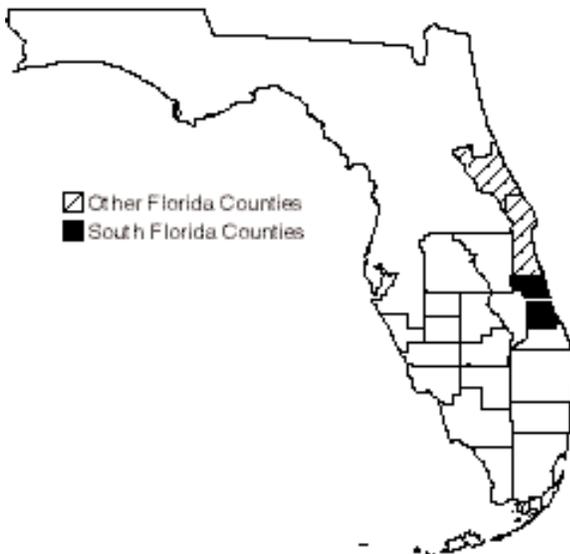

Southeastern Beach Mouse

Peromyscus polionotus niveiventris

Federal Status:	Threatened (May 12, 1989)
Critical Habitat:	None Designated
Florida Status:	Threatened
Recovery Plan Status:	Contribution (May 1999)
Geographic Coverage:	South Florida

Figure 1. County distribution of the southeastern beach mouse; this species is only found in coastal



The southeastern beach mouse is a subspecies of the oldfield mouse that occurs in coastal habitats along the east coast of Florida. Its range formerly extended along about 280 km of the coast, in beach dunes, from Volusia to Broward counties. It is now restricted to about 64 km of coastline, having been extirpated in the southern portion of its former range. Extensive habitat loss because of commercial and residential construction along the Atlantic coast has left a fragmented population in small pockets of suitable habitat. Surveys are needed to determine the status of the southeastern beach mouse in South Florida.

This account represents South Florida's contribution to the recovery of the southeastern beach mouse (FWS 1993).

Description

The southeastern beach mouse is the largest of the seven recognized subspecies of beach mice, averaging 139 mm in total length (range of 10 individuals = 128 to 153 mm), with a 52 mm tail length (Osgood 1909, Stout 1992). Females are slightly larger than males. These beach mice are slightly darker in appearance than some other subspecies of beach mice, but paler than inland populations of *P. polionotus* (Osgood 1909). Southeastern beach mice have pale, buffy coloration from the back of their head to their tail, and their underparts are white. The white hairs extend up on their flanks, high on their jaw, and within 2 to 3 mm of their eyes (Stout 1992). There are no white spots above the eyes as with *P. p. phasma* (Osgood 1909). Their tail is also buffy above and white below. Juvenile *P. p. niveiventris* are more grayish in coloration than adults, otherwise they are similar in appearance (Osgood 1909).

Taxonomy

Peromyscus polionotus is a member of the order Rodentia and family Cricetidae. The southeastern beach mouse is

one of 16 recognized subspecies of oldfield mice *P. polionotis* (Hall 1981); it is one of the seven of those subspecies that are called “beach mice.” The southeastern beach mouse was first described by Chapman (1889) as *Hesperomys niveiventris*. Bangs (1898) subsequently placed it in the genus *Peromyscus*, and Osgood (1909) assigned it the subspecific name *P. polionotus niveiventris*.

Distribution

The oldfield mouse (*P. polionotus*) is distributed throughout dry, sandy habitats on inland sites in northeastern Mississippi, Alabama, Georgia, South Carolina, and Florida. Seven subspecies of the oldfield mouse occur on beaches and dunes of the Atlantic coast of Florida and the Gulf coast of Alabama and Florida, and are collectively known as “beach mice.”

Five subspecies of beach mice occur on the Gulf coast from Mobile Bay, Alabama to Cape San Blas, Florida: the Alabama beach mouse (*Peromyscus polionotus ammobates*), the Perdido Key beach mouse (*P. p. trissyllepsis*), the Choctawhatchee beach mouse (*P. p. allophrys*), the Santa Rosa beach mouse (*P. p. leucocephalus*) and the St. Andrews beach mouse (*P. p. peninsularis*); the latter four occur on the Gulf coast of Florida. The Anastasia Island beach mouse (*P. p. phasma*) and the southeastern beach mouse occur on the Atlantic coast of Florida, but their ranges do not overlap.

Historically, the southeastern beach mouse occurred along about 280 km of Florida’s southeast coast, from Ponce Inlet, Volusia County, southward to Hollywood, Broward County, and possibly as far south as Miami Beach in Miami-Dade County, Florida (Stout 1992). The type locality for the southeastern beach mouse is East Peninsula, Oak Lodge, opposite Micco, Brevard County, Florida (Osgood 1909). Based on the most recent published literature, this subspecies is currently restricted to about 80 km of beach, occurring in Volusia County, Brevard County, and scattered locations in Indian River and St. Lucie counties (Figure 1). The southeastern beach mouse is geographically isolated from all other subspecies of *P. polionotus*.

Habitat

Essential habitat of the southeastern beach mouse is the sea oats (*Uniola paniculata*) zone of primary coastal dunes (Humphrey and Barbour 1981, Humphrey *et al.* 1987, Stout 1992). This subspecies has also been reported from sandy areas of adjoining coastal strand vegetation (Extine 1980, Extine and Stout 1987, Rich *et al.* 1993), which refers to a transition zone between the foredune and the inland plant community (Johnson and Barbour 1990). Although individuals can occur and reproduce in the ecotone between the former sea oats zone and the shrub zone, they will not survive as a population there (L. Ehrhart, University of Central Florida, personal communication 1998). Beach mouse habitat is heterogeneous, and distributed in patches that occur both parallel and perpendicular to the shoreline (Extine and Stout 1987). Because this habitat occurs in a narrow band along Florida’s coast, structure and composition of the vegetative communities that form the habitat can change dramatically over distances of only a few meters.

