The Small Mammals of Two Dune Communities in Southeastern Virginia

Robert K. Rose and Justin L. Sweitzer

Department of Biological Sciences, Old Dominion University, Norfolk, VA, 23529

Tetra Tech, 451 Presumpscot Street, Portland, ME 04103

ABSTRACT

Small mammals were surveyed using live and pitfall traps between the primary and secondary dunes at two locations on the shores of the Chesapeake Bay near the Atlantic Ocean: Little Creek Amphibious Base in Norfolk and Joint Expeditionary Base Fort Story in Virginia Beach, Virginia. Captures were dominated by house mice (Mus musculus) in interdunal habitats with sparse grass, whereas white-footed mice (Peromyscus leucopus) were found primarily in shrubby live-oak thickets on the tops of dunes. Hispid cotton rats (Sigmodon hispidus) were present only at Fort Story, and then only in patches of dense herbaceous vegetation just above the wrack line.

INTRODUCTION

Relatively little research has been conducted of small mammals in dune communities of the Atlantic Coast (e.g., Shure 1970), and even less is known of the biota of estuarine dunes (Varnell et al. 2010). Dunes are dynamic landforms that are subject to rapid changes in size, shape, and vegetation due to weather events such as hurricanes and nor’easters (Cowles 1899). Even a strong prevailing wind can bury a plant in sand in a day (pers. obs.). The result is that the quality of dune communities is constantly changing. Further, the soils of dunes typically are sandy, porous, and low in nutrients, and therefore unsuitable for plants not adapted to such conditions. Plant communities of dunes from southern New Jersey to northern North Carolina have few species and often are dominated by Ammophila breviligulata (American beachgrass) and Panicum amarum var amarum (bitter panic grass; Day et al. 2001, Leonard and Judd 2011).

Perhaps because dune systems are ever-changing, many dune organisms are colonizing species and adapted to disturbed conditions. Colonizing species often are the first to arrive in newly formed environments and they reproduce quickly, expanding their populations rapidly to exploit resources before other species arrive. Among small mammals, house mice (Mus musculus) and white-footed mice (Peromyscus leucopus) are the major colonizing species in disturbed or emerging habitats in eastern North America (e.g., Courtney and Fenton 1976, DeLong 1978, Mehlhop and Lynch 1978).

1 Corresponding author: brose@odu.edu
We studied small mammals inhabiting the plant communities between primary and secondary dunes of the lower Chesapeake Bay estuary. Our objectives were to learn what small mammals were present in the interdunal communities of two relatively undeveloped beaches, those at the Little Creek Amphibious Base in Norfolk (hereafter, Little Creek) and at the Fort Story Joint Expeditionary Forces Base in Virginia Beach, Virginia (hereafter, Fort Story).

Our study is the only published information describing small mammal communities in estuarine dune habitats in the mid-Atlantic region.

MATERIALS AND METHODS

Little Creek was surveyed from 6-11 February 2012, using 90 Fitch live traps (Rose 1994) and 59 pitfall traps set in 15 transects along 4.1 km of beach. Pitfall traps were made from #10 cans set into the ground so the top of the can was level with the surface. Fitch traps were placed 10 m apart in each transect, near grasses or other plant cover, when possible. The six live traps in each transect were baited with a mixture of wild bird seed and sunflower seeds and polyfill was added for insulation. Both kinds of traps were marked with surveyors’ flags, which proved helpful because one day sand carried by a persistent 40-mph wind buried several traps of both types within 24 hours. The location of each transect was recorded with a GPS device, and the dominant plants were noted. Fort Story was surveyed from 7-12 February, using 90 Fitch traps and 30 pitfall traps in 15 transects along 4.3 km of beach, with methods similar to those used at Little Creek.

Traps were checked daily, providing 894 trap-nights at Little Creek and 720 trap-nights at Fort Story. Small mammals caught in live traps were evaluated for sex and reproductive condition, and were weighed with a Pesola® pencil scale before being released at the point of capture. Approximately half of rodents were given numbered ear tags to learn whether we were recapturing animals (mostly we caught different ones each day). For reproductive status of males, we recorded the location of the testes (descended or abdominal). We noted whether females were pregnant or had perforate vaginas, the relative size of nipples and condition of the pubic symphysis (closed, slightly open, open). Because our study was conducted in mid-winter, we expected minimal, if any, evidence of reproduction.

Our field methods followed the guidelines of the American Society of Mammalogists as outlined in Sikes, Gannon et al. (2011). A wildlife collecting permit for this study (No. 043768) was issued to the junior author by the Virginia Department of Game and Inland Fisheries. Specimens from the pitfall traps that were of scientific value were prepared as museum specimens to be deposited in the collection of a research museum. A small series of skins, skeletons and tissues of white-footed mice was deposited at the National Museum of Natural History (Smithsonian) in Washington, D. C. Pending verification by genetic analysis, they have been catalogued as *Peromyscus leucopus easti*.

