REPEATED CAPTURE OF BEACH MICE (PEROMYSCUS POLIONOTUS PHASMA AND P. P. NIVEIVENTRIS) REDUCES BODY MASS

ALEXIS A. SUAZO,* ANGELIQUE T. DELONG, ALICE A. BARD, AND DONNA M. ODDY

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Body mass is commonly used as an indicator of habitat quality and body condition in small-mammal populations. We examined the effects of consecutive days of livetrapping on body mass of 2 federally listed subspecies of beach mice on the eastern coast of Florida: the Anastasia Island beach mouse (Peromyscus polionotus phasma) and the southeastern beach mouse (P. p. niveiventris). Mean mass loss (approximately 0.5 g/recaptured day) was additive and occurred for Anastasia Island beach mice over 2 consecutive days and for southeastern beach mice over 3 consecutive days. Researchers should exercise caution when their trapping protocols call for consecutive nights of trapping.

Key words: Anastasia Island beach mouse, mass loss, Peromyscus polionotus niveiventris, Peromyscus polionotus phasma, repeated capture, southeastern beach mouse

Body mass is recorded in most ecological studies of small-mammal population dynamics as an indicator of habitat quality (Peles and Barrett 1996) and to monitor population health. However, extensive livetrapping may undermine use of body mass as an index of population health and alter population dynamics of the species being trapped (Pearson et al. 2003). Studies on body mass of rodents in Europe and Africa have suggested that individuals generally do not recover from trapping stress within 24 h, although absolute mass losses were small on a daily basis (Korn 1987). Nevertheless, small changes compound when the animal is captured day after day and average body mass decreases continuously (Korn 1987). If body-mass declines are cumulative, repeated captures of individuals may be deleterious and ultimately cause mortality either in the trap or after release (Pearson et al. 2003).

Mass loss during livetrapping has been documented in several taxonomic groups of small mammals from a wide range of environments. In North America, mass loss has been documented for cotton rats (Sigmodon hispidus) and prairie voles (Microtus ochrogaster) from northeastern Kansas that were captured for 3 consecutive days (Slade 1991). These mass losses might affect subsequent growth and survivorship (Slade 1991). Effects of livetrapping on body mass also vary as a function of species, season, and population demography. For example, changes in body mass of prairie deer mice (Peromyscus maniculatus) were affected by age, season of capture, and reproductive condition of adult females (Kaufman and Kaufman 1994).

Based on results from previous studies, we expected to observe mass declines in 2 populations of consecutively recaptured beach mice (Peromyscus polionotus) in coastal Florida. All but 1 subspecies of beach mice are listed under the Endangered Species Act of 1973 (United States Fish and Wildlife Service 1985, 1989). Most populations of this taxon are small and fragmented so that biotic and abiotic factors may operate singly or in combination to bring them to extinction (Gilpin and Soulé 1986; Shaffer 1981; Wilcox and Murphy 1985). If multiple captures result in body-mass declines, extensive trapping periods may negatively affect these small populations and exacerbate their already precarious status. We used field data obtained during 2 mark–recapture studies to examine the effects of consecutive days of livetrapping on body mass.

MATERIALS AND METHODS

We collected data from March 1995 to June 2002 to study effects of 2 consecutive captures on the Anastasia Island beach mouse (P. p. phasma). Livetrapping was conducted quarterly at Anastasia Island.
State Park, St. Johns County, Florida. Anastasia Island State Park contains 650 ha, of which 202 ha is beach dune habitat. Beach dunes are vegetated by sea oats (Uniola paniculata), railroad vine (Ipomoea pes-caprae), beach morning glory (I. stolonifera), and beach elder (Iva imbricata) and support a stable mouse population. Each trapping period consisted of 2 consecutive nights in which 2 transect lines were set north to south 1.6 km apart on primary sand dunes. Each transect line consisted of 20 trapping stations 15 m apart. We used 2 Sherman live traps (5.2 × 6.5 × 16.7 cm, H. B. Sherman Traps, Inc., Tallahassee, Florida) at each station baited with sunflower seeds. Traps were set late in the afternoon and checked early the following morning. On cold nights (<15°C), cotton was put in each trap to provide insulation and trapping was not conducted when temperatures were forecast to be <10°C.