Southeastern beach mouse.
Original photograph by Paul
Tritaik.



Primary dune vegetation described from southeastern beach mouse habitat includes sea oats, dune panic grass (*Panicum amarum*), railroad vine (*Ipomaea pes-caprae*), beach morning glory (*Ipomaea stolonifera*), salt meadow cordgrass (*Spartina patens*), lamb's quarters (*Chenopodium album*), saltgrass (*Distichlis spicata*), and camphor weed (*Heterotheca subaxillaris*) (Extine 1980, J. Stout, University of Central Florida, personal communication 1996). Coastal strand and inland vegetation is more diverse, and can include beach tea (*Croton punctatus*), prickly pear cactus (*Opuntia humifusa*), saw palmetto (*Serenoa repens*), wax myrtle (*Myrica cerifera*), rosemary (*Ceratiola ericoides*), sea grape (*Coccoloba uvifera*), oaks (*Quercus sp.*) and sand pine (*Pinus clausa*) (Extine and Stout 1987).

Although Extine (1980) observed this subspecies as far as 1 km inland on Merritt Island, he concluded that the dune scrub communities he found them in represent only marginal habitat for the southeastern beach mouse; highest densities and greater survival of mice were observed in beach habitat. In the same study site, Extine (1980) and Extine and Stout (1987) reported that the southeastern beach mouse showed a preference for areas with clumps of palmetto, sea grape, and expanses of open sand. In Indian River County, southeastern beach mice inhabit dunes that are only 1 to 3 m wide and dominated by sea oats and dune panic grass (Humphrey and Frank 1992). According to Stout (1992), southeastern beach mice do not occur in areas where woody vegetation is greater than 2 m in height.

Within their dune habitat, beach mice construct burrows to use as refuges, nesting sites, and food storage areas. Burrows of *P. polionotus*, in general, consist of an entrance tunnel, nest chamber, and escape tunnel. Burrow entrances are usually placed on the sloping side of a dune at the base of a shrub or clump of grass. The nest chamber is formed at the end of the level portion of the entrance tunnel at a depth of 0.6 to 0.9 m, and the escape tunnel rises from the nest chamber to within 2.5 cm of the surface (Blair 1951). A beach mouse may have as many as 20 burrows within its home range. They are also known to use old burrows constructed by ghost crabs (*Ocypode quadrata*).

Behavior

Not much is known about the life history and ecology of the southeastern beach mouse. Therefore, this section makes inferences about their biology using data from studies of other beach mice.

P. polionotus is the only member of the genus that digs an extensive burrow for refuge, nesting, and food storage (Ehrhart 1978). To dig the burrow, the mouse assumes a straddling position and throws sand back between the hind legs with the forefeet. The hind feet are then used to kick sand back while the mouse backs slowly up and out of the burrow (Ivey 1949). Burrows usually contain multiple entrances, some of which are used as escape tunnels. When mice are disturbed in their burrows, they open escape tunnels and quickly flee to another burrow or to other cover (Ehrhart 1978).

Beach mice, in general, are nocturnal. They are more active under stormy conditions or moonless nights and less active on moonlit nights. Movements are primarily for foraging, breeding, and burrow maintenance. Extine and Stout (1987) reported movements of the southeastern beach mouse between primary dune and interior scrub on Merritt Island, and concluded that their home ranges overlap and can reach high densities in their preferred habitats.

Reproduction and Demography

Studies on *Peromyscus* species in peninsular Florida suggest that these species may achieve greater densities and undergo more significant population fluctuations than their temperate relatives, partially because of their extended reproductive season (Bigler and Jenkins 1975, Smith and Vrieze 1979). Subtropical beach mice can reproduce throughout the year; however their peak reproductive activity is generally during late summer, fall, and early winter. Extine (1980) reported peak reproductive activity for *P. p. niveiventris* on Merritt Island during August and September, based on external characteristics of the adults. This peak in the timing and intensity of reproductive activity was also correlated to the subsequent peak in the proportion of juveniles in the population in early winter (Extine 1980). This pattern is typical of other beach mice as well (Rave and Holler 1992).

Sex ratios in beach mouse populations are generally 1:1 (Extine 1980, Rave and Holler 1992). Blair (1951) indicated that beach mice are monogamous; once a pair is mated they tend to remain together until death. He also found, however, that some adult mice of each sex show no desire to pair.

Nests of beach mice are constructed in the nest chamber of their burrows—a spherical cavity about 4 to 6 cm in diameter. The nest comprises about one-fourth of the size of the cavity and is composed of sea oat roots, stems, leaves and the chaffy parts of the panicles (Ivey 1949).

The reproductive potential of beach mice is generally high (Ehrhardt 1978). In captivity, beach mice are capable of producing 80 or more young in their lifetime, and producing litters regularly at 26-day intervals (Bowen 1968). Litter size of beach mice, in general, ranges from two to seven, with an average of four. Beach mice reach reproductive maturity as early as 6 weeks of age (Ehrhart 1978).

Dispersal of young mice and the disappearance of adults may be the primary reasons for population fluctuations in certain areas (Blair 1951). Young beach mice move an average of 432 m before establishing residence in a new area. Although reproductive potential is high, mortality of adult beach mice is also quite high. Only 19.5 percent of the beach mice present in Blair's study in January survived to May of that same year.

Foraging

Beach mice typically feed on seeds of sea oats and dune panic grass (Blair 1951). The southeastern beach mouse probably also eats the seeds of other dune grasses, railroad vine, and prickly pear cactus. Although beach mice prefer the seeds of sea oats, these seeds are only available as food after they have been dispersed by the wind. Beach mice also eat small invertebrates, especially during late spring and early summer when seeds are scarce (Ehrhardt 1978). Beach mice will store food in their burrows.

