Ground-Nesting Waterbirds and Mammalian Carnivores in the Virginia Barrier Island Region: Running out of Options

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ABSTRACT


We examined changing patterns of distribution of two large mammalian predators, the raccoon (Procyon lotor) and red fox (Vulpes vulpes), and beach-nesting terns and Black Skimmers (Rynchops niger) along ca. 90 km of the Virginia barrier island landscape between the periods 1975–1977 and 1998. Based on evidence from trapping, scent stations, den observations and sightings of the two predators, there has been a marked increase in their island ranges. In 1975–77, only 6 of the 11 surveyed barrier islands definitely harbored at least one of the two mammals, but by 1998, 11 of 14 islands showed evidence of one or both during the spring and summer. Concurrently, annual beach-nesting bird surveys have been conducted since the mid 1970s during June. From 1977 to 1998, the number of colonies of terns (Common (Sterna hirundo), Gull-billed (S. ussuriensis), Least (S. antillarum), Royal (S. maximus), and Sandwich (S. sandvicensis)) and Black Skimmers declined from 23 colonies on 11 barrier islands to 15 colonies on 10 islands. In addition, the populations decreased dramatically for all species except the marginal Sandwich Tern and Least Tern. This pattern suggests that mammalian predation may be a major factor in colony site selection or success, although we have no data on success at most locations. The only consistently large colony over the years has been the Royal Tern colony on Fisherman Island, one of the few with no residual large mammals. Because these declining waterbird species appear to be running out of options for suitable colony sites in Virginia, we discuss the prospects of conducting limited predator removals on certain islands. In addition, considerations of strict management and enforcement of protection at critical mammal colony sites that now attract large numbers of certain species, are timely. Lastly, where dredged material disposal projects are planned, providing nesting sites for these colonial species and nesting sites for migrant birds may be appropriate.

ADDITIONAL INDEX WORDS: Barrier islands, mammalian predation, waterbirds.

INTRODUCTION

The role of predatory mammals, trophic cascades and effects on avian diversity in fragmented habitats has received recent attention (Crooks and Soule, 1999). Mammalian predation has long been established as one of the key selective forces in the evolution of coloniality in birds (Lack, 1968; Nelson, 1978; Wittenberger and Hunt, 1985; Krebs and Snell-Courey, 1988; Rolland et al., 1996). More recently, the role of predatory mammals and trophic cascades and their effects on avian diversity in fragmented habitats have been revealed. In addition to its evolutionary implications, it has become a growing management concern to seabird conservation biologists as nonindigenous or native mammals are introduced or spread in many parts of the world, often causing reproductive failure in colonies (see chapters in Croxall et al., 1984; Nettleship et al., 1994). Predation on nesting seabirds by rats (e.g., Rattus norvegicus) in Europe (Moeller, 1983) and New Zealand (Moors et al., 1990) and larger mammals such as red fox (Vulpes vulpes) and Arctic fox (Alopex lagopus) in both Europe (Lasson, 1980) and North America (Jones and Byrd, 1975; Macarone and Montevocchi, 1981) are but examples of a ubiquitous global problem. Along the Atlantic Coast of the United States, a third widespread predator, the raccoon (Procyon lotor) is a component member of the mammalian community on coastal islands (Patterson et al., 1990). Recent indications are that raccoons may be an increasing threat to ground-nesting birds in a number of mid- and south Atlantic coastal areas (in Virginia, Patterson et al., 1990; in South Carolina, P. Wilkinson, South Carolina Wildlife and Marine Resources, pers. comm.; and in eastern
Florida, H.T. Smith, Florida Department of Environmental Protection, pers. comm.). In coastal Virginia, a number of species of ground-nesting colonial waterbirds including Common Terns (Sternus hirundo), Gull-billed Terns (S. niloticus), Royal Terns (S. maxima), Sandwich Terns (S. sandvicensis), Least Terns (S. antillarum), and Black Skimmers (Oxyrhyncus nigripes) are prominent members of the breeding community of waterbirds. However, in the past two decades, populations of these species seem to have declined (except Royal Terns) considerably on the barrier islands (Williams et al., 1990). Some combination of storm and tidal flooding, food limitation, competition with larger gulls, as well as mammalian predators, is probably as play to explain these declines (Burger and Gochfeld, 1990, 1991; Erwin et al., 1998). In this paper, we focus on landscape-scale changes in the distribution of raccoons and foxes as dominant mammalian predators on the barrier islands and compare corresponding changes of these ground-nesting seabirds. We test the following hypothesis: Changes in the distribution of red foxes and/or raccoons on the Virginia barrier islands has had no effect through time on the distribution and/or colony sizes of beach-nesting terns and Black Skimmers.