We used data collected from September 1995 to October 1997 to examine effects of 2 and 3 consecutive captures on the southeastern beach mouse (P. p. niveiventris) as part of a population dynamics study at Cape Canaveral Air Force Station in Brevard County, Florida. Cape Canaveral Air Force Station has an area of about 6,396 ha, of which 640 ha is coastal dune and strand. Livetrapping was conducted quarterly; each trapping period consisted of up to 5 consecutive days. However, only mice that were captured for 3 consecutive days were used in the analyses. Primary dunes were dominated by sea oats, beach grass (Panicum amarum), and various herbs and small shrubs. Coastal grasslands were dominated by purple muhly grass (Muhlenbergia capillaries), a sedge (Fimbristylis castanea), beardgrass (Angropogon), and Schizachyrium. In the coastal strand, dominant shrubs were saw palmetto (Serenoa repens), sea grape (Coccoloba uvifera), wax myrtle (Myrica cerifera), tough buckthorn (Sideroxylon tenax), nakedwood (Myrcianthes fragrans), and rapanee (Rapanee punctata). Study grids were adjacent to the high-tide mark and extended inland over the coastal dunes through the grassland and coastal strand. Four trapping grids varying in size from 1 ha to 1.5 ha were set 1.6–3.2 km apart. We used 1 Sherman live trap (23 × 23 × 8 cm) per station set 10 m apart.

We used a Pesola spring scale (Pesola AG, Baar, Switzerland) with a clip to weigh beach mice to the nearest 0.5 g. To weigh beach mice, we used the clip to suspend mice by their tails to avoid errors associated with tare weights. All mice were uniquely marked with numbered Monel ear tags (Neway Products, Murray, Utah) and released at the site of capture. Animals were reexamined and reweighed at each subsequent capture. We followed guidelines of the American Society of Mammalogists for animal care and use (Animal Care Use and Committee 1998).

We analyzed only masses of male mice to minimize bias due to pregnancy or lactation. All age classes were included in the analysis. Percentages of body-mass changes were obtained by examining the weight dynamics in the populations, that is, mass loss, mass gain, or no mass change. We report descriptive statistics for weight changes on trapping days 1, 2, and 3 (mean and SE). We conducted linear regression analyses on the initial mass versus mass lost for each day of trapping days 1, 2, and 3 (mean and SE). We report descriptive statistics for weight changes on day 3. We conducted linear regression analysis with day 2 capture mass compared to mass change on day 3. Mass on day 2 explained 13.8% of the variation in mass change during day 3 (r = 0.371, P = 0.002). The slopes of all regression lines were significantly different from horizontal, indicating that initial weight made a significant contribution to the models (Fig. 1).

We used Cook’s distance to examine the overall influence of outliers on the models. The outlier in Fig. 1a (17 g body mass, 6.5 g mass loss) was not removed from the data set because Cook’s distance was <1. However, an outlier (19.5 g body mass, 6.5 g mass loss) was removed from the data set shown in Fig. 1b (Cook’s distance >1). Its removal changed the amount of variation explained but did not change the significance of the model.

**RESULTS**

We captured 104 Anastasia Island beach mice on 2 consecutive days (out of a total of 651 captures) and 70 southeastern beach mice on 2 and 3 consecutive days (out of a total of 639 captures) during the course of the study. Of male mice examined, 58% of the 104 Anastasia Island beach mice and 50% of the 70 southeastern beach mice lost mass on the 2nd day of capture. Both subspecies lost an average of 4% body mass. The mean (n = 104) body mass of male Anastasia Island beach mice decreased from 13.6 ± 0.21 g on day 1 to 13.1 ± 0.19 g on day 2, whereas mean (n = 70) body mass of male southeastern beach mice changed from 13.3 ± 0.25 g on day 1 to 12.8 ± 0.23 g on day 2. By the 3rd day, 71% of southeastern beach mice had mass declines averaging 8% initial body mass. The mean body mass of male southeastern beach mice dropped from 12.8 ± 0.23 g on day 2 to 12.3 ± 0.22 g on day 3.