Relationship to Other Species

Southeastern beach mice co-occur with cotton mice (*P. gossypinus*) and cotton rats (*Sigmodon hispidus*), although local distributions and population variations may not be related (Extine 1980). It is unknown whether these species compete for food resources. Recent trap efforts south of Sebastian Inlet in Indian River County indicate that cotton mice are more prevalent in the coastal strand habitat, rather than the dune habitat preferred by the beach mouse. Ivey (1949) also states that cotton mice occur in a variety of vegetative communities, but prefer wooded and more mesic habitats. Cotton rats, however, are prevalent in both dune and coastal strand habitat.

Southeastern beach mice probably interact with house mice (*Mus musculus*), particularly in disturbed habitats where house cats are present. Humphrey and Barbour (1981) speculated that competitive exclusion by house mice was a factor in the extinction of the pallid beach mouse. Frank and Humphrey (1992) discuss the potential threat of house mice to the Anastasia Island Beach mouse, and Briese and Smith (1973) found that house mice competed with *P. polionotus* in Georgia for available habitat when the *Peromyscus* population became reduced because of disturbance or predation.

As stated previously, beach mice dig burrows in the dune; however, they are also known to occasionally use old burrows constructed by ghost crabs. In South Florida, the coastal habitat is also used by four species of endangered or threatened sea turtles; where the southeastern beach mouse occurs these are predominantly the loggerhead turtle (*Caretta caretta*) and the green turtle (*Chelonia mydas*). From an ecosystem perspective, conservation efforts should be implemented to benefit all of these species simultaneously, and management activities should avoid any potential conflict between these species.

Predation is the primary cause of mortality of adult beach mice (Blair 1951). Known and probable predators of the southeastern beach mouse include snakes, bobcats (*Lynx rufus*), gray foxes (*Urocyon cinereoargenteus*), raccoons (*Procyon lotor*), striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), armadillos (*Dasypus novemcinctus*), owls, hawks, great blue herons (*Ardea herodias*), red-imported fire ants, and domestic cats and dogs.

Status and Trends

The distribution of the beach mouse is extremely limited due to modification and destruction of its coastal habitats. Along Florida's Gulf coast, the Alabama beach mouse, the Perdido Key beach mouse, and the Choctawhatchee beach mouse were federally listed as endangered in 1985. The St. Andrews beach mouse was federally listed as endangered in 1998. On the Atlantic coast of Florida, the Anastasia Island Beach mouse (*P. p. phasma*) and the southeastern beach mouse were federally listed as endangered and threatened, respectively, in 1989 (54 FR 20602). One additional subspecies, the pallid beach mouse (*P. p. decoloratus*), was formerly reported from two sites on the Atlantic coast, but extensive surveys conducted since 1959 provide substantial evidence that this subspecies is extinct (Humphrey 1992).

The distribution of the southeastern beach mouse has declined significantly, particularly in the southern part of its range. Historically, it was reported to occur from Ponce (Mosquito) Inlet, Volusia County, to Hollywood Beach, Broward County (Hall 1981). Bangs (1898) reported it as "extremely abundant on all the beaches of the east peninsula from Palm Beach at least to Mosquito (Ponce) Inlet." More recently, the southeastern beach mouse has been reported only from Volusia County (Canaveral National Seashore to about 11 km north of the Volusia-Brevard County line), Federal lands in Brevard County (Canaveral National Seashore, Merritt Island NWR, and Cape Canaveral Air Force Station), a few localities in Indian River County (Sebastian Inlet SRA, Treasure Shores Park, and several private properties), and St. Lucie County (Pepper Beach County Park and Fort Pierce Inlet SRA) (Humphrey *et al.* 1987, Robson 1989, Land Planning Group, Inc. 1991, Humphrey and Frank 1992, FWS 1993).

Large, healthy populations of the southeastern beach mouse are still found on the beaches of Canaveral National Seashore, Merritt Island NWR, and Cape Canaveral Air Force Station in Brevard County—all federally protected lands (U.S. Air Force 1989, Provanca and Oddy 1992). The distribution of this subspecies in the South Florida Ecosystem, however, is severely limited and fragmented. There are not enough data available in South Florida to determine population trends for the southeastern beach mouse; however, recent surveys reveal that it occurs in very small numbers where it is found (Table 1).

In Indian River County, the Treasure Shores Park population has experienced a significant decline over the past few years, and it is uncertain whether populations still exist at Turtle Trail or adjacent to the various private properties (P. Tritaik, Archie Carr NWR, personal communication 1996). Trapping efforts during the past 6 years in this area have documented a decline from an estimated 300 individuals down to numbers in the single digits (L. Ehrhart, University of Central Florida, personal communication 1998). The status of the species south of Indian River County is currently unknown. No beach mice were found during recent surveys in St. Lucie County; it is possible that this species is extirpated there. The southeastern beach mouse no longer occurs at Jupiter Island, Palm Beach, Lake Worth, Hillsboro Inlet or Hollywood Beach. Given these data and trends, it is likely that without

Table 1. Surveys conducted for *Peromyscus polionotus niveiventris* in South Florida.