METHODS

We obtained information on the June to August, 1975-77 (4099 trap-nights) distribution (presence/absence of red foxes and raccoons on seven Virginia (Accomack and Northampton counties) barrier islands from previously published accounts (Douglas et al., 1979) and from field records from U.S. Fish and Wildlife Service (USFWS) personnel (Fisherman Island) (Figure 1). Data were collected based on sightings, trapping, and from den observations. The islands from Assawoman to Cedar were not trapped for mammals during 1975-77, however 1977 field records of Gerald Hennessey, former Director of the Virginia Coast Reserve/The Nature Conservancy (for Assawoman and Metomkin islands), and one of us (HRF in 1977 on Metomkin Island) were reviewed for track records of raccoons and foxes during the period May-August (for Metomkin). Cedar Island and Ship Shoal Island were not surveyed at all for large mammals during this period. Comparison of beach surveys for tracks with trapping results indicate that, at least for presence/absence data, beach surveys are equally effective at detecting presence of these two large mammals (R.D. Dutcher, Utah State University, unpubl.). From October 14 to 21, 1998, surveys of foxes and raccoons were conducted over an eight day period by one of us (JEJ), using the scent station technique (see Wilson et al., 1996). During March 13-18, 1999, additional week-long beach surveys (tracks only) were conducted at the same sites by JEJ and colleagues. Evidence of mammal presence on the barrier islands was based on finding tracks (at either scent stations or anywhere along the beach border/fat line between stations) at seven barrier islands (surveyed by JEJ) as well as searches of the entire length of the four northern islands for tracks and/or den sites in April-May 1998 by I. Ailes (USFWS) and B.R. Truitt. While these methods are not directly comparable between the two time periods, we feel the thoroughness of the surveys should be sufficient to document at least the presence of the two large mammal species given the ease with which track detection on narrow sandy beaches can be made (R.D. Dutcher, pers. comm.).

Bird nesting colony information was obtained from the USFWS records and The Nature Conservancy-sponsored barrier island bird surveys conducted annually since 1975 from Fisherman Island (Assawoman Island (e.g., see Erwin and Kochershen, 1978; Williams et al., 1990). From these data and from maps, we determined the number of colonies of terns and Black Skimmers, estimated the combined abundance of all species in the colonies (many are mixed-species colonies), and then for display, categorized these into three size groups: small (<100 birds, or 50 pairs), medium (100 to 300 birds), and large (>300 birds). We compared average colony size changes between 1977 and 1998 using a Wilcoxon two-sample test for Common Terns, Black Skimmers, and Least Terns, the ones with large enough samples for analysis. As in earlier publications (Erwin and Kochershen, 1978), we define colony sites as nesting assemblages that are at least 200 m distant from the next nearest assemblage.

RESULTS

The distribution of large mammals and birds has clearly changed from 1977 to 1998 (Table 1, Figure 1). Racoon prese
Table 1. Recent surveys of mammalian predators and beach-nesting wading birds at barrier islands in coastal Virginia, 1977 and 1980. Mammals are fox (F) or raccoon (R). Bird colonies categorized into small (S = <100 birds), medium (M = 100–200), and large (L ≥ 300 birds) size. NA (not applicable) indicates that the island did not exist in 1977.

