nine missing eggs classified as unknown losses could have been carried off by rice rats. The ends of the eggs were removed neatly, and the inside of each egg was polished clean. Avian predators are rarely this neat; they also typically remove the egg from the nest, and are generally diurnal (J. Brunjes, personal observation).

Nesting platforms hold possibilities for future management of Forster's Terns. However, without predator exclusion our platform failed to produce any chicks. The platform could be modified to exclude Marsh Rice Rats by trimming the underlying vegetation, raising the platform slightly, and wrapping slick tin around the legs to hinder the rats' ability to climb into the platform. Our attempt to control predators on Harbor Island, a technique shown to improve nesting success of waterfowl suffering from heavy mammalian predation (Balser et al. 1968; Duebbert and Kantrud 1974; Duebbert and Lokemoen 1980), seemed to slow predation initially, allowing some birds to hatch, but then predation rapidly increased as the rats learned to avoid the traps.

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Documenting Pronglorn Antelope, *Antilocapra americana*, in the Peace River Grasslands, Alberta

THERESA A. FERGUSON

Anthropology, Athabasca University, 1 University Drive, Athabasca, Alberta T9S 3A3 Canada
Present address: 10733 150 St. NW, Edmonton, Alberta T5P 1R4 Canada

Ferguson, Theresa A. 2003. Documenting Pronghorn Antelope, *Antilocapra americana*, in the Peace River grasslands, Alberta. Canadian Field-Naturalist 117(4): 657-658.

Fur trade records of the 1800-1855 period document the harvest of antelope in the central Peace River area of northern Alberta.

Key Words: Pronghorn Antelope, *Antilocapra americana*, fur trade, northern Alberta.

Although descriptions of the early historic distribution of Pronghorn Antelope, *Antilocapra americana* Ord, in Alberta restrict them to the south and east portion of the province extending only as far north as 53°N latitude (Mitchell 1980; Soper 1964), fur trade records from the central Peace (56-57°) make sporadic reference to antelope in the 1800-1850 period. See Documents Cited section).

The fur trade posts under consideration here are located in relative proximity.[1] Fort Dunvegan was the longest lived establishment (1805-1918), with several locations, all in the same area as the present day Dunvegan, Alberta (HBCA, PAM, B.56). Fort St. Mary was situated 1818-1820 at the confluence of the Smoky and Peace rivers (HBCA, PAM, B.190). The Hudson's Bay Company post at [Fort Waterloo] Lesser Slave Lake (HBCA, PAM, B.115/a) was located 1815-1933 at the west end of Lesser Slave Lake and its hunting territory extended into the tributaries of the Peace River. The Ile de Campement of Harmon's 1816 diary was situated farther north on the Peace, possibly at the confluence of the Notikewin River (Lamb 1957: 117). Fur trade records do not support the distribution of antelope as far north as Fort Vermilion [Alberta] (HBCA, PAM, B.224); and so few of the Fort St. John [British Columbia] post records have survived, that no particular conclusion can be drawn from the absence of references to antelope in those documents (HBCA, PAM, B. 189).

Antilocapra americana are referred to in these records by different terms: "antelope", "cabri"/"cabrit" and possibly "jumping deer". "Antelope" appeared only in the post-1850 records of Fort Dunvegan. Richardson (1829: 262) speculated that the term, "cabri/cabrit," as used in the Canadian fur trade for antelope, originated from a corruption of the Spanish, *cabra*, or goat. This usage is still found in older English dictionaries (e.g., Webster's 1957). This term appears in the Fort Dunvegan and Lesser Slave Lake post journals and in Harmon's 1816 diary from Ile de Campement. The term, "jumping deer," is found in the Fort St. Mary records of 1819/20 and in the Lesser Slave Lake records of 1819-1821. Whether this use refers to Pronghorn Antelope is not entirely clear. While the term, "jumping deer," was used historically for antelope (e.g., Coues 1965: 634), it is also used for other species, for instance, Mule Deer (*Odocoileus hemionus*), a species which may also have been present in the area of the Peace River under discussion.

The sporadic nature of the historical references to antelope in this area is related to their lack of significance as a provisioning resource in an area where Bison (*Bison bison*) were abundant. Thus, although Harmon described the area around Ile de Campement as rich

[1]Editor's Note: see map in *The National Atlas of Canada*, Fourth Edition (Revised) 1974. Pages 79-80, Posts of the Canadian Fur Trade. MacMillan Company, Toronto.