Author	Date	Locality	Number Captured	Pop. Size	Trap Nights
Humphrey <i>et al.</i> (1987)	7/30-8/1	Sebastian Inlet SRA, Indian River County	2		69.0
	"	Turtle Trail Public Beach Access, Indian River County	3		113.5
	"	Pepper Park, St. Lucie County	1		107.5
	"	Seaside Beach Park, St. Lucie County	1		78.5
Robson (1989)	8/12-8/15	Sebastian Inlet SRA, Indian River & Brevard County	4		176.0
	"	Fort Pierce Inlet SRA, St. Lucie County	1		123.0
	3/03-3/05	St. Lucie Inlet State Park, Manatee County	0		62.0
	2/29-3/02	MacArthur Beach State Park, Manatee County	0		74.0
	1/31-2/03	Melipon, Palm Beach County	0		250.0
Land Planning Group (1991)	3/04-07	Seaside Subdivision, Indian River County	46		224.0
Humphrey and Frank (1992)	12/24-29	Treasure Shores Park, Indian River County	191	303	859.0
Rish <i>et al.</i> (1993)	12/09-11	Beach dunes of Windsor Properties, Indian River County	34	7	68.0
	12/14-20	Coastal strand, Windsor Properties, Indian River County	64	27	733.0
Weigle (1995)	5/02-05	Beach dunes, Ocala and Golf and Beach Club, Indian River County	4		158.0
	4/19-22	Coastal strand, Ocala and Golf and Beach Club, Indian River County	1		163.0
Band (1997)	5/11	Sebastian Inlet SRA, Indian River County	3		116.0
	7/26-27	"	13		701.0
	5/9-10	"	6		68.0
	4/9	"	2		300.0
Elmhart and Thirsk (1997)	4/25-26	Archie Carr NWR, Indian River County portion	42		640.0
	4/18-19	"	10		412.0
	4/24-25	Archie Carr NWR, Treasure Shores Park, Indian River County	8	8	544.0
	11/29-30	Archie Carr NWR, Treasure Shores Park, Indian River County	5		494.0
	2/18-19	Treasure Shores/Seaside Subdivision, Indian River County	13		701.0
	4/9-10	"	3		693.0
	6/30-7/1	"	6		753.0
12/15	"	2		391.0	
Jennings and Miller (1997)	3/31-4/3	Fort Pierce Inlet SRA, St. Lucie County	0		206.0
	"	Pepper Beach County Park, St. Lucie County	0		276.0
	"	2 private parcels, St. Lucie County	0		344.0

management intervention the entire South Florida population of southeastern beach mice will be lost in the near future.

The primary threat to the survival and recovery of the southeastern beach mouse is the continued loss and alteration of coastal dunes. Large-scale commercial and residential development on the Atlantic coast has eliminated beach mouse habitat in Palm Beach and Broward counties. This increased urbanization has also increased the recreational use of dunes, and harmed the vegetation essential for dune maintenance. Loss of dune vegetation results in widespread wind and water erosion and reduces the effectiveness of the dune to protect other beach mouse habitat.

In addition to increased urbanization, coastal erosion is responsible for the loss of the dune environment along the Atlantic coast, particularly during tropical storms and hurricanes. The construction of inlets has exacerbated coastal erosion problems along the Atlantic coast. There are six man-made inlets on the Atlantic coast from Brevard County to Broward County that disrupt longshore sediment transport; because of this disruption beach habitat is gained on the north side of an inlet and becomes severely eroded immediately to the south. In Indian River County, for example, erosion has been nearly 2 m per year at Sebastian Inlet SRA (just south of Sebastian inlet); this is six times the average erosion rate for the county (J. Taber, Indian River County, personal communication 1996). Erosion of the dune habitat adjacent to the Treasure Shores Park has accelerated by nearly 0.3 m per year over the past 10 years (DEP 1996).

The encroachment of residential housing onto the Atlantic coast increases the likelihood of predation by domestic cats and dogs. A healthy population of southeastern beach mice on the north side of Sebastian Inlet SRA in Brevard County was completely extirpated by 1972, presumably by feral cats (R. Johns, Sebastian Inlet SRA, personal communication 1996). Urbanization of coastal habitat could also lead to potential competition of beach mice with house mice and introduced rats.

Management

Southeastern beach mice live in a dynamic, harsh environment that is exposed to recurring tropical storms. Historically, beach mice populations fluctuated in response to changes in the environment. In the past, local populations probably became extinct when storms destroyed their habitat; these areas were then recolonized by adjacent populations that survived the storms. Today, however, increased urbanization along the Atlantic coast has eliminated much of the coastal dune and created isolated patches of habitat available to the beach mouse.

Ongoing management practices within the range of the southeastern beach mice restrict beach access to designated crossovers (boardwalks) to minimize the human trampling of the dune systems. Since public beaches on Florida's east coast receive heavy public use, continuing to enforce these restrictions on dune access will be essential to the recovery of the southeastern beach mouse.

Beach nourishment projects are conducted periodically by the COE to maintain the beach in areas of greatest erosion. Southeastern beach mice could be adversely affected if dredged sand is placed on or near their habitat. It is

critical that effects to beach mice also be evaluated for any land-modification projects in coastal habitat, and that any dredged material be compatible with existing beach sand.

Although there are a number of State and county regulations pertaining to residential, commercial and recreational development in coastal areas, none specifically address protection of beach mouse habitat. The regulations dictate requirements for siting and construction of buildings, utilities, and access corridors.

The Coastal Barriers Resources Act of 1982, as amended (16 U.S.C. 3501 *et seq.*) prohibits the expenditure of Federal funds that encourage development within the undeveloped, unprotected 186 units of the Coastal Barriers Resources System (CBRS); however, construction in these units is still proceeding, even with no Federal involvement. Examination of aerial photographs for 157 CBRS units revealed a 40.7 percent increase in the number of structures between 1982 and 1986/1988. Over half of this construction occurred in the State of Florida (Jones and Stolzenburg 1989).

Habitat fragmentation has created disjunct, isolated populations of southeastern beach mice in South Florida. Although the populations of *P. p. niveiventris* in Brevard County are large and healthy because they are protected on public lands, they are geographically, and thus genetically, isolated from populations in Indian River County because of Sebastian Inlet. No natural dispersal can occur from Brevard County populations to enhance the populations to the south. The five inlets between Indian River and Broward counties also create unnatural barriers to dispersal along this length of coast. As a result of this isolation, southeastern beach mouse populations are probably now ephemeral and have a high risk of extinction.

The long-term persistence of a given population may depend on the ability of mice from adjacent parts of the range to recolonize beaches. To avoid excessive risks of extinction from demographic, catastrophic, or genetic events, an attempt should be made to establish viable populations of southeastern beach mice in remaining areas of suitable habitat throughout their historic range. Although population viability analyses (a technique to estimate the probability of survival, for various time periods, of animal populations of differing effective breeding size) have not been done for beach mice, relocation experiments with other subspecies of beach mice have been successful. However, due to the limited amount of habitat available along the Atlantic coast, it may be difficult to establish new populations of *P. p. niveiventris* with good prospects for long-term survival. Three sites in South Florida that warrant evaluation as potential recipient sites are Fort Pierce Inlet SRA, Avalon SRA, and Pepper Beach County Park in St. Lucie County.

If translocation projects are attempted, proven reintroduction protocols should be followed. Holler *et al.* (1989) successfully re-established the Perdido Key beach mouse by translocating 15 pairs from Gulf State Park at Florida Point in Alabama to an unoccupied site at Gulf Islands National Seashore. Frank (1995) successfully translocated 55 Anastasia Island beach mice (27 females and 28 males) from two locations on Anastasia Island to a site at Guana River SP where the subspecies had been extirpated. In general, it is recommended that the source population of mice for a translocation come from a large, healthy

population, and that the release site be an area that is protected and unoccupied. It is also recommended to move mice during the fall season when more food is available. Monitoring of the introduced population will determine whether additional augmentation is needed. In addition, once the translocated population is stable, mice should be exchanged with the donor population (N. Holler, Alabama Cooperative Fish and Wildlife Research Unit, personal communication 1996).

The State of Florida administers land acquisition programs that can be used to secure coastal dune habitat for the southeastern beach mouse and other endemic species. Reintroduction of this species into these protected areas, and managing the areas to avoid invasion by exotic vegetation and depredation of mice by domestic animals, may help to ensure the survival and recovery of the beach mouse over the long term. Likewise, the Archie Carr NWR was established in 1989 to protect beach habitat along a 20-mile section of coast in Brevard and Indian River counties. An ecosystem approach to coastal resource protection is being employed to link the beach and dune habitats, maritime forests, wetlands, and estuarine systems. As proposed, the refuge would protect four segments of Atlantic beach and dunes totaling 14.9 km.

Surveys to determine the status of the southeastern beach mouse in the South Florida Ecosystem in areas of suitable habitat are imperative. Monitoring protocols exist that suggest trapping should be conducted twice per year, early to mid-fall and late winter. A trapping protocol to determine presence/absence of beach mice has been standardized, and is included with each collecting permit issued by the GFC and FWS. This protocol describes how sampling should be done, and the appropriate number of traps to use. It also requires that material (such as cotton batting) be placed in traps when nighttime temperatures are forecast to be < 18.5 degrees C, and that traps be checked beginning at 11:00 p.m. when nighttime temperatures are forecast to be < 10 degrees C.

It is important to note that hantavirus is now a concern when trapping rodents. In Florida, the cotton rat has been identified as a carrier for the virus causing hantavirus pulmonary syndrome (CDC 1996). There have been no documented cases of hantavirus associated with beach mice work; however, because cotton rats may be present when trapping for beach mice, precautions should be taken to minimize the likelihood of exposure.

Literature Cited

- Bangs, O. 1898. The land mammals of peninsular Florida and the coastal region of Georgia. Boston Society Natural History Proceedings 28:157-235.
- Bard, A. 1997. Data summaries for southeastern beach mouse trapping effort at Sebastian Inlet State Recreation Area, Indian River County. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Bigler, W.J. and J.H. Jenkins. 1975. Population characteristics of *Peromyscus gossypinus* and *Sigmodon hispidus* in tropical hammocks of South Florida. Journal of Mammalogy 56:633-644.
- Blair, W.F. 1951. Population structure, social behavior and environmental relations in a natural population of the beach mouse (*Peromyscus polionotus leucocephalus*). Contributions Laboratory Vertebrate Zoology, University of Michigan 48:1-47.
- Bowen, W.W. 1968. Variation and evolution of Gulf coast populations of beach mice (*Peromyscus polionotus*). Bulletin Florida State Museum of Biological Science 12:1-91.
- Briese, L.A. and M.H. Smith. 1973. Competition between *Mus musculus* and *Peromyscus polionotus*. Journal of Mammalogy 54:968-969.
- Centers for Disease Control and Prevention [CDC]. 1996. Hantavirus in the United States: a brief review. Centers for Disease Control and Prevention Document #0994929. 15 November 1996.
- Chapman, F.M. 1889. Description of two new species of the genus *Hesperomys* from Florida. American Museum of Natural History Bulletin 2:117.
- Florida Department of Environmental Protection [DEP] 1996. Unpublished data summaries of shoreline erosion measured in terms of the change in mean high water level, from Ocean Hideaway to Treasure Shores. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Ehrhart, L.M. 1978. Pallid beach mouse. Pages 8-9 in J.N. Layne, ed. Rare and endangered biota of Florida, vol. 1: Mammals. University Presses of Florida; Gainesville, Florida.
- Ehrhart, L.M. 1998. Comments on technical/agency draft multi-species recovery plan for South Florida. January 27, 1998.
- Extine, D.D. 1980. Population ecology of the beach mouse, *Peromyscus polionotus niveiventris*. Unpublished M.S. thesis, Department of Natural Sciences, University of Central Florida; Orlando, Florida.
- Extine, D.D., and I.J. Stout. 1987. Dispersion and habitat occupancy of the beach mouse *Peromyscus polionotus niveiventris*. Journal of Mammalogy 68:297-304.
- Frank, P.A. and S.R. Humphrey. 1992. Populations, habitat requirements, and management of the endemic Anastasia Island beach mouse (*Peromyscus polionotus phasma*), emphasizing the potential threat of exotic house mice (*Mus musculus*). Final report no. NG88-006 to Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.
- Frank, P.A. 1995. Re-establishment of the Anastasia Island beach mouse to the beaches of northern St. Johns County, Florida. Final report to the U.S. Fish and Wildlife Service for contract number 41910-3-0287. On file at the U.S. Fish and Wildlife Service South Florida Ecosystem Office; Vero Beach, Florida.

- Hall, E.R. 1981. The mammals of North America, second edition. John Wiley and Sons; New York, New York.
- Holler, N. 1996. Telephone conversation. 30 May 1996.
- Holler, N.R., D.W. Mason, R.M. Dawson, T. Simons, and M.C. Wooten. 1989. Reestablishment of the Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*) on Gulf Islands National Seashore. *Conservation Biology* 3(4):397-404.
- Humphrey, S.R. 1992. Pallid beach mouse. Pages 19-23 in S.R. Humphrey, ed. Rare and endangered biota of Florida. vol. I.: Mammals. University Presses of Florida; Gainesville, Florida.
- Humphrey, S.R., and D.B. Barbour. 1981. Status and habitat of three subspecies of beach mice in Florida. *Journal of Mammalogy* 68:297-304.
- Humphrey, S.R. , and P.A. Frank. 1992. Survey for the southeastern beach mouse at Treasure Shores Park. Final report to Indian River County Board of Commissioners. 22 January 1992.
- Humphrey, S.R., W.H. Kern, Jr., and M.S. Ludlow. 1987. Status survey of seven Florida mammals. Florida Cooperative Fish and Wildlife Research Unit technical report no. 25. Gainesville, Florida.
- Ivey, R.D. 1949. Life history notes on three mice from the Florida east coast. *Journal of Mammalogy* 30:157-162.
- Jennings, D.P., and J.B. Miller. 1997. Data summaries for Southeastern beach mouse trapping effort in St. Lucie County. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Johnson, A.F. and M.G. Barbour. 1990. Dunes and maritime forests. Pages 429-480 in R.L. Myers and J.J. Ewel, eds. *Ecosystems of Florida*. University of Central Florida Press; Orlando, Florida.
- Jones, E., and W. Stolzenburg. 1989. Building in the Coastal Barrier Resources System. Report prepared for the National Wildlife Federation. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Johns, R. 1996. Interagency meeting on the southeastern beach mouse in Sebastian, Florida. May 10, 1996; 22 October 1996.
- Land Planning Group, Inc. 1991. Southeastern beach mouse survey of Seaview Subdivision, Indian River County, Florida. Final Report to Financial Services Group, Inc., Stuart, Florida. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Osgood, W.H. 1909. Revision of the American genus *Peromyscus*. *North American Fauna* 28. Government Printing Office; Washington, D.C.
- Provancha, J.A. and D.M. Oddy. 1992. A mark and release study on the southeastern beach mouse (*Peromyscus polionotus niveiventris*) on the Kennedy Space Center, Florida. *Florida Scientist* (Supplement 1):28.
- Rave, E.H. and N.R. Holler. 1992. Population dynamics of Alabama beach mice (*Peromyscus polionotus ammobates*) in south Alabama. *Journal of Mammalogy* 73(2):347-355.

- Rich E. R., Morris, J. G. and Knight, Mcguire and Associates. 1993. Windsor: Southeastern beach mouse survey and habitat management plan. Prepared for Windsor Properties, Vero Beach Florida. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- Robson, M.S. 1989. Southeastern beach mouse survey. Nongame Wildlife Section Report, Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.
- Smith, A.T. and J.M. Vrieze. 1979. Population structure of Everglades rodents: responses to a patchy environment. *Journal of Mammology* 60:778-794.
- Stout, I.J. 1992. Southeastern beach mouse. Pages 242-249 in S.R. Humphrey, ed. Rare and endangered biota of Florida. vol. I: Mammals. University Presses of Florida; Gainesville, Florida.
- Stout, J. 1996. Interagency meeting on the southeastern beach mouse in Sebastian, Florida. 10 May, 1996; 22 October 1996.
- Taber, J. 1996. Interagency meeting on the southeastern beach mouse in Sebastian, Florida. 22 October 1996.
- Tritaik, P. 1996. Interagency meeting on the southeastern beach mouse in Sebastian, Florida. 10 May 1996; 22 October 1996.
- Tritaik, P. 1997. Data summaries for southeastern beach mouse trapping effort at Treasure Shores Park. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.
- U.S. Air Force. 1989. Biological assessment of potential impacts to federally listed threatened species: Florida scrub jay and southeastern beach mouse (*Aphelocoma coerulescens coerulescens* and *Peromyscus polionotus niveiventris*). Cape Canaveral Air Force Station, Florida.
- U.S. Fish and Wildlife Service [FWS]. 1993. Recovery plan for the Anastasia Island and southeastern beach mouse. U.S. Fish and Wildlife Service; Atlanta, Georgia.
- Weight, R. L. 1995. Orchid Island Golf and Beach Club East of A1A, Indian River County, Florida. Confidential environmental assessment report for Orchid Island Golf and Beach Club, Vero Beach, Florida. On file at the U.S. Fish and Wildlife Service, South Florida Ecosystem Office; Vero Beach, Florida.

Recovery for the Southeastern Beach Mouse

Peromyscus polionotus niveiventris

Recovery Objective: DELIST.

South Florida Contribution: PREVENT EXTIRPATION, then stabilize and increase population.

Recovery Criteria

The current, approved recovery plan for the southeastern beach mouse states that this species can be considered for delisting if 10 viable, self-sustaining populations can be established throughout a significant portion of its historic range. Meeting these criteria will be difficult, if not impossible, without management intervention in South Florida. Information from recent surveys in Indian River County indicates the southeastern beach mouse is rare, and may be threatened with extirpation due to erosion, habitat destruction, and predation by domestic animals. Recent surveys in St. Lucie County have shown no evidence of this species. The nature of the habitat loss provides limited potential for habitat restoration or rehabilitation in South Florida. Consequently, the recovery contribution for South Florida is to prevent the extirpation of the southeastern beach mouse by increasing the numbers of individuals in existing populations, and by increasing the numbers of populations.