<table>
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</thead>
<tbody>
<tr>
<td>Assawoman</td>
<td>R, F</td>
<td>0</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>Monticello</td>
<td>U</td>
<td>L</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>Cedar Island</td>
<td>NA</td>
<td>NA</td>
<td>F</td>
<td>L</td>
</tr>
<tr>
<td>Cedar</td>
<td>S</td>
<td>F</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Dawson Shoals</td>
<td>0</td>
<td>0</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Pocomoke</td>
<td>R, F</td>
<td>R, F</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Hoop</td>
<td>R, F</td>
<td>R</td>
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<tr>
<td>Cabe</td>
<td>R</td>
<td>S</td>
<td>L</td>
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<tr>
<td>Little Cobb</td>
<td>R</td>
<td>L</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Wreck</td>
<td>S</td>
<td>R</td>
<td>L</td>
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<tr>
<td>Myrtle</td>
<td>M</td>
<td>K</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Ship Shoal</td>
<td>M</td>
<td>L</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>Smith</td>
<td>L</td>
<td>R, F</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Fisherman</td>
<td>0</td>
<td>L</td>
<td>0</td>
<td>L</td>
</tr>
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</table>

Total: 15 (11) 23 colonies 11 (14) 13 pools.

1. Survey data from: Dawson et al. 1979 for surveys from Pocomoke south to Smith Islands; the Assawoman to Dawson Shoals region was not included in the trap survey. See Methods for details. A "*" indicates unusually high population levels; a "?" indicates that the island was not surveyed for mammals. Fisherman Island was surveyed by USFWS refuge personnel. Cedar Island did not exist in 1977 whereas Dawson Shoals is an exposed sandy shoal that has no cover to support any mammals.
2. Bird survey data from Erwin and Williams 1979; note islands have more than one colony site.

On barrier islands increased from six (probable) to seven islands in that period, while foxes increased from (probably) seven in 1977 to six in 1980. In 1977, foxes located the one published location (Hog Island, Dawson et al., 1979), in addition to sightings of fox and raccoon sign (referred to as "probable") by Mr. Gerald Hennessey, former Director of the Virginia Coast Reserve, on Assawoman Island, and finding an active fox den by B.B. Truitt on Pocomoke Island in February 1977. Of 13 barrier islands available in 1977, fox or raccoon presence was definitely at only six of the 11 surveyed (Cedar and Ship Shoal not surveyed). In 1998, however, 11 of 14 surveyed islands were occupied by at least one of the two mammals (Table 1, Figure 2).

Concurrently, beach-nesting waterbirds were reduced from 23 colonies on 11 islands in 1977 to only 13 colonies on 10 islands in 1980 (Table 1, Figure 2). The most noteworthy changes were the losses of several large colonies on Smith and Monticello islands. In general, when foxes occur, there are no large colonies that persist for the entire nesting season. When we compared population sizes, we noted large decreases in all species except the ephemeral Sandwich Tern and Least Tern (Table 2). Average sizes of colonies declined for Common Terns and Black Skimmers. The mean colony size declined from 64 to 124 birds for Common Terns (Wilcoxen test, Z = -1.90, P = 0.05), and from 160 to 200 for Black Skimmers, although because of the limited sample size and large variation, this decline was not statistically significant (Wilcoxen test, Z = -1.25, P = 0.22). For Least Terns, the mean changed only slightly from 30 to 32 in the two periods (Wilcoxen test, Z = -0.37, P = 0.71).

Table 2. Changes in the estimates of breeding adults and numbers of colonies (in parentheses) on Virginia barrier islands of beach-nesting waterbirds, 1977 and 1980.