In both subspecies, mean mass lost increased with increasing initial mass. Initial mass explained 22% of the variation in mass change for Anastasia Island beach mice on day 2 (r = 0.47, P < 0.001), and 7% and 17% of the variation in mass change for southeastern beach mice on days 2 (r = 0.27, P = 0.026) and 3 (r = 0.41, P = 0.001), respectively (Fig. 1). The contribution of day 3 (i.e., 2nd day of recapture) to the mass change of southeastern beach mice was examined by performing a regression analysis with day 2 capture mass compared to mass change on day 3. Mass on day 2 explained 13.8% of the variation in mass change during day 3 (r = 0.371, P = 0.002). The slopes of all regression lines were significantly different from horizontal, indicating that initial weight made a significant contribution to the models (Fig. 1).

We found body mass declined when Anastasia Island beach mice and southeastern beach mice were trapped over consecutive days, a result that agrees with studies of other rodent species (Korn 1987; Pearson et al. 2003; Slade 1991). In our populations, individuals lost approximately 0.5 g each time they were recaptured. Clearly, both subspecies of beach mice were unable to maintain a constant body mass when captured repeatedly.

It is difficult to predict exactly how much mass loss is tolerable for individuals of these subspecies before negative effects are observed. The ability of small mammals to maintain a constant body mass is dependent on the species; some can tolerate being confined in live traps better than others (Korn 1987). Confinement within live traps for 12 h caused a loss of about 10% of initial body weight in meadow voles (Microtus pennsylvanicus—Bietz et al. 1977) and animals dying in traps lost more mass than did survivors (Pearson et al. 2003). In the populations of beach mice in this study, animals lost 4% of initial body mass on day 2 and 8% of initial body mass on day 3. Body mass and survival are often correlated, (McClenaghan and Gaines 1978; Myers and Master 1983), thus animals that...
experience small, cumulative mass declines might be more likely to die soon after release.

The mass of beach mice on the 1st day of capture affected mass loss during trap confinement. Small (<10-g) Anastasia Island and southeastern beach mice gained mass on the 1st day of recapture, but small southeastern beach mice exhibited declines on day 3. However, only 2 small mice were captured on 3 consecutive days. Our results from the 1st day of recapture agreed with other research in which small-sized animals gained or lost less weight when recaptured multiple times (Kaufman and Kaufman 1994; Pearson et al. 2003; Slade 1991). Differences in mass loss due to body mass may be partly due to the increased growth rates in smaller individuals. However, smaller animals may not be less susceptible to the trapping experience. Studies of trap mortality suggest that juveniles are more sensitive to trap stress than are adults (Drickamer and Paine 1992). Because smaller animals are expected to gain mass day after day, any observed mass loss may have a severe impact on these individuals. However, smaller animals have smaller maintenance requirements that can be met by consuming the bait inside traps or eating soon after release (Slade 1991).

Our results of mass loss in larger animals (>10 g) were consistent with published work. Slade (1991) found mass declines to be greater in larger cotton rats and prairie voles between successive captures within a 3-day trapping period. In this instance, larger animals would be more severely impacted from repeated livetrapping. If livetrapping is frequent and extensive, it may reduce the survival of large, reproductively active adults.

Our data sets did not allow us to analyze the response of female beach mice to consecutive days of trapping; therefore, we can only speculate about the effects of repeated days of capture on female beach mice, especially during times of high reproductive activity. Breeding female beach mice may be physiologically stressed because of the high cost of reproduction, and repeated captures of reproductively active females may lead to weight loss and decreased survival. Carefully designed studies would provide information on the influence of livetrapping on female beach mice weight dynamics.

Consecutive days of capture had an additive effect on weight change of recaptured mice. Persistent effects of repeated captures are of particular concern with research protocols that require relatively long trapping periods, for example, >5 days (Nichols et al. 1984; Otis et al. 1978; Pollock 1982). Beach mice populations have been trapped for up to 5 consecutive days (Frank 1996; Moyers 1996; Rave and Holler 1992; Van Zant and Wooten 2003). We recommend that small-mammal trapping not be conducted over consecutive trapping days. Short-term changes in mass should be examined for significant long-term effects on population dynamics (Slade and Iskjaer 1990). Comparisons of survival of animals trapped for 1 day to survival of animals trapped on consecutive days should elucidate the effects of multiple days of trapping.

Assessing habitat quality and monitoring population dynamics is an important component to managing these small populations of beach mice. Van Horne (1983) argues that biologists seldom question the assumptions implicit in their assessment of habitat quality. Body mass should not be used as an index of habitat quality in studies with multiple recaptures.

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