This objective will be accomplished when: further degradation of suitable, occupied habitat due to trampling and coastal erosion has been prevented; feral and non-native nuisance species have been eliminated in suitable, occupied habitat; existing populations, within their historic range, are protected either through land acquisition or cooperative agreements; the coastal dune and coastal strand communities that provide habitat for the southeastern beach mouse are managed to prevent non-native species from re-establishing populations in suitable, occupied habitat; potential coastal dune and coastal strand habitats in Indian River and St. Lucie counties are restored or rehabilitated to provide habitat for the southeastern beach mouse; translocations of this subspecies have been conducted from Brevard County into suitable habitat in Indian River and St. Lucie counties; and the Indian River and St. Lucie County populations of southeastern beach mouse exhibit a stable age structure, maintain a 1:1 male:female ratio, and sustain a rate of increase (r) that is equal to or greater than 0.0 as a 3-year running average for 6 years.

Species-level Recovery Actions

S1. Determine the distribution and status of the southeastern beach mouse in South Florida.

- S1.1. Conduct surveys** for the southeastern beach mouse in suitable habitat throughout Indian River, St. Lucie, and Martin counties to determine its current distribution. Surveys should follow the live-trapping protocol for beach mice established by the GFC and FWS.
- S1.2. Survey known populations** at least once per year during winter/spring months (when populations are at their highest numbers), for a minimum of 5 years, in areas where beach mice are known to occur to assess the status of the population(s) and document fluctuations in total numbers.

- S1.3. Maintain distribution data in GIS database.** A GIS database will provide maps of the distribution of the southeastern beach mouse and allow for analyses of population and habitat trends.
- S2. Protect and enhance existing populations of southeastern beach mice in South Florida.**
- S2.1. Work with Federal, State, and local agencies** to protect known populations of the southeastern beach mouse, as well as occupied and unoccupied dune and coastal strand communities.
- S2.2. Work with private landowners.** Encourage landowners along the coasts of Indian River, St. Lucie, and Martin counties to manage their properties in ways compatible with the continued existence of healthy dune habitat and beach mice. The FWS should interact with these owners by providing technical advice or entering into cooperative agreements to effect beach mouse conservation.
- S2.3. Use provisions of the ESA to protect beach mice.** In South Florida, consultations pursuant to section 7 of the ESA will be required for most activities of the FWS, the COE, and the Federal Emergency Management Agency that affect southeastern beach mouse populations. Projects that may affect the conservation of beaches occupied by beach mice, such as jetty construction and beach renourishment, require Federal permits and therefore are subject to section 7 consultation under the ESA; these consultations should prevent further isolation of beach mouse populations to assure survival and recovery. The FWS should evaluate private development activities to determine if they will violate the take provisions of section 9 of the ESA. Take incidental to such activities can be permitted only under section 10(a) of the ESA, and requires the development of habitat conservation plans.
- S2.4. Control/prevent establishment of non-native, domestic, or feral animals.** Human visitation and residence in and near beach mouse habitat makes it likely that animals associated with man (primarily cats, dogs, black rats, and house mice) will become established. These animals threaten the survival of beach mice through predation or competition. To minimize these risks, the following tasks should be addressed:
- S2.4.1. Discourage free-ranging cats and dogs.** Develop and implement ordinances, regulations, covenants, deed restrictions, and other mechanisms to discourage the introduction and establishment of dogs and cats in beach mouse habitat.
- S2.4.2. Control domestic or feral cats on public lands.** Managers of public lands should remove domestic and feral cats from beach mouse habitat whenever their presence is detected.
- S2.4.3. Discourage establishment of exotic rodents.** Discourage the establishment and spread of exotic rodents by containment and prompt removal of garbage from residences and recreational areas, and by minimizing the deposit of materials (*e.g.* construction materials, riprap, or other debris) in beach mouse habitat that might provide shelter for exotic rodents. Rodent traps or poisons that might affect beach mice should not be used in beach mouse habitat.
- S2.4.4. Establish a management program to eliminate fire ants** from public lands where beach mice are known to occur.
- S2.5. Re-establish populations of southeastern beach mouse in South Florida.** Recovery of the southeastern beach mouse in Indian River and St. Lucie counties will require the re-establishment of populations within its historic range.

- S2.5.1. Identify recipient sites for translocating southeastern beach mice.** Recipient sites must be of suitable habitat within the historic range, of sufficient size, and protected. Beach mice and their sign should be absent from a recipient site as determined by surveys conducted in at least two seasons and for 2 years. Follow the live-trapping protocol established by the FWS and GFC to conduct surveys.
- S2.5.2. Restore or improve habitat** where necessary to make the recipient sites suitable for beach mice.
- S2.5.3. Identify suitable donor populations.** Determine population size and health of potential donor populations through surveys. Donor populations should either be large and stable enough to withstand removal of mice without adverse effect, or be classified as non-viable under current habitat conditions. The Brevard County populations of the southeastern beach mouse are currently the only potentially suitable donor populations.
- S2.5.4. Obtain stock for translocation.** Select the number, ages, and sex ratios of mice to be translocated, and the timing of the translocation. Select only healthy mice from a preselected donor site (see **S2.5.3.**), based on overall fitness, body measurements, and/or blood samples. Previous translocations of beach mice have involved trapping mice from donor sites at high population levels during fall and winter and releasing mice at a 1:1 sex ratio.
- S2.5.5. Release mice into new sites.** Release technique, whether “soft release” or “hard release,” should be mutually agreed upon by all parties involved with the translocation. Translocations should be done in the fall or winter to provide maximum opportunity for reproduction during the first year. Translocations should extend over 3 years to ensure an adequate founder population.
- S2.5.6. Perform exchanges of 2 to 3 healthy pairs of mice between founder and re-established populations** at 2 to 3 year intervals once populations meet the conditions set above. These small and infrequent exchanges of mice can help guard against loss of alleles in each population, and against genetic divergence of either population from the other.
- S2.5.7. Monitor introduced and donor populations** using live-trapping and tracking surveys to determine survival, reproductive success, and the intrinsic rate of increase to determine whether the introduction was successful. When the first translocated population is determined to be successful, based on demographic data, a translocation to a second area should begin.
- S2.6. Initiate captive propagation as necessary for survival and recovery of the southeastern beach mouse.** Captive propagation is used to re-establish or supplement wild populations for recovery, and should be used only when extinction of this subspecies is likely due to significantly low population numbers or habitat loss and degradation. A controlled propagation program must be integrated with other recovery actions.
- S2.6.1. Develop plan for captive propagation using the Department of Interior/Department of Commerce (DOI/DOC) Controlled Propagation Policy.** If it is necessary to establish a breeding colony to prevent extinction of this subspecies, follow the direction provided in the DOI/DOC Controlled Propagation Policy.

- S2.6.2. Revise this recovery plan for the southeastern beach mouse to include the captive propagation plan.** In accordance with DOI/DOC policy, the captive propagation plan produced from **S2.6.1** must be part of an approved recovery plan prior to its implementation.
- S3. Conduct research on life history of the southeastern beach mouse.**
- S3.1. Conduct studies on basic biology of the southeastern beach mouse.** Collect data on reproduction, adult and juvenile survival and mortality, age structure, longevity, movements, dispersal, home range size, food requirements, *etc.*
- S3.2. Conduct risk assessment and population viability analyses on the southeastern beach mouse** once basic biological information is collected. These modeling efforts will determine the minimum population size necessary to prevent extinction, the number of mice needed to ensure recovery, and the minimum number of distinct populations of beach mice needed to ensure persistence of the species. These data will also provide information needed to identify potential donor populations for translocation purposes. Results of these data need to be used in planning management strategies for the survival and recovery of this species.
- S4. Monitor beach mouse populations** to assure that further declines in range and numbers do not occur without recovery actions being taken. Collect data on gender, reproduction, adult and juvenile survival, and dispersal to determine population size, structure, and composition, as well as juvenile recruitment into the breeding population. Monitoring each population will also provide information on sites from which to select animals for reintroduction purposes.
- S5. Increase public awareness about beach mice.** Produce brochures, signs, and other materials to educate the public about the ecological role of beach mice in beach and dune communities, and the need to avoid foot traffic in and over dune habitat. The public should understand that continued existence of beach mice is an indication that healthy beach and dune systems are being maintained.

Habitat-level Recovery Actions

- H1. Prevent degradation of existing beach mouse habitat.** Coastal dunes are a dynamic ecosystem. When combined with the natural fluctuations in population numbers of beach mice, it is expected that population levels and habitat occupancy will be variable over time. These are important considerations when making decisions about habitat protection.
- H1.1. Prevent direct destruction of habitat;** specifically, further degradation and fragmentation of coastal dune habitats in Indian River, St. Lucie, and Martin counties to assure the survival and recovery of the southeastern beach mouse.
- H1.1.1. Ensure that project activity (construction of roads, parking lots, buildings, and other structures) is set back behind primary dunes** and outside of areas occupied by beach mice. At a minimum, new construction should always be located landward of the coastal construction control line.
- H1.1.2. Manage human use of beaches** to avoid damage to dunes and adjacent coastal strand habitats used by the mice. Prevent or eliminate human access to dunes in some areas, and provide dune crossovers (boardwalks) and signage at essential beach access points to avoid dune erosion and blowouts.
- H1.1.3. Enforce regulations** prohibiting use of motor or man-powered vehicles on beaches and dune habitat.

- H1.1.4. Ensure that beach renourishment and other projects avoid damaging beach mouse habitat.** Potential oil spill cleanups, or restoration of beaches following other natural or manmade catastrophes, must also be carried out in a way to minimize adverse effects on the dunes.
- H1.2. Acquire potential suitable habitat** through Federal, State or non-governmental conservation organization efforts as lands become available for purchase. Identifying suitable habitat patches within the matrix of remaining coastal dune to acquire and conserve is critical to the long-term viability of this species.
- H1.3. Discourage establishment of exotic plants.** Exotic plants are not currently a threat to the southeastern beach mouse, but coastal plant communities occupied by beach mice should be monitored for evidence of invasive vegetation.
- H2. Restore areas to suitable habitat.**
- H2.1. Restore severely eroded areas through the use of sand fences and/or revegetation with sea oats and other native dune vegetation.** In Indian River County, dune restoration should be initiated at Treasure Shores Park.
- H2.2. Implement management actions (*i.e.*, prescribed burns) that enhance habitat for beach mice.** These actions should be implemented in habitat in need of restoration where beach mice could naturally disperse, and in areas identified as potential reintroduction sites.
- H3. Conduct research on habitat requirements for the southeastern beach mouse.**
- H3.1. Identify the essential components** of what defines habitat for the southeastern beach mouse (*i.e.*, vegetative structure and composition, physical characteristics of the dune and coastal strand, spatial configuration, *etc.*).
- H3.2. Determine the minimum amount of suitable habitat needed** to support a viable population of southeastern beach mice, and the amount of habitat required to obtain recovery for a single population.
- H3.3. Identify the types of management actions that enhance habitat for beach mice.** For example, prescribed burns in an area that is in need of restoration may result in an increase in utilization by beach mice.
- H4. Monitor the status of beach mouse habitat.**
- H4.1. Identify all coastal areas in Indian River, St. Lucie, and Martin counties that currently provide or that could provide habitat for the southeastern beach mouse.** Maintain this information in a GIS database to document habitat trends.
- H4.2. Assess the effects of erosion or other causes of habitat loss in areas where beach mice occur** and implement restoration activities when warranted.
- H4.3. Ensure that occupied habitat and surrounding dune and coastal strand communities are maintained in suitable condition for beach mice.**
- H5. Increase public awareness about the coastal dune ecosystem.** The general public regularly uses beach areas in and adjacent to beach mouse habitat for recreational purposes. Inform the public of recreational practices that are compatible with the continued existence of beach mice. The Archie Carr Working Group could serve as a catalyst for public information and education materials.