RESULTS

We caught only 17 small mammals at Little Creek but 103 at Fort Story (Table 1). White-footed mice were the most frequently captured species at Little Creek, whereas house mice were most numerous at Fort Story. Five species of small mammals were captured during the six days of trapping (Table 1). We only caught three small
mammals in pitfall traps, in part because blowing sand often filled the traps. Thus, our traps caught 3 rodent species at each location, but eastern harvest mice were caught only at Little Creek and hispid cotton rats were present, and fairly common, in dense grassy habitats only at Fort Story. We also caught 3 Song Sparrows (Melospiza melodia) in the live traps at Little Creek.

At Fort Story, almost all (54; 92%) house mice were taken in traps set in grassy habitat, with the remaining 5 taken in shrub thicket (Fig. 1). By contrast, 24 white-footed mice were trapped in shrub thickets at Fort Story, with 1 in grassy habitat and 2 at the grass-shrub edge. The majority of hispid cotton rats (12 of 15) were captured in grassy habitats, often ≤2 meters of bare beach, but always in dense grassy vegetation dominated by American beachgrass and sea oats (Uniola paniculata).

Habitat associations were such that a given habitat tended to have a single species (Table 2). At Little Creek, white-footed mice were caught at four transects, three of which yielded only Peromyscus leucopus. Similarly, most of the 59 house mice caught at Fort Story were taken on transects yielding only that species. House mice were the one species associated with another species of small mammal outside of its typical grassy habitat (Table 2).

Evidence of Reproduction
None of the house mice or hispid cotton rats showed signs of reproduction. All females had non-perforate vaginas and males had abdominal testes. However, three of the house mice were tiny (6-7 g), indicating they were juveniles born within recent weeks. By contrast, the white-footed mice showed evidence of current reproduction, with some large males having descended testes, a good predictor of fertility (McCray and Rose 1992). Further, some females had medium-large nipples, indicating recent lactation, and two small white-footed mice had gray pelage, indicative of young animals. Additionally, male white-footed mice that were retained for genetic analysis had convoluted epididymides, confirming the presence of mature sperm, and one female had 3 embryos.

Multiple captures
In eight instances the Fitch live traps had multiple captures, always of conspecifics. Two house mice were observed in a trap five times, two white-footed mice were captured together once, two cotton rats once, and one trap yielded three house mice.

TABLE 1. Small mammals of the dune communities at Little Creek (Norfolk) and Fort Story (Virginia Beach), Virginia, February 2012. Mus musculus = M.m., Peromyscus leucopus = P.l., Sigmodon hispidus = S.h., Reithrodontomys humulis = R.h., Blarina carolinensis = B.c.

<table>
<thead>
<tr>
<th></th>
<th>M.m.</th>
<th>P.l.</th>
<th>S.h.</th>
<th>R.h.</th>
<th>B.c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little Creek</td>
<td>4</td>
<td>12</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fort Story</td>
<td>59</td>
<td>28</td>
<td>15</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Thus, traps with multiple captures yielded more than 10 percent of total captures in our short field study.

**Table 2.** Associations among species at the 15 transects at Little Creek and Fort Story. “Nothing” means 9 transects at Little Creek yielded no small mammals. The column headings with species names show the numbers of transects yielding only that species; the last two columns show the number of transects yielding two species. *M.m.* = house mouse, *P.l.* = white-footed mouse, *S.h.* = hispid cotton rat.

<table>
<thead>
<tr>
<th>Site</th>
<th>Nothing</th>
<th><em>M.m.</em></th>
<th><em>P.l.</em></th>
<th><em>S.h.</em></th>
<th><em>M.m.</em> &amp; <em>P.l.</em></th>
<th><em>M.m.</em> &amp; <em>S.h.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Little Creek</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fort Story</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Thus, traps with multiple captures yielded more than 10 percent of total captures in our short field study.

**Discussion**

The numbers of small mammals taken in pitfall and live traps differed greatly between the two locations, despite similar numbers of live traps and transects at each. Furthermore, almost half (7) of the 15 transects at Little Creek yielded no small mammals.
mammals, but at Fort Story all transects produced at least one small mammal. This difference in capture success may have been due to differences in habitat quality; at Fort Story, all dunes (except one place) appeared to be fairly intact, but primary dunes at Little Creek often were absent or poorly formed. For example, a dune near a shooting range at Little Creek was perhaps 10 m tall and had been previously enhanced with earth-moving machinery. This tall dune was stabilized with thickets of mixed shrubs and grasses consisting of bayberry (*Morella pensylvanica*), live oak (*Quercus virginiana*), common persimmon (*Diospyros virginiana*), trumpet honeysuckle (*Lonicera sempervirens*), and coastal little bluestem (*Schizachyrium littorale*) and yielded the highest number (9 of 12) of white-footed mice at Little Creek. Likewise, the tallest dunes at Fort Story, some perhaps also made taller during dune restoration activities, yielded most of the white-footed mice; 26 of 28 (93%) captures were from adjacent tall dunes, separated by a paved road leading to the beach and each vegetated with live oak thickets and some maritime forest. Thus, tall and well-vegetated dunes at both sites were prime habitats and locations where most of white-footed mice were found. No house mice were captured on the tall dunes.

A strong relationship was observed between habitat type and the species of small mammal present. Presence of white-footed mice was associated with thickets, whereas house mice were most numerous in sparse grasses. Patches of tall dense grass often yielded hispid cotton rats. House mice and white-footed mice were only captured in the same transect when those transects possessed both habitat types. Shure (1970), who studied small mammals of a New Jersey barrier beach, also found white-footed mice had a strong affinity for woody thickets or heath, whereas house mice were found in grassy areas. Scott and Dueser (1992), in their studies on Assateague Island, Virginia, demonstrated in reciprocal removal experiments of these two species that each species remained only in its preferred habitat even in the absence of the other. For example, *Mus* did not move into thickets when white-footed mice had been removed. Similar strong associations between *Mus* and grassy habitats and between *P. leucopus* and woody habitats have been reported by Cranford and Maly (1990), from dune communities on Assateague Island, Virginia, and Kirkland and Fleming (1990) on Wallops Island, Virginia. (The northern distribution of the hispid cotton rat on the Atlantic coast ends at Fort Story, located at the southern rim of the Chesapeake Bay, so they are not present on the Eastern Shore.)

Some transects in shrub thickets or maritime forest had numerous acorns on the ground, but such places yielded no white-footed mice, despite acorns being a major food source (Batzli 1977, Wolff et al. 1985). The presence of unexploited acorns suggested that although resources were available, the habitat was otherwise unsuitable for white-footed mice. At both Little Creek and Fort Story, white-footed mice were densely packed in a few locations (with no acorns), such as on transects 6 and 7 at Fort Story. Five traps on a transect on the tallest dune yielded five white-footed mice on two occasions, suggesting the use of multiple traps at a trapping point would have yielded even more *P. leucopus*. The densities of white-footed mice we observed in the thickets of these tall dunes appear to be much greater than those reported for the species in hardwood forests of the eastern US (e.g., Batzli 1977). Shure (1970) also found white-footed mice had higher abundances in maritime vegetation than those reported in mainland studies.
The grassy areas where house mice dominated appeared to be highly variable in their structure and percentage of ground cover. We estimated grassy interdunal swales to be 20-40 percent vegetated, with the majority of the ground surface being bare sand. Such habitats are the equivalent of early successional stages and may be ideal for house mice to colonize and occupy. Because the dense ground cover required by native herbivorous small mammals, such as meadow voles, never develops in these sandy places, populations of house mice likely persist free from competition for resources by other species. Other studies show that once populations of native rodents become established, house mice disappear (e.g., Lidicker 1966, Caldwell and Gentry 1965).

The absence of one species, eastern harvest mouse, was unexpected at Fort Story; one was caught at Little Creek. The eastern harvest mouse is a versatile small mammal in eastern Virginia. Although found at highest densities in grassy oldfields (Cawthorn and Rose 1991), it is often present in a wide range of habitats, including pine forests, hardwood forests, roadsides, i.e., places lacking the vegetation structure of grassy oldfields. One 6-g female was caught on a Little Creek transect dominated by grasses. Harvest mice often are associated with hispid cotton rats (Cameron and Kincaid 1982), but none was caught at Fort Story, where cotton rats were taken at 6 different transects (Table 2). Harvest mice eat seeds and some insects (Kincaid and Cameron 1985), a diet similar to that of house mice.

In conclusion, the rodents of the interdunal communities in eastern Virginia are predictable. White-footed mice occupied shrub thickets, house mice were found in sparse grasses, and hispid cotton rats, when present, were found in patches of tall dense grasses.

ACKNOWLEDGMENTS
We thank the Virginia Department of Game and Inland Fisheries for the permit to conduct this field study, the Department of the Navy, Naval Facilities Engineering Command Mid-Atlantic (NAVFAC MIDLANT) for their cooperation in granting access to each base and for allowing us to publish our results, and Curtis Hickman and Zaneta Hough of Kerr Environmental, Inc. of Virginia Beach for their field assistance early in the study. Both authors contributed equally to the field study.

LITERATURE CITED