<table>
<thead>
<tr>
<th>Species</th>
<th>1977</th>
<th>1980</th>
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<tr>
<td>Common Tern</td>
<td>5660 (14)</td>
<td>872 (7)</td>
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<tr>
<td>Gull-billed Tern</td>
<td>215 (2)</td>
<td>11 (4)</td>
</tr>
<tr>
<td>Least Tern</td>
<td>300 (5)</td>
<td>305 (8)</td>
</tr>
<tr>
<td>Sandwich Tern</td>
<td>656 (1)</td>
<td>338 (1)</td>
</tr>
<tr>
<td>Black Skimmer</td>
<td>10 (1)</td>
<td>54 (1)</td>
</tr>
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1. Data from Erwin and Kuehnlein 1979.
2. Data from: Erwin, unpublished field records (1980).
review by BURGER and GOCHFELD, 1994; ROLAND et al., 1998). It appears that where fuses especially are present, large colonies either do not become established or if nesting begins, they fail early in the nesting cycle (Table 1). Such a pattern was noted earlier in Gulf-billed Terns at Motomkin and Cedar Sandbars in the mid 1990s (EWIN et al., 1998). A predator removal experiment would be an effective way to determine more directly the role of predation on colony es-
establishment, or colony restoration (see MANAGEMENT IM-
PLICATIONS section below).

Unfortunately we do not have data on the fate of all colo-
nies surveyed in 1977 and 1998. The only consistency over the
past twenty years has been the large (>2000 pairs) Royal
Tern colony at Adams Island, the eastern portion of Fish-
erman Island, which is one of the few islands that has not
had large mammalian resident predators during that period.

The extent to which the declines in the species in Table 2
can be attributed to predators is unknown. Food limitation
has been implicated in the past for Black Skimmers (EWIN, 1977), however, no data are available on population changes
of forage fishes over the entire region that most of the terns
and skimmers depend upon during spring and summer. The
only exceptions noted in species declines are Sandwich Terns
and Least Terns. The Sandwich Tern is a species on the edge
of its range which only nests with Royal Terns in very small
numbers in Virginia. Least Terns, in contrast, have always
been widespread in coastal Virginia (EWIN, 1979). In
the face of mammalian predation, they are probably better
adapted than the other tern species because they are more
cryptic in their nesting, their nests are widely separated, they read-
ily resume following nest failure, and their colony sites tend
to have low site fidelity among years (EWIN, 1978; BURGER,
1984; BURGER et al., 1998).

Further evidence that predation is a major factor in colony
site change is the founding of a new colony during the early
1980s at a manmade island, the Chesapeake Bay Bridge-
Tunnel, 60 km southwest of Fisherman Island at the southern margin of Chesapeake Bay. This site has no large
mammals in residence. More than 1000 Common Terns and
120 Black Skimmers were nesting at this newly founded site
in the 1982-84 period, about the time the predator ex-

dansion started along the coast (KAIN, 1985). By 1987 more
than 1200 breeding pairs were on the island.

Management Implications

Unless a major epidemic or hurricane is effective in reduc-
ing the numbers of gulls and auks on the barrier islands, the

current pattern of occupation appears to be irreversable to the
future of ground-nesting birds in eastern Virginia. Although a few species are adaptable to shifting trophic hab-

ites e.g.,
mammals islands (EWIN, 1980; EWIN et al., 1998; BURGER
and GOCHFELD, 1990, 1991), many species are more
limited in their nest or colony site choices (BURGER and
BUCKLEY, 1972). Unlike North Carolina where there are a
number of large colonies of (mammals) islands as colony site
alternatives to natural barrier islands (PASSENL and SOUT, 1979),
there are far fewer options for waterbirds in coastal Virginia. Future breeding activities in coastal Virginia should
strongly consider building several islands, or at least adding
to existing sand/dune bars for waterbirds.

Such a pessimistic outlook for waterbirds argues for con-
sidering limited predator controls, at least at a few selected
islands. We realize that large-scale predator control is nei-
ther effective in general nor is it politically or ethically ac-
ceptable in contemporary society (CHOBAN and SOUT, 1993).
Also, a recent review of predator control studies reveals that,
although local reproductive success may be enhanced with
 predator removal, there is seldom an effect on the overall
breeding population size of the species being protected (COTE
and RUTHERFORD, 1996).